PLAN 2035

The National Long Range Transportation Plan

Moving People, Conserving Wildlife

July, 2016

As the first National Long Range Transportation Plan for the U.S. Fish and Wildlife Service (the Service), PLAN 2035 provides direction and structure for the Service's Federal Lands Transportation Program.

PLAN 2035 was prepared as a collaborative effort among the Federal Highway Administration (FHWA); the Service's Regional Transportation Coordinators; and HQ staff from the National Wildlife Refuge System and the Fish and Aquatic Resources Division. This collaboration ensures that the plan truly addresses the diverse needs of all U.S. Fish and Wildlife Service stations across the country.

Through implementation, the Service will continue to build on successes in providing visitors a safe and enjoyable transportation network to access their National Wildlife Refuges and National Fish Hatcheries.

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The Public Lands Scholars Program - Montana State University

Cover: Muscatatuck NWR
Indiana

From the Transportation Program Manager...

After nearly four years of collaboration and planning, the U.S. Fish and Wildlife Service is pleased to present our Agency's Long Range Transportation Plan. The first national level, long range transportation planning document for a federal land management agency, the publication of this plan marks a significant achievement for transportation planning in the public lands arena.

On the most basic level, transportation is about movement of people or things across time and space. In the domain of transportation within Fish and Wildlife Service, we are tasked with managing a system that provides mobility and access to sensitive habitats and natural resources in rural landscapes, urban areas, wetlands, coastal plains, mountain highlands and everything in between.

With more than 150 million acres, 565 national wildlife refuges, 70 national fish hatcheries, and 38 wetland management districts, the task is daunting in scope alone. PLAN 2035 is our Agency's answer to solving resource management challenges through transportation solutions. Safety toolkits, roadway design standards, multi-modal access opportunities and a myriad of other policies and practices not only let us connect to and move freely about our lands, but also help us improve these legacy resources for generations of visitors to come.

We need a robust network of not just roads and parking lots, but foot and bicycle paths, transit systems, bridges and water trails that lay lightly on the landscape, yet are resilient to the consequences of natural disasters. While our refuges and fish hatcheries were created to protect and conserve biodiversity, we should also recognize the role they play in the mitigation of climate change and its impacts. Our lands should be accessible to all populations including underrepresented and transit dependent communities. Our urban units should function as training grounds for the next generation of land managers while our rural and remote units should drive regional tourism and bolster economic development.

The guidance and policies contained in this plan will set the stage for achieving this lofty vision while establishing the transportation program as a progressive, innovative and integral part of the Fish and Wildlife Service.

In closing, the transportation program is appreciative of the partnership and support the Federal Highway Administration has and will continue to provide in the Federal Lands Transportation Programs. We will continue to demonstrate our strength as a core partner as well as the value of investing in America's Wildest Lands and Great Outdoors.

Executive Summary

Siletz Bay NWR

Oregon

Why Transportation?

The primary function of any transportation system is the simple movement of people, goods or equipment across time and space. However, in the realm of federal land management, the transportation system of the U.S. Fish and Wildlife Service (FWS or the Service) must be so much more. Transportation touches every aspect of the Service from the public that relies on safe access networks to the land managers that need to be able to move freely about the landscape, transportation is indispensable.

The purpose of this document is to illuminate the best known practices to manage a transportation system for a resource conservation agency.

In the face of changing climates, shrinking budgets and increased visitation, defining priorities for a national transportation program is a challenge. This Long Range Transportation Plan (LRTP or PLAN 2035) will help guide programmatic decisions while ensuring the transportation program supports the Service mission:

Working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.

- FWS Mission

To help balance this dual-purpose (resource conservation and public benefit) mission, this plan proposes a vision and six strategic goals that the transportation program will uphold through the actions and policies in this plan. The centerpiece of the plan is a performance based project selection process that will directly link the goals of the program with the way transportation projects are planned, designed and delivered.

While it is difficult to put a price on the ecological services the FWS provides (like habitat conservation, outdoor education, critical species protection and improvements in environmental quality), the financial dividends that the Refuge and Hatchery systems pay to local economies are well documented in national reports like Banking on Nature (October, 2013).

These outcomes, both monetary and nonmonetary, are predicated on safe, sustainable and resilient mobility and access networks that are the direct purview of the transportation program.

Thanks to nearly two decades of dedicated funding, the transportation program has been able to determine inventories, collect condition data, address the most pressing safety issues and fix the highest priority assets. Looking forward, the program must take a more strategic approach to demonstrate program stewardship while maintaining the Service's commitment to leadership in the federal lands transportation arena. This document is a first step in meeting that commitment while helping to build a world class and context-sensitive transportation network that services our lands.

PLAN 2035 is written for Service project leaders at individual units, Regional Service leadership, national level decision-makers, non-Service partners, and stakeholders.

It should be noted that PLAN 2035 focuses on public use transportation facilities that connect to or are within Service lands. There are other Service programs relating to non-public use (or admin. only) transportation facilities as well as efforts within the federal-aid transportation system that are not eligible for Federal Lands Transportation Program (FLTP) funding. Being beyond the scope of this effort, those systems and programs generally are not covered in this plan.

Transportation Vision

'To work collaboratively for future planning and stewardship of a context sensitive, multi-modal transportation system that helps conserve natural resources, provides a superior level of safety, delivers cost effective and environmentally sustainable transportation options, generates local economic opportunities and enhances the visitation experience for all visitors including underrepresented and mobility limited-populations.'

Program Principles

Consistent with Department of Transportation (USDOT) and national transportation policy (Fixing America's Surface Transportation and Moving Ahead for Progress in the 21st century, see page 62) guidance, the transportation program has adapted these three principles that guide this plan:

[T] - Transportation - The most basic function of any transportation network, the safe and efficient movement of people and equipment is essential to the program. The Refuge System is also mandated to operate and maintain a safe and functioning transportation network to service wildlife dependent recreational uses as provisioned in the National Wildlife Refuge Improvement Act of 1997.

[RM] - Resource Management - Transportation infrastructure, if not designed in the proper way, can fragment habitat, disrupt wildlife and even cause irreparable damage to an ecosystem. Parking lots, roads and trails must be thoughtfully planned, designed and constructed to preserve, conserve and enhance Service lands.

[EG] - Economic Generation - Parks, refuges and other public lands are economic drivers for local communities. Not only do they provide increased quality of life for nearby residents, but they draw visitors and tourists domestically and internationally that support local/regional economies and add to the tax base. Safe and efficient access to and within Refuges and Hatcheries, bolsters visitation and supports economic generation for the United States.

Investment Strategy

The national investment strategy is a high level framework for complying with the policy directives in Executive Order 13327 (Federal Real Property Asset Management), guidance from the Office of Management and Budget, asset management principles at the Department of Interior, policy priorities of the Fish and Wildlife Service and current transportation legislation (FAST Act).

Transportation improvement plans and regional LRTPs should be consistent with this national investment strategy framework:

- Develop connections to people and urban refuges.
- Maintain state of good repair on high priority (mission dependent) transportation assets.
- Decommission or phase out low-priority (non-mission dependent) transportation assets.
- Improve safety.
- Support high-use recreation areas.
- Support financial sustainability.
- Seek partnerships for project implementation.

The Six Strategic Goals

The six strategic goals are the framework for the policy guidance in this plan. Individually, they represent the ideal state of one aspect of the transportation program. Collectively they represent the 20 year transportation vision.

Goals are defined on pages 16–17. Each goal has specific objectives and performance measures to help the transportation program track and demonstrate progress over time. The six strategic goals are:


Coordinated Opportunities


Asset Management


Safety


Environmental


Access, Mobility and Connectivity


Visitor Experience

Selection Process

The project selection process, built around the six strategic goals, is the outline for a data driven and performance based planning process to develop capital improvement plans at the regional level.

The framework is intended to be flexible and can be tailored to individual regions based on differing needs and priorities.

Each strategic goal is associated with an evaluation criteria element in the project scorecard (Step 3). The scoring process is meant to help determine a project's consistency with the strategic goals in this plan and a project's priority relative to other proposals through a consistent, quantitative ranking formula.

Project Selection Framework Steps:

1. Region Solicits Projects From Units

2. Region Prepares Applications for Scoring

3. Scoring and Project Scorecard

4. Ranking and Prioritization

5. Determine Projects for Regional Program

6. Eligibility Check and Program

7. Adapt for Next Cycle

Funding

Funding for the FWS public-use transportation network can either come from Federal Lands Transportation Program (FLTP) base allocations (authorized in national transportation policy, currently FAST Act), the Service's base appropriation, or supplemental sources like grants and non-governmental partnerships.

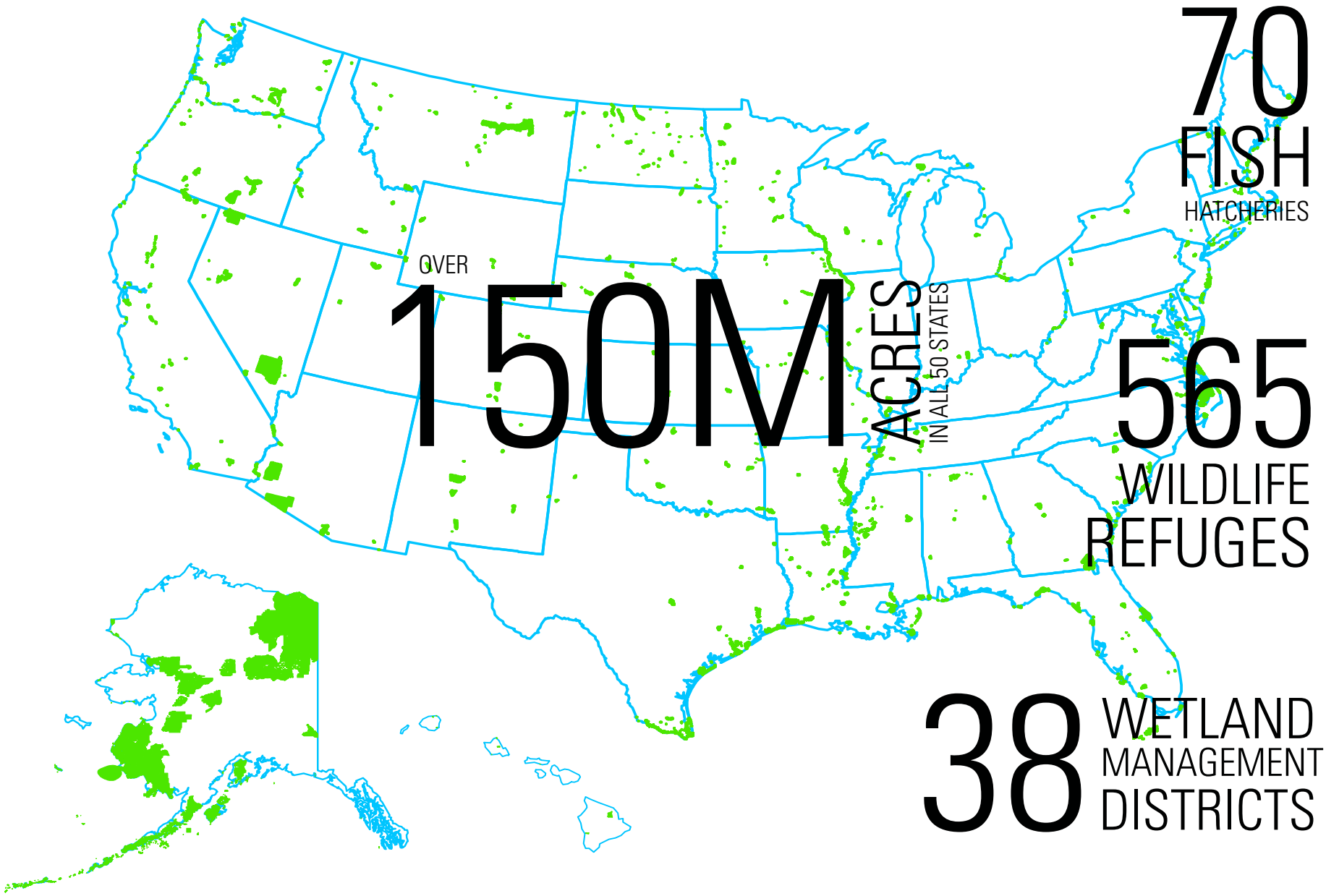
FLTP base funds are sub-allocated to the individual regions based on a formula that was established in the early days of the FLTP. This plan does not propose any change to the current formula.

The project selection process is intended to be used (or adapted) for projects programmed with FLTP base funds. To give the program consistency, demonstrate performance management, and advance strategic goals, PLAN 2035 proposes the selection process for scoring, prioritizing, and programming FLTP base allocations.

Because the needs of the program far outweigh the funds available through FLTP base allocations, the program must actively seek supplemental funds. Programs like the Federal Lands Access Program (FLAP) are key in leveraging the limited dollars available to address transportation needs in Service lands.

Low priority and administrative transportation assets are not eligible for FLTP funding. Instead, these assets should be maintained with deferred maintenance (DM) funds and/or general station funds on a case by case basis.

Introduction



The Road Ahead...

FLTP Network

The FWS transportation program has evolved significantly since its inception with the Refuge Roads Program in 1998. The program has built databases, catalogued and inventoried assets, repaired the most critical facilities and generally maintained a quality transportation network for land managers and the visiting public.

Transportation policy in the United States changed substantively in 2012 with the signing into law of Moving Ahead for Progress in the 21st Century, or MAP-21. Seeking economies of scale and institutional efficiencies, most federal lands transportation programs were consolidated under the Federal Highway Administration's new Federal Lands Transportation Program, or FLTP. This program emphasizes multi-modal mobility options, off-site access networks, streamlined data collection/storage processes and an overall cooperative management approach to transportation in the federal lands domain. It also stresses the importance of access improvements at high-use recreation areas and federal economic generators like Refuges and Hatcheries.

MAP-21 also established performance requirements for all transportation related activities, including transportation in federal lands. These requirements have long been in place for state, regional and local transportation agencies, however this approach is new to federal land management agencies. Development of LRTPs, goals, objectives, and performance targets are now required elements of all transportation programs under this legislation.

Demonstrating that program allocations are a sound investment of public funding will become key in securing transportation dollars in the future. There is a long road ahead, but PLAN 2035 is an important first step in defining the Service's transportation vision and telling the story of our success.

The FWS transportation program must transform itself from an organization with a variety of disparate transportation assets spread across the country to a better connected, data informed, and priority driven transportation system that serves the public and supports the Service conservation mission.

This transformation will demonstrate program stewardship while at the same time helping the program build a better connected, dynamic and resilient transportation network.

The first of its kind, this plan and the policies contained herein represent a big step forward for the Service and transportation practice in federal lands.

Special Note:

During the final public review of PLAN 2035, President Obama signed the Fixing America's Surface Transportation (FAST) Act on December 4, 2015. While detailed guidance is forthcoming from FHWA, substantial change to the approach in PLAN 2035 is not expected. Funding amounts and other salient details have been updated in this final plan. FAST Act authorized the same $30 M annual funding to the FWS transportation program that MAP-21 did.

Because the LRTP was written under MAP-21, many sections will continue to refer to policy under MAP-21.

A systematically applied, ongoing process that provides key information to help decision makers understand the outcomes of investment decisions, improves communication between decision makers and the public and ensures that performance targets are developed based on objective information and data.

- Transportation Performance Management - MAP-21

Context

Program Partners

In 2013, the FWS transportation program marked a 15-year milestone in its partnership with the Federal Highway Administration.

Part of the U.S. Department of Transportation (USDOT), the FHWA provides stewardship and oversight of the FLTP, and is an indispensable partner of the FWS transportation program. Through the regionally based Federal Lands Highway offices, FHWA provides planning, programmatic guidance, data gathering, engineering, asset management, design and project delivery services that support the program. Together, the Service and FHWA have worked successfully to support, maintain and improve the FWS transportation network, deliver mission critical projects and develop improved access to Refuges and Hatcheries.

The partnership between the FWS and the FHWA will continue through the recent five year transportation authorization of the FAST Act.

The Service would also like to recognize the role of the John A. Volpe National Transportation Systems Center (Volpe). Also part of USDOT, Volpe provides technical support, administrative assistance, research, analysis and planning to the FWS transportation program.

Planning Efforts

The publication of this document comes amidst an agency wide effort to develop high level planning documents and policy to guide the resource conservation mission of the Service into the future.

In 2011, the Service unveiled a bold, new vision for the National Wildlife Refuge System entitled 'Conserving the Future'. The transportation program is in a unique position to play an important role in implementing the vision because many of the key elements of the vision fall within the purview of the program.

In late 2013, the FWS published an update to its regular 'Banking on Nature' report which catalogues the economic benefits of the National Wildlife Refuge System. In these reports, access networks are consistently cited as indispensable prerequisites to unlocking the economic dividends that these lands provide.

PLAN 2035 is a companion document to a number of already published transportation plans including the FWS Roadway Design Guidelines (2012), and the Transportation Needs and Planning For the Future (2013) white paper that details the overall needs of the program. Those needs will be updated during the first few years of PLAN 2035.

Concurrently with the publication of PLAN 2035, each Service region is in various stages of drafting its own LRTP.

How to Read this Plan

PLAN 2035 is written for Service project leaders at individual units, regional transportation and facilities staff, national-level transportation planners, and even non-Service partners.

This is not a top-down policy document. This plan is intended to provide high level guidance and programmatic consistency for decision making processes at the regional levels. The broad scope of this plan should give the transportation program a common framework to work from and will also help inform the ongoing development of regional LRTPs, which will be more prescriptive in nature.

The following support documents, included in the Appendix, are intended to be used in conjunction with PLAN 2035:

- Appendix 1: FWS Roadway Design Guidelines and Project Checklist - The Design Guidelines highlight best practices in planning, design and construction of transportation facilities in ecologically sensitive areas. The Project Checklist provides a way to track integration of the Guidelines in transportation projects.

- Appendix 2: Safety Analysis Toolkit - A suite of tools that support the Agency's Safety Management System (SMS), the toolkit takes collision and facility data and makes recommendations for further study to determine if countermeasures are needed.

Policy Framework of Transportation Program

FWS Mission:
'Working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.'

Vision - Conserving the Future:
Completed in 2011, Conserving the Future is a comprehensive path forward for the current and future stewardship of the Refuge system. The Vision produced 24 'Recommendations' with discreet goals and performance targets.
The FWS transportation program can directly help advance the following Recommendations:

2 - Climate Change
11 - Community Partnerships
13 - Urban Initiative
17 - Hunting and Fishing
18 - Outdoor Recreation

National Transportation Policy - FAST Act
Signed into law in 2015, FAST Act is the source of funding for the FWS transportation program. Part of the multi-partner Federal Lands Transportation Program (FLTP), the FWS transportation program delivers projects that uphold these core principles:

[T] Transportation
[RM] Resource Management
[EG] Economic Generation

Transportation Program 20 Year Vision:
Dovetailing with the FWS mission, the 20 year transportation vision is a single statement that describes where the program aims be in 2035.

The Six Strategic Goals and Objectives:
The six strategic goals are broad statements about the desired state of six elements of the transportation program and network. The objectives under each are measureable milestones that relate to the goals.

Data Collection:
These key data collection efforts help the program make project decisions and measure progress toward completing the objectives and performance targets in this plan.

- RIP - Road Inventory Program (Condition Assessments)
- RATE - Regional Alternative Transportation Evaluations
- Visitor Surveys - Visitation Patterns and Access Levels
- RAPP - Refuge Annual Performance Planning (Visitation and Usage Data)

Project Selection Process:
The project selection process, based around the six strategic goals and driven by data, is designed to prioritize FLTP transportation projects. Projects that most clearly accomplish goals and objectives will rise to the top of regional scoring processes and will be selected for programming. See section on Implementation.

Funding:
Tailor funding streams (FLTP and competitive sources) to best leverage available transportation dollars and advance goals and objectives.

Measure, Evaluate, Adjust:
On a 5 year cycle, measure performance, evaluate outcomes and and adjust policy by updating this national long range transportation plan.

Vision and Goals

20 Year Transportation Program Vision:

'To work collaboratively for future planning and stewardship of a context sensitive, multi-modal transportation system that helps conserve natural resources, provides a superior level of safety, delivers cost effective and environmentally sustainable transportation options, generates local economic opportunities and enhances the visitation experience for all visitors including underrepresented and mobility limited populations.'

Humboldt Bay NWR
California

A Clear Path Forward

As the premier wildlife management agency in the world, the U.S. Fish and Wildlife Service is expected to steward the assets and natural resources entrusted to it so that present and future generations of visitors can benefit and appreciate the biodiversity of the United States.

In planning the future of the transportation program, the vision is a single statement that describes the desired state of the program in 20 years... It is a conceptual ideal that projects, policies and actions should support to keep the promise that was made to the American people when the first National Wildlife Refuge was established at Pelican Island in 1903.

Based on the 20 year vision, this plan presents six strategic goals that describe in broad terms the desired condition of various unique elements of the transportation program. The objectives that follow are actionable management techniques and policies that can be implemented to advance the strategic goals.

The Six Strategic Goals

Coordinated Opportunities Goal:

The program will seek joint transportation opportunities that support the Service mission, maximize the utility of Service resources, and provide mutual benefits to the Service and external partners.

- Objective 1: Identify and increase key internal and external partnerships at the national, regional, and unit levels.
- Objective 2: Maximize leveraged opportunities by identifying and pursuing funding for projects of mutual interest and benefit.
- Objective 3: Develop best practices for external engagement that illustrate success in forming and nurturing coalitions and partnerships that support the Service's mission.
- Objective 4: Coordinate within Service programs, including Refuges, Ecological Services, Fish and Aquatic Conservation, Hatcheries, and Migratory Birds, during the development of regional long-range and project level plans.

Supports Principles: [T] [RM] [EG]

Asset Management Goal:

The program will operate and maintain a functional, financially sustainable and resilient transportation network to satisfy current and future land management needs in the face of a changing climate.

- Objective 1: Use asset management principles to maintain important infrastructure at an appropriate condition level.
- Objective 2: Prioritize work programs through the project selection process detailed in this plan or an adaptation, thereof.
- Objective 3: Evaluate life cycle costs when considering new assets to determine long term financial sustainability.
- Objective 4: Consider the impacts of increased climate variability in the planning and management of transportation assets.

Supports Principles: [T] [RM]

Safety Goal:

The program's network will provide a superior level of safety for all users and all modes of transportation to and within FWS lands.

- Objective 1: Identify safety issue 'hot-spots' within the Service's transportation system with the Safety Analysis Toolkit.
- Objective 2: Implement appropriate safety countermeasures to resolve safety issues and reduce the frequency and severity of crashes (also with the Safety Analysis Toolkit).
- Objective 3: Address wildlife-vehicle collisions with design solutions (Environmental Enhancements).
- Objective 4: Use cooperation and communication among the '4Es' of safety including: engineering, education, enforcement and emergency medical services.

Supports Principle: [T]

Environmental Goal:

Transportation infrastructure will be landscape appropriate and play a key role in the improvement of environmental conditions in and around Service lands.

- Objective 1: Follow the Roadway Design Guidelines for best practices in design, planning, management, maintenance and construction of transportation assets.
- Objective 2: Reduce greenhouse gas (GHG) emissions and air pollutants by increasing transportation options and alternative fuels.
- Objective 3: Protect wildlife corridors, reduce habitat fragmentation, and enhance terrestrial and aquatic organism passage on and adjacent to Service lands to conserve fish, wildlife and plant populations.

Supports Principles: [T] [RM]

Access, Mobility and Connectivity Goal:

The program will ensure that units open to the public have adequate transportation options for all users including underserved, underrepresented, and mobility limited populations.

- Objective 1: Offer a wide range of transportation modes and linkages for on and off site access.
- Objective 2: Provide clear wayfinding information both on and off Service lands.
- Objective 3: Through the Urban Refuges initiative, integrate Service transportation facilities with local community transportation systems in a way that encourages local visitation and provides economic benefits to partner and gateway communities.
- Objective 4: Through coordinated planning, provide context-appropriate transportation facilities that address the specific needs of local visitor groups and respect the natural setting of the refuge or hatchery.
- Objective 5: Address congestion issues to and within Service units.

Supports Principles: [T] [RM] [EG]

Visitor Experience Goal:

The program will enhance the visitation experience through improvement and investment in the transportation network.

- Objective 1: Improve traveler information through use of intelligent transportation systems (ITS).
- Objective 2: Integrate interpretation, education, and resource stewardship principles into the transportation experience.
- Objective 3: Evaluate the feasibility of alternative transportation systems at all stations and implement where appropriate.
- Objective 4: Encourage connections with existing and planned public and private transportation services.
- Objective 5: Design infrastructure in such a way that highlights the landscape, and not the transportation facility.

Supports Principles: [T] [RM] [EG]

Strategy to Address Needs

Choctaw NWR

Alabama

Tie Projects to Policy

The Service's transportation system is more than its physical assets. It is a network of events, expectations and relationships all happening in the domain of sensitive landscapes and diverse wildlife.

The strategy to accomplish the transportation vision involves advancing the strategic goals through policy, projects and other actions.

A performance based planning approach requires an explicit link between program goals and projects. This section makes this connection through analysis of our needs as a program followed by exploration of a series of case study projects that exemplify program principles and strategic goals.

Program Needs

In a broad sense, the gap between current conditions and desired conditions represent the needs of the transportation program. While the program has worked diligently to improve overall conditions since the inception of the Refuge Roads Program in 1998, there is still much room for improvement.

Total Program Needs (Priority Assets and Projects)

Need	Current Condition	Desired Condition
Pavement Cond. Rating Roads and Parking System Avg.	62 PCR Rating	≥ 80 PCR Rating
Bridge Rating System Avg.	65% Good or Excellent	≥ 95% Good or Excellent
Trails All Surface Types	84% Good or Excellent	≥ 95% Good or Excellent
Large Projects (>$3M) Delivery Schedule	1 Every 2 Years	2-3 Every Year
Environmental Enhancements (>$1M)	Minimal	2-3 Every Year
Transit	Maintenance of Current Portfolio	Modest Expansion of Portfolio at Key Locations
Deferred Maintenance Roads, Bridges and Trails	$433M 3.4% of Total Replacement Value	< $250M < 2% of Total Replacement Value

Sources: FHWA RIP, FWS Resource Paper, Facilities Branch Quarterly Report Q3 2014 and Year End Report 2013

Paved or Engineered Surfaces: Roads and Parking Areas (Asphalt and Gravel)

While offering multi-modal and alternative transportation options is key for the program, roads and parking lots remain the most important facilities in the transportation network. The program manages over 5,400 miles of public use roads and over 5,000 parking areas across the nation. Based on data collected by FHWA through the Road Inventory Program or RIP, current funding levels are only sufficient to maintain existing pavement condition ratings (38% fair/poor/failed) for all public use roads and parking areas, see page 40.

Bridges

There are over 301 NBI bridges (public bridges over 20 feet long) that are managed by the transportation program. These facilities are an integral part of the public road system because they provide access to refuge facilities, natural resources and auto tour routes. Since 1994 the Service has ensured that all bridges are routinely inspected to comply with National Bridge Inspection Standards (NBIS). While the program has been able to improve average bridge conditions over the lifetime of the transportation program, many larger needs remain unmet and bridge closures due to failures or safety issues can impact visitors and resource managers alike.

Trails and Boardwalks

Trails and boardwalks provide access to geographically constrained areas while providing visitors with unique ways to experience Refuges and Hatcheries. In addition, these facilities are relatively inexpensive to build and maintain. For these reasons, trails are a key component of the FWS transportation portfolio and should always be considered as an option for augmenting access and mobility in and around Service lands. While current funding levels are sufficient to maintain present trail conditions, significant boardwalk repairs can impact regional improvement budgets.

Deferred Maintenance Backlog and Tiering Efforts

Deferred maintenance (DM) affects the entire transportation network. In 2010, transportation assets accounted for roughly 60% of DM Servicewide (*Life-Cycle Investment Needs for Constructed Facility Assets and Mobile Equipment in the National Wildlife Refuge System, 2010*).

Through data cleanup and effective asset management, the transportation program has been able to reduce this number to less than 4% of replacement value (well within the asset management industry standard tolerance of <10%). The same report also documents that, on average, Service-owned roads, bridges, and trails exceed normal useful life despite the fact that the average age of transportation infrastructure in the FWS system is increasing over time.

The program is currently undergoing a network-wide 'tiering' effort to determine relative priority of the Service's roads and parking lots with the aim of right sizing the DM backlog by eliminating work orders for assets of less than $5,000 and by removing non-mission dependent assets from the backlog. This has been a successful process resulting in reduction of nearly $700M in DM numbers since 2010.

Tier 1 facilities generally include main ingress/egress routes, auto-tour routes and visitor center parking lots. Tier 2 facilities generally include secondary connector roads, primary administrative facilities and parking pull-outs. Tier 3 facilities are generally non-mission critical and low-volume with non-engineered/native surfaces. While tier 3 facilities will still be eligible for FLTP funding in limited instances, they will not be inventoried by FHWA in the upcoming RIP cycle 5.

Summaries of tiering efforts should be included in regional LRTPs.

Large Projects

Individual project needs can frequently exceed financial resources available within regional funding allocations. For the transportation program, projects over $3M are considered 'large', yet many transportation needs far exceed this amount (see Transportation Needs and Planning for the Future, 2013)

In order to overcome these kinds of shortfalls the program has had to rely on outside funding (grants and earmarks) or banking of FLTP funds over several years. Funding from outside sources can be erratic and storing funds over several years limits the movement of capital and delays needed improvements in the transportation system that fit within the program's limited budget. The program needs to be able to deliver 2-3 large projects per year from base FLTP funds.

Environmental Enhancements

Transportation facilities like roads, bridges and parking areas can cause negative impacts to surrounding ecosystems and sensitive habitats. Habitat fragmentation, water quality issues, stormwater runoff and construction activities can all be detrimental to the very resources the Service is entrusted to protect. Environmental enhancements are design solutions intended to soften these impacts and indeed improve adjacent natural resources while providing important access and mobility. Aquatic and terrestrial passages, bioswales, and pervious pavements are just some of the enhancement possibilities outlined in the Roadway Design Guidelines. These enhancements can increase project costs because they can add complexity and time to otherwise standard transportation projects. Ideally the program would deliver 2-3 enhancement projects per year, unfortunately the program can only afford to integrate enhancements on a very limited basis.

Transit and Electric Vehicles

Transit systems and trail networks are very important components of the transportation program's multi-modal portfolio.

On-site transit systems, while few in number, provide important access opportunities for mobility limited populations while also allowing refuge managers to control visitation and recreational patterns on sensitive landscapes. FLTP funds may be used to acquire rolling stock and to pay for operations and maintenance costs however, under the current funding outlook, expansion of the transit portfolio is not a high priority.

Despite limited budgets, the transportation program is piloting a number of electric vehicle (EV) related initiatives including the procurement of EV or hybrid fleet vehicles and the installation of electric vehicle charging infrastructure (or EVSE) for Service employees and the visiting public to use. EVs can provide noise and emission free transportation, which is ideal for sensitive landscapes like Refuges. The Service recently inaugurated its first solar powered, public use EV charger at Ottawa NWR in Oak Harbor, Ohio. These initiatives are being led under a nascent partnership between the Service and the U.S. Department of Energy's Clean Cities Program.

See: http://www1.eere.energy.gov/cleancities/index.html

Tesla charging at Ottawa NWR, 2015

Program Needs

Planning

Transportation planning is essential to making data informed decisions about how, where and why to take action. The following planning activities help managers make informed decisions: program cohesion (outcomes clearly tied to mission), performance management (measurable performance targets), project selection (outlined in this LRTP), high-level guidance, data collection/analysis and demonstration of compliance with federal requirements.

Staffing

The transportation program currently supports two staff at the headquarters office and ten regional coordinator staff throughout the eight regions. Through a staffing assessment conducted by the John A. Volpe National Transportation Systems Center on behalf of the program, transportation and facilities staff expressed need for additional capacity to leverage funds, manage databases, and provide technical planning assistance to units.

Staff relies on internal and external partners for help with project review and management, technical assistance to units, leveraging new funding sources, and general program oversight. These partnerships, however, cannot meet all of the transportation program's capacity needs. The staffing assessment concluded that adding staff capacity in the following functions and roles at the national level could help address program needs.

- **Transportation Scholar (Varies)**

One creative solution to address the program's staffing shortfall is to continue to bring on public lands transportation scholars. This program connects emerging transportation professionals with different federal public land units across the country. In the past, the FWS has placed a number of scholars to work at various levels of the organization to assist with project planning, grant writing and policy initiatives.

- **Facilities Liaison (Regional)**

This position would work with the Facilities Branch and focus exclusively on transportation asset management. The liaison would have access to the Financial and Business Management System (FBMS) and other database management systems and coordinate training or provide technical assistance to transportation staff for database requests. The position would also oversee budgeting for FHWA transportation funds, including FLTP funds, Emergency Relief for Federally Owned Roads (ERFO), and deferred maintenance.

- **Grant-Writing (Headquarters and Regional)**

With possible future funding limitations, regional staff are increasingly pressured to identify and leverage new funding sources to meet their transportation needs. A half-time position at the national level would identify supplemental and discretionary funding sources, match sources with appropriate unit needs, and assist with grant writing to best leverage limited FLTP funds.

- **Planner (Headquarters)**

The staffing report also noted the need for short and long-range planning activities at the headquarters level. An HQ level transportation planner would be responsible for overseeing national and regional planning efforts such as: including transportation in the Service's landscape planning efforts, ensuring that Comprehensive Conservation Plans (CCPs) address relevant transportation issues and providing technical assistance to units for transportation planning. The position would also make connections with State DOTs, State and regional governments, and metropolitan planning organizations (MPOs) to help stations better participate in State and regional transportation planning and to ensure that Service's plans connect to wider transportation networks and organizations.

- **Fulfilling Staffing Needs**

After reviewing these findings, HQ is attempting to fill two new positions with multi-regional and national level responsibilities in 2016.

The National Investment Strategy

The national investment strategy is high level guidance for complying with the policy directives of the Service and the Federal Highway Administration (FHWA). The following focus areas provide direction for decision making at all levels of the transportation program. Transportation improvement plans and regional LRTPs should, in general, be consistent with these focus areas:

Develop Connections to People and Urban Refuges

The Refuge System vision, Conserving the Future, calls for an increased Service presence in urban areas (Recommendation 13). The transportation program is an excellent means to achieve the Recommendation because it can help provide and build the access opportunities needed to reach out to new and diverse audiences.

The Urban Refuge Initiative has identified 101 Refuges in the system as 'urban' classifying them in different tier categories based on visitation. In addition, the Initiative has defined seven 'Standards of Excellence' to guide the program, including Standard 6: Provide Equitable Access.

At the time of publication of this plan, work is underway to identify a list of priority urban transportation projects.

Maintain State of Good Repair on Priority Assets

Preventative maintenance on roads, bridges and parking areas can cost 20-30 times less than more significant rehabilitation or complete reconstruction. For this reason, program funds should be directed towards preservation of high priority (mission critical) assets in good or better condition. The use of Roadway Inventory Program (RIP) data is key for prioritization of regional capital improvement plans.

Decommission or Phase out Low Priority Assets

Assets in poor or failed conditions should be slated for reconstruction or decommissioning based on Asset Priority Index (API) scores and tier-levels. This reduces the deferred maintenance backlog, simplifies RIP data collection and helps the program 'right size' the transportation network. API scores can be found in the FWS asset management database (SAMMS). The tiering effort also helps define non-priority assets. Until the program has addressed all of its most pressing needs, adding new assets to the transportation network is not a priority except in the cases of new access to a location, trails and multi-modal connections which can augment access opportunities to Refuges and Hatcheries.

Improve Safety

With a low-volume and low-speed roadway network, the standard of safety is much higher for the FWS transportation system when compared to a state DOT, for example. The transportation program is working towards zero fatalities and minimal wildlife/vehicle collisions (WVC's) through various design solutions, data collection efforts and safety countermeasures identified in this plan. See Appendices: Safety Analysis Toolkit and Roadway Design Guidelines

Support High-Use Recreation Areas

Current transportation legislation calls for the identification and strategic support of high-use recreation sites and/or economic generators. According to the working definition developed by the Service's transportation program, high use recreation sites and economic generators are those Refuges and Hatcheries that are open to the public and whose annual visitation numbers exceed the average annual visitation rates for that region.

Support Financial Sustainability

Financial sustainability, from an asset management perspective, means more than merely preserving pavement conditions at appropriate levels. The transportation program must take into account life-cycle costs of transportation improvements while at the same time investing in projects that are resilient to the impacts of climate change. The FWS land base includes coastal lowlands, barrier islands, wetlands, fire-adapted grasslands and other landscapes that are, by their very nature, vulnerable to hazards. Inland flooding, coastal flooding, fire and other stressors threaten the natural resources the FWS is entrusted to protect. Transportation systems are key in responding to and adapting from emergencies and natural disasters and therefore should be managed in a way that ensure their long term sustainability and resilience.

Seek Partnerships for Project Implementation

The needs of the FWS transportation network far outweigh the current funding for the program. Whenever possible, base allocations should be leveraged with outside resources to maximize the utility of FLTP base dollars.

Coordinated Opportunities Strategic Goal:

The program will seek joint transportation opportunities that support the Service mission, maximize the utility of Service resources and provide mutual benefits to the Service and external partners.

Friends Organizations (2014)

approx **230** Groups

&

approx **50k** Members

Coordinated Opportunities Snapshot

Coordinated opportunities may be considered an implementation principle or critical success factor that supports the other strategic goals, as well as a goal unto itself. The transportation program relies upon, and benefits from, connections with other transportation systems and organizations who share facilities, interests, boundaries, or goals. Equally important are connections to other branches and departments within the FWS.

Coordinated opportunities with other agencies and organizations allow for transportation solutions that support the Service's mission, maximize the utility of Service resources, and provide mutual benefits to the Service and external partners. The condition of the Service's transportation system in regard to coordinated opportunities is therefore determined by the agency's ability to, and record of, partnering with others to implement mutually beneficial transportation projects.

The FWS partners with fifteen different types of organizations at the national level and an additional 10 categories of partners at the local and State levels. Examples of successful partnerships are detailed in this section and throughout this plan.

The following four steps outline an approach for pursuing coordinated opportunities:

- **Identification of Transportation Needs**

With guidance from the regional offices, field stations should identify their transportation needs and see where their projects may fit in the larger (regional) capital improvement program. Step one of the project selection process is a 'solicitation' phase where stations submit their proposals for review by the region. It is important to note that needs, especially safety needs, can exist on connecting transportation facilities outside FWS boundaries. Needs should be consistent with local and/or regional transportation plans (STIPs, TIPs, LRTPs, etc.).

- **Isolate Opportunities**

Since base FLTP funding cannot address all transportation needs, leveraging of supplemental funding (or technical capacity) is key to the program. Transportation program managers should help disseminate information about state, local and federal programs that can provide funding or technical expertise (like design/engineering).

- **Engagement**

Once opportunities are identified, transportation or field staff should reach out to partner organizations to determine areas of mutual interest. Partners can include: universities or other educational facilities, 'friends of' groups, volunteer organizations, research organizations, other FLMAs, state DOTs, MPOs/RPOs, homeowners groups, transit authorities, local government authorities and environmental or conservation organizations. Field staff should prioritize organizations whose purview is in close physical proximity to FWS lands as they are most likely to have overlapping interests with the Service.

- **Partnership Activities**

The final step is to commence partnership activities. These can be informal (once yearly trail maintenance by the friends group) or more formal activities (like construction project management by the state DOT). The more formal activities generally warrant a memorandum of understanding (MOU) or other legal instrument that clearly outlines the cooperative arrangement between the Service and the partner organization. Partnership activities can also be specific to an individual project.

Source: FWS Friends Fact Sheet

Case Study:

Visitors Center and Parking Lot
Tualatin River NWR, Sherwood, OR

Coordinated Opportunities (Primary Goal)

- Objectives 2, 3

Asset Management

- Objectives 1, 3

Environmental

- Objective 1

Access, Mobility and Connectivity

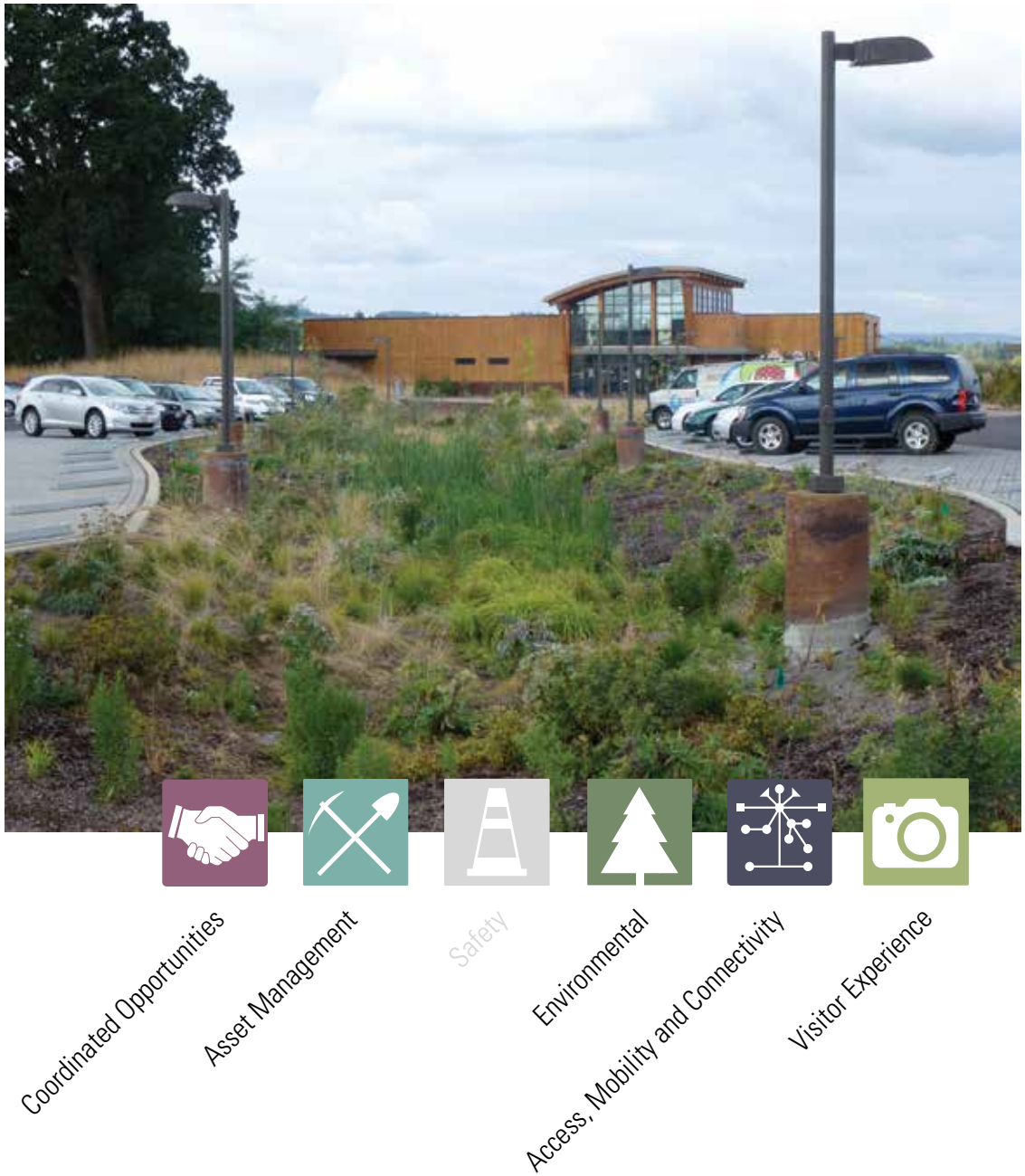
- Objectives 1, 3, 4, 5

Visitor Experience

- Objectives 2, 5

The relationship the FWS has with its various friends groups is one that pays significant dividends. Dating back to the cooperating associations formed in the 1930s, these partnerships have provided much needed assistance in the forms of: volunteer hours, specialized knowledge/information, links to local communities, assistance to leverage funds and advocacy at local and national levels for policy and funding.

While building new transportation assets is not a priority for the program, sometimes large scale improvements can include transportation facilities like this example at Tualatin River NWR. The local friends group worked with elected representatives to secure discretionary funds to build a new visitor's center and parking lot. Meeting key elements of the FWS Roadway Design Guidelines, the parking lot features: pervious surfaces, amended soils, native vegetation and a bioswale that controls stormwater and filters runoff.



Asset Management Strategic Goal:

The program will operate and maintain a functional, financially sustainable and resilient transportation network to satisfy current and future land management needs in the face of a changing climate.

Asset Management Snapshot

Asset management is the process of strategically maintaining, upgrading, and operating physical assets. The practice includes preservation, upgrading, and timely replacement of assets through cost-effective management, programming, and resource allocation decisions.

To quantitatively determine the condition of Service transportation assets, data are analyzed from the Service Asset Maintenance Management System (SAMMS), FLH's Road Inventory Program (RIP), and FHWA's National Bridge Inventory (NBI). The Service also uses an Asset Priority Index (API) to determine the relative importance of an asset based on mission dependency and substitutability. Finally, the transportation program is currently undergoing a nationwide 'tiering' process to right-size the DM backlog.

To achieve a financially sustainable portfolio, vulnerability to natural disasters and changing climate patterns should always be taken into account when considering the maintenance or replacement of an asset. A resilient transportation system will be minimally impacted by weather events and natural disasters.

Another key element in advancing the asset management strategic goal will be the implementation of standardized project selection processes at the regional level. The selection process framework outlined in this plan will provide guidance for regions to be able to quantitatively rank and prioritize projects for their work programs. This will give consistency to the transportation program and will ensure that regional allocations are advancing strategic goals and balancing program principles.

These ongoing processes and data-collection/analysis efforts follow established guidance found in this plan or elsewhere in Service policy. This ensures programmatic consistency and gives the Service and transportation program an excellent snapshot of overall conditions across the entire transportation network. All this information is essential to the program's data-driven decision making processes, which inform how, when, and where the transportation program should act to improve, replace or decommission its various assets.

These processes are also helpful in fulfilling the Service's commitment to measure and monitor performance of the transportation network over time and to deploy funds strategically to maintain a resilient, efficient and cost-effective system.

ROADS
In GOOD or better condition

5,400 Miles of Public use Roads

BRIDGES
In GOOD or better condition

300 Public Use Bridges

TRAILS
In GOOD or better condition

2012 84%

2,100 Miles of Surface Trails

Sources: FHWA Roads Inventory Program 2013, FWS Bridge Inventory Program 2013

Case Study:

Pavement Preservation
Crab Orchard NWR, Marion, IL

Asset Management (Primary Goal)

- Objectives 1, 3

Safety

- Objectives 1, 2, 3

Environmental

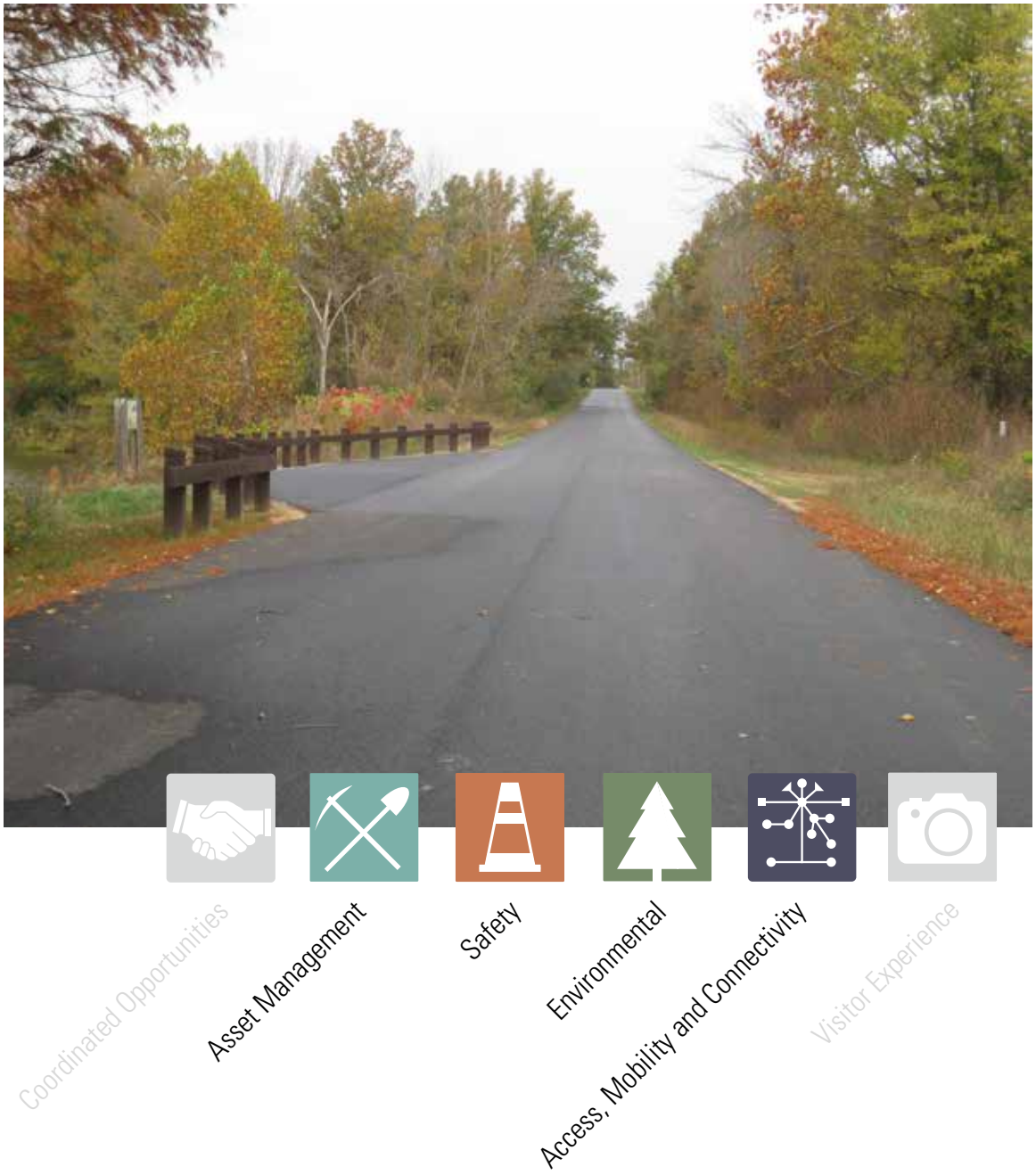
- Objective 1

Access, Mobility and Connectivity

- Objectives 3, 4, 5

Starting in 2010 the FWS Midwest region began a paved road and parking area surface preservation program at Crab Orchard National Wildlife Refuge in southern Illinois. Converted from private property in the 1950's, this refuge has the highest paved road total in the NWR system. Maintenance and upkeep of the paved surfaces was taking up an inordinate amount of program funding, so the region decided that repaving the roads at Crab Orchard was a priority for long-term cost reduction.

To date the transportation program has rehabilitated nearly 17 lane miles of roads and over 22,000 square yards of parking area. The region intends to accomplish another 15 lane miles and 16,000 square yards of parking improvements, documented as a priority in the five year capital improvement program. Once completed, the majority of the paved public use routes inside the refuge will have a good or better condition rating with better roadside drainage and reduced long term maintenance costs.



Safety Strategic Goal:

The program's network will provide a superior level of safety for all users and all modes of transportation to and within FWS lands.

Safety Snapshot

FWS is committed to providing the utmost in safe and reliable access to and within refuges and hatcheries. Unlike many state level departments of transportation (DOTs), the Fish and Wildlife Service's mobility network is designed to provide service at much slower speeds and much lower volumes. As such, the Service has established a target of zero fatalities and zero wildlife/vehicle collisions (WVC). To accomplish this target, the Service has set into motion efforts to improve existing data collection efforts (specifically in the RIP/RATE surveys) to assist with analysis and recommendations.

The Fatality Analysis Reporting System (or FARS, a nationwide census program run by the National Highway Traffic Safety Administration, NHTSA) and the Safety Management System (or SMS, a program run by the Federal Highway Administration) are programs that track the number, location, frequency and severity of crashes and incidents on refuges and hatcheries.

FARS is a nationwide dataset that provides NHTSA, Congress, and the American public with annual motor vehicle fatalities data. Reported data includes information such as the nature of accidents, accident location, and number of fatalities.

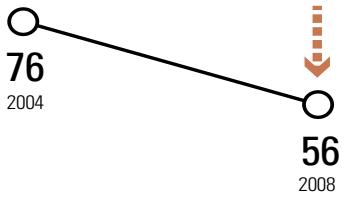
SMS uses FARS data to populate crash information and produce safety solutions and interventions for Service-owned and non-Service-owned roads in Service lands. This protocol combines engineering (safety improvements), education (public availability of information), enforcement (by FWS Law Enforcement staff), and emergency medical services (with local first responders) to comprehensively address the safety strategic goal.

The 2014 update to the SMS protocol minimizes the reliance on data collection efforts required of unit-level staff, and instead uses existing sources of crash and other safety data to identify issues and develop potential projects and programs for implementation. The program has also developed a safety analysis toolkit, included in this publication, that will help refuge and hatchery staff identify safety issues and implement appropriate countermeasures.

Data sources include: national and state crash reporting systems, qualitative information, Service regional studies, and unit-level inventories. Once data are assembled, they are analyzed to determine locations where safety issues appear to exist, and what kinds of interventions may be appropriate to improve safety at those locations. More information about the Service's SMS update can be found in the Service's Transportation Program Safety Management Report.

Sources: FARS, NHSTA

Total Accidents on FWS Lands



Reduction of 26%

Total Human Fatalities on FWS Roads System

2

Past 5 Years

FWS 20 Year Target

Ø

Zero Human Fatalities
Minimal Wildlife/Vehicle Collisions

Case Study:

Access Improvement
San Luis NWR, Los Banos, CA

Safety (Primary Goal)

- Objectives 1, 2, 4

Coordinated Opportunities

- Objective 1

Asset Management

- Objective 1

Access, Mobility and Connectivity

- Objectives 3, 4

Transportation facilities that visitors and staff use to access Refuges and Hatcheries (off-site facilities) are as important to the program as the facilities that are on Service lands. These can include rural roads, trails and state or local highways that connect to the FWS network. Frequently there can be safety related concerns at the interface between FWS lands and off-site facilities. Given the high standard of safety goals for the program (zero fatalities in 20 years) addressing any and all safety hazards, especially at this jurisdictional interface, is of utmost importance.

The principal ingress of San Luis NWR is located directly off a state owned highway. Because of the lack of acceleration/deceleration lanes and turn pockets, visitors and staff would have to make dangerous maneuvers at high speeds to access the refuge. After 10 years of collaboration with CalTrans, the program was able to build access improvements from both northbound and southbound approaches, increasing safety for the over 100,000 yearly visitors and administrative personnel.

Environmental Strategic Goal:

Transportation infrastructure will be landscape appropriate and play a key role in the improvement of environmental conditions in and around Service lands.

Environmental Snapshot

Conservation and protection of wildlife and habitat are at the core of the Service's mission. Rather than disrupting an ecosystem, transportation infrastructure should facilitate the improvement of the landscape and the conservation of natural resources.

General understanding about the impacts of transportation systems on habitat are widely known within the Service, and are addressed in planning by comprehensive conservation plans (CCPs) Landscape Conservation Cooperatives (LCCs) and environmental impact statements (EIS). The Service and transportation program also follow the principles of Compensatory Mitigation (Avoidance, Minimization, Rehabilitation and Restoration) to achieve no net loss of environmental and cultural resources.

Additionally, the FWS Roadway Design Guidelines and Project Checklist (included in this publication) will give best practice guidance and methodology for planning, designing, maintaining and building transportation infrastructure in a way that stitches together sensitive habitats, manages stormwater runoff, restores native vegetation and helps manage invasive species.

The transportation program also plays a key role in the Service's goals of reducing GHG emissions, as a large part of the carbon footprint of the Service comes from the use of the transportation facilities. The Climate Leadership In Refuges (CLIR) tool is a web-based application currently in testing that will provide unit-level analysis of all on and off-site carbon and GHG impacts of a refuge. The application also tailors specific recommendations for mitigation of these impacts over time. These recommendations can include: upgrading of service equipment, changes in visitor and/or staff behaviors, development of multi-modal or transit connections and other facilities-related (buildings, etc.) activities.

The Service is also working to better understand how climate change will impact transportation facilities and what might be done to create a resilient transportation network that is environmentally and financially sustainable in the long term.

FWS Fleet Carbon Mitigations Actual Performance

- 2 % yr	Petroleum use reductions (2005 base)
+ 10 % yr	Use of alternative fuels
75 %	New fleet vehicle acquisitions that use alternative fuels
12 %	Percentage of entire FWS fleet that is alternative fuel capable

Roadway Effects on Landscapes

Habitat Fragmentation
Roadkill
Materials and Chemicals
Aquatic Passage Issues
Non-Native Plants
Traffic Disturbance
Construction Disturbance

Roads can impact landscapes from:

0 to over 1Km away

Roadway Design Guideline Elements

LE - Landscape Ecology
PC - Planning Context
DE - Design and Engineering
OP - Organism Passage
SM - Stormwater Management
VE - Visitor Experience

Sources: 5 Year Vehicle Management Plan FWS 2009, Visitor's Survey 2012 (USGS)

Case Study:

Aquatic Organism Passage
Kenai NWR, Soldotna, AK

Environmental (Primary Goal)

- Objectives 1, 3

Asset Management

- Objectives 1, 2

Coordinated Opportunities

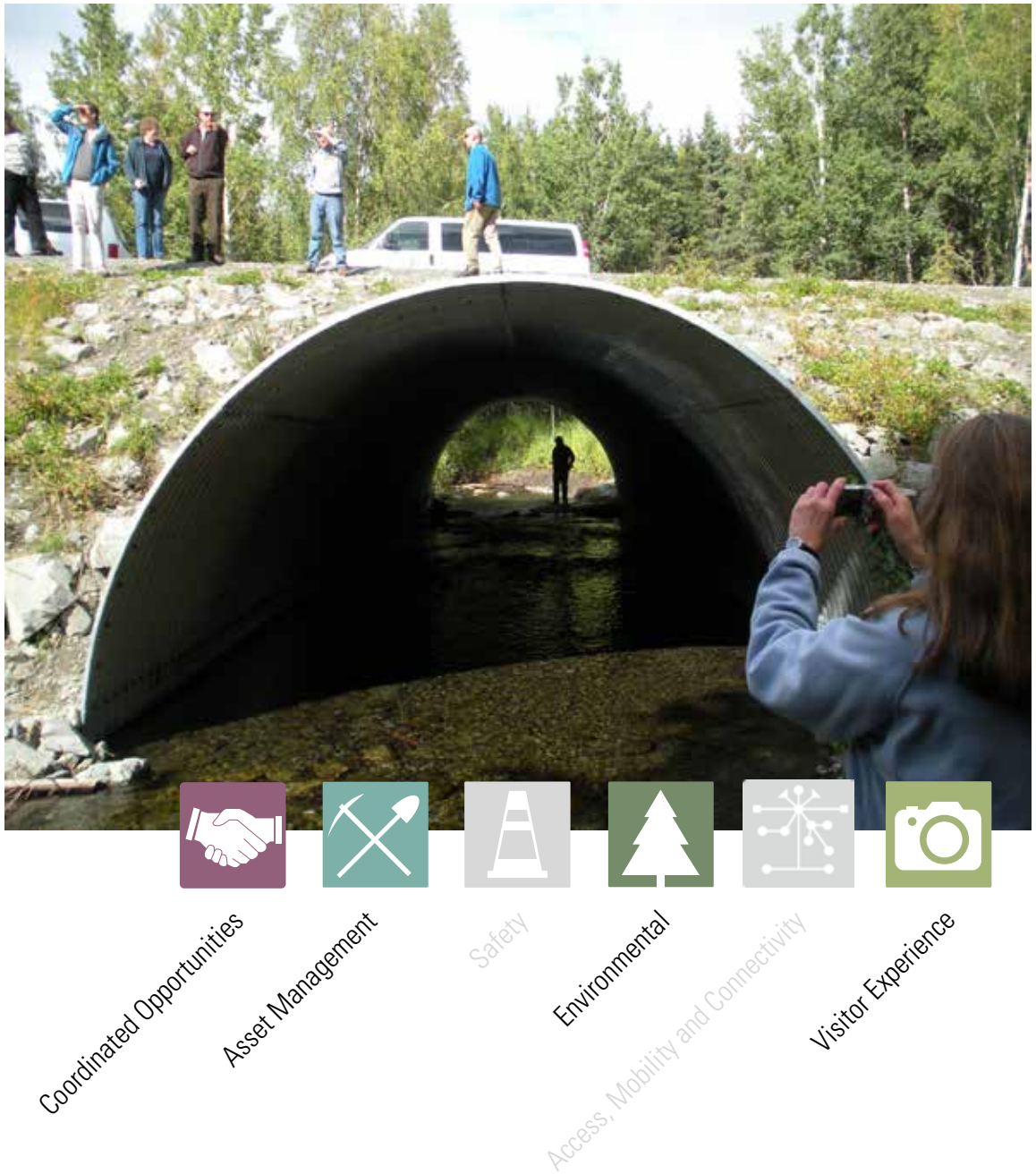
- Objectives 1, 2, 4

Visitor Experience

- Objectives 2, 5

Ecological stream and river functions, such as the movement of woody debris, sediment transport and aquatic organism passage, can be impeded by roadway infrastructure. Box culverts, bridges, dams, dikes and roads all disrupt the free flow of natural processes of aquatic resources on refuges. Recognizing the importance of habitat connectivity, the program is keenly focused on environmental enhancements (that can be found in the Roadway Design Guidelines) to transportation facilities that improve aquatic and terrestrial organism passage.

An excellent example of how environmental enhancements can repair fragmented habitat can be found at Kenai National Wildlife Refuge near Soldotna, Alaska. Together with its partners from the Kenai Watershed Forum, the Alaska Department of Fish and Game, the Kenai Peninsula Economic Development District, Chevron and Peak Oilfield Service Company, the transportation program retrofitted a number of existing box culverts with bottomless culverts and thus improved flow, circulation and access for more than 10 miles of aquatic habitat.



Access, Mobility and Connectivity Strategic Goal:

The program will ensure that units open to the public have adequate transportation options for all users including underserved, underrepresented, and mobility limited populations.

Access, Mobility and Connectivity Snapshot

This plan expands upon the internal asset inventory (on-site) definition to include non-FWS owned (or off-site) facilities that connect and provide access to Service owned lands and transportation systems. Programs like the Federal Lands Access Program (FLAP) exist solely to support projects that improve access to federal lands such as refuges and hatcheries. Judging the condition of, and finding opportunities to improve, access to and within Service lands can be achieved through examination of visitation data, measuring the accessibility of urban refuges and hatcheries, alternative transportation evaluations, and visitor surveys. The Service surveyed visitors throughout the country and found that 58 percent of station visits originate more than 50 miles from the refuge (National Visitor Use Survey, 2012). This indicates that improving access and mobility, especially for off-site access improvements, supports the economic generation program principle.

Surveys also indicate the possibility of latent demand for off-site alternative transportation options. While 35 percent of refuges have multimodal access, only 14 percent of visitors actually used some form of ATS. This, despite the fact that 23 percent of respondents of the same survey indicated that off-site alternative transportation options could enhance the visitation experience.

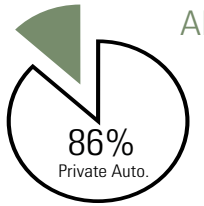
Source: Visitors Survey 2012 (USGS)

The ongoing RIP/RATE surveys and Multimodal Catalog (FLH and Volpe Center) will give the program an excellent picture of the different transportation options and preferences of the visiting public. These efforts will help the program develop better access for underserved, underrepresented and mobility limited populations.

On-site transportation patterns are also measured through various ongoing data collection methods including the Refuge Annual Performance Planning survey (or RAPP). The latest numbers indicate that 35 percent of all visitors use auto tour routes, 33 percent use hiking trails, 5 percent use bicycle facilities and 7 percent use water facilities (like water trails and boat docks/launches). When asked about preferences in using various modes of transportation to tour a refuge, watercraft, pedestrian trails and open-air trams were popular options, each receiving over 50 percent likeliness of usage.

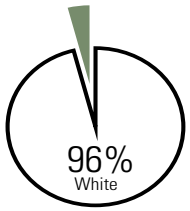
RAPP numbers show that over 47 million people visited refuges in 2013. This marks an increase of 20 percent from just 5 years prior. U.S. Census projections suggest that the upward trend in visitation to Refuges will continue underlining the need for the transportation program to plan for and improve access, mobility, and connectivity throughout the network.

Visitation By Mode



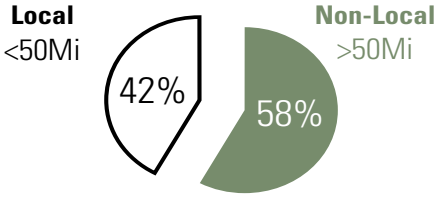
Lacking Transportation Options

Race



Lacking Diversity

Distance Traveled



FWS Units Drive Tourism

Case Study:

Bicycle Boardwalk
Chincoteague NWR, Chincoteague, VA

Access, Mobility and Connectivity (Primary Goal)

- Objectives 1, 2, 3, 4, 5

Asset Management Goal

- Objectives 3, 4

Safety Goal

- Objective 2

Environmental Goal

- Objectives 1, 2

Visitor Experience

- Objectives 2, 5

Because of the importance of water resources to migratory birds and fish, Refuges often are located in places with abundant hydrological resources like coastlines and lakes. Frequently, the Refuges in these areas are essential elements to a region's tourism infrastructure. Visitors and residents alike benefit from the recreational opportunities and quality of life dividends that Refuges can provide. Quality access, mobility and connectivity options are essential to managing natural resources as well as providing the public with opportunities to recreate and learn about habitat and ecology.

This bicycle boulevard inaugurated in 2012 at Chincoteague NWR parallels the main access road that connects the popular coastline with the nearby village, providing visitors with a safe, non-motorized and enjoyable way to travel between the two. The facility also reduces traffic congestion, helps refuge staff manage visitation and helps meet GHG emissions reduction goals.

Visitor Experience Strategic Goal:

The program will enhance the visitation experience through improvement and investment in the transportation network.

Visitor Experience Snapshot

It is important to keep in mind that transportation doesn't merely provide access opportunities. It is the means, not the end, and transportation infrastructure should highlight the landscapes and resources the Service is endowed with protecting. The visitor experience goal, therefore, builds upon the desire to provide adequate access and focuses on how the quality of the visitation experience can be improved through investments in the transportation network.

The most recent visitor use survey (2011) compared importance and satisfaction ratings across a number of station services, including 12 discreet transportation elements (below).

- Conditions of roads
- Number of parking places
- Directional signs on highways
- Condition of parking areas
- Number of pullovers
- Directional signs on station
- Safety of driving conditions
- Directional signs on trails
- Condition of trails/boardwalks
- Safety of station entrances
- Disabled access
- Condition of bridges

75 percent of respondents ranked the transportation elements as 'highly important' as well as indicating a high degree of satisfaction with the element.

Strategies for addressing visitor experience through the Service's transportation system are also tied to the visitation levels. Visitation levels are relevant to transportation improvement strategies because, generally, units with higher visitation will benefit more from transportation related improvements.

Gateway communities are also potential locations for visitor enhancements, particularly as they relate to wayfinding, which informs visitors about neighboring refuges and hatcheries. These enhancements can improve ease of travel to and within units, thus improving visitor experience.

This philosophy of focusing investments on areas of greatest use and importance also applies to activities enjoyed most frequently by Refuge and Hatchery visitors. The 2004 and 2011 visitor surveys and 2010 RAPP data suggest that transportation investments that accommodate wildlife observation (like auto tour routes) are the most effective in enhancing visitor experience.

Furthermore, survey results identify private vehicles, walking/hiking, and private vehicles with trailers as the top three modes of visitor travel within refuge units. Transportation assets supporting these modes will therefore have a greater ability to improve visitor experience through regular maintenance and investment.

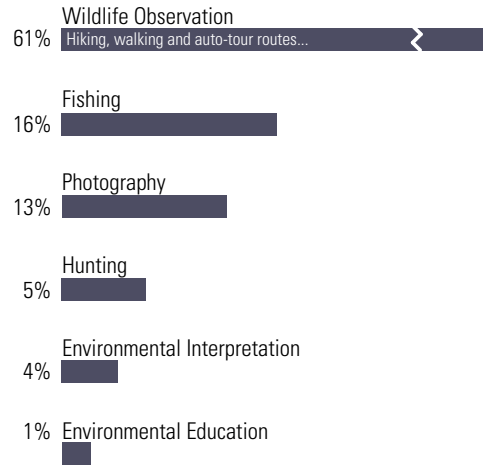
Source: National Wildlife Refuge Visitor Survey 2010/2011: National-level Results

Satisfaction with 12 Transportation Elements

75%

Highly Important and Very Satisfied
'Keep Up the Good Work'

'Big Six' Activities



Focus Investment Where it has the Most Impact

Case Study:

Auto Tour Route Paving
J.N. Ding Darling NWR, Sanibel, FL

Visitor Experience (Primary Goal)

- Objectives 2, 4, 5

Asset Management

- Objectives 1, 3, 4

Environmental

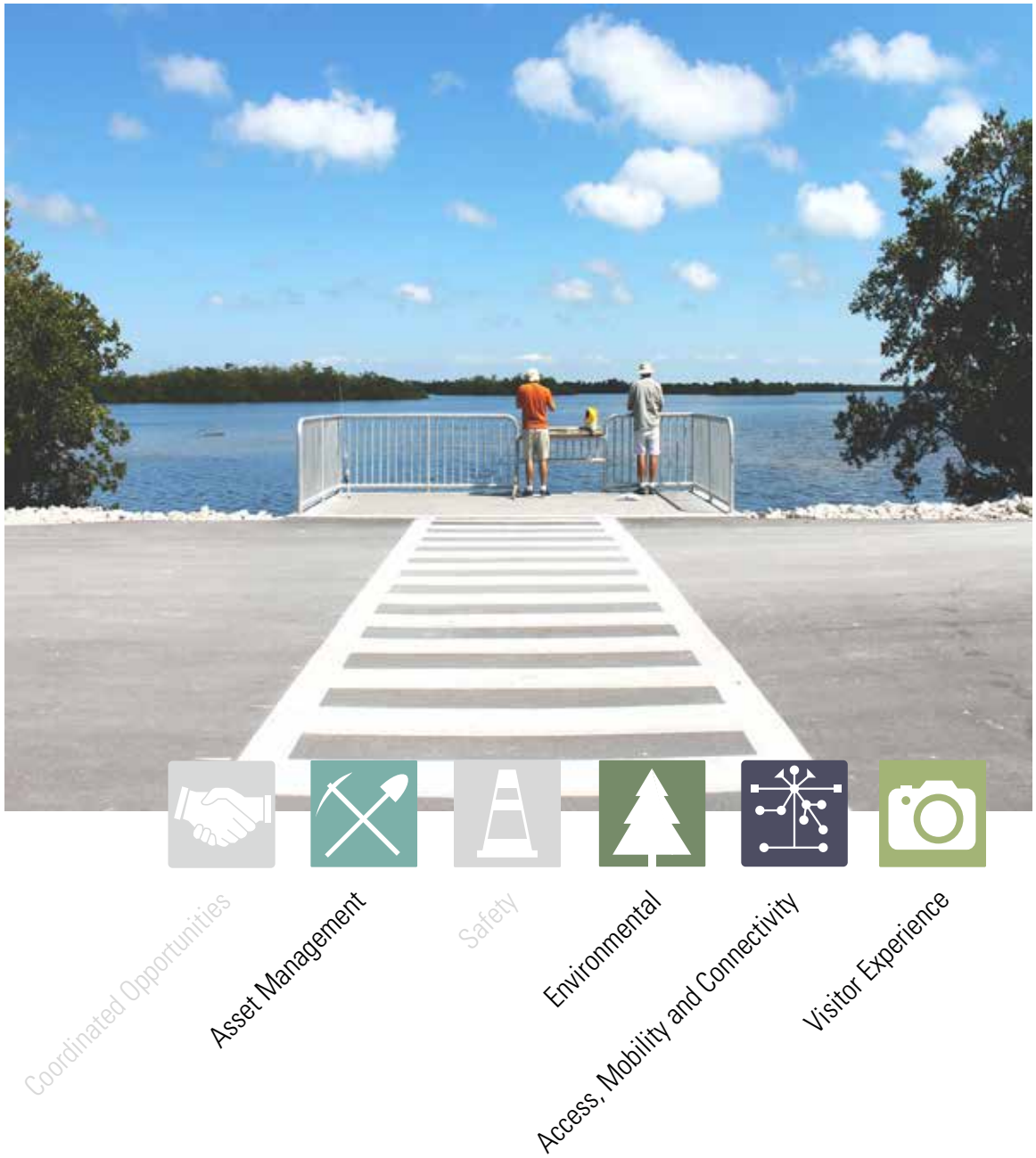
- Objectives 1, 2, 3

Access, Mobility and Connectivity

- Objectives 2, 3, 4, 5

The J.N. 'Ding' Darling National Wildlife Refuge is located along Florida's southwest coast on Sanibel Island, covering over 6,400 acres and supporting hundreds of species of wildlife and plants. The refuge receives hundreds of thousands of visitors annually, many of whom walk, bicycle or drive along the auto tour route. It is one of the top birding areas in the nation as it plays host to many migratory birds.

In 2013, the FHWA assisted the FWS in the repaving of Wildlife Drive, the main auto tour route on the Refuge. Because of concerns related to the deteriorated condition of the semi-pervious pavement, the construction and engineering team used a limestone aggregate asphalt to provide a heat reflective, smooth surface accessible to bicycles, wheelchairs, and strollers. Pervious shell parking shoulders were added to slow stormwater movement and filter contaminants from the water bodies on-site. Two new water control structures were installed to improve water circulation and traffic calming humps were added or relocated to improve safety The newly paved route provides improved access to the numerous trails and viewing platforms on the refuge while facilitating multimodal circulation along with wildlife observation and fishing.



Funding

Don Edwards San Francisco Bay NWR

California

Bridge the Gap

The transportation assets spread across National Wildlife Refuges, National Fish Hatcheries and other Service lands require constant investment to manage and operate. As outlined in the vision, the program is striving to build a transportation network that is safe, multi-modal, resilient to changing climatic conditions, and integrated with surrounding communities and regions. However, the needs of the current or any future system far exceed the available FLTP base program funds.

For this reason it is imperative for the program to bridge the gap and pursue creative and alternative funding sources. Any funding strategy should include grants and other opportunities at local, state or national levels, congressional earmarks, friends group activities and any other available sources.

This section begins with a brief history of transportation program funding, analyzes some national level funding-related data, details a number of federal funding programs that can be used to leverage FLTP program dollars and finally lists a number of federal funding sources that can be leveraged to address critical needs and funding gaps.

History of Program Funding

While the Service did build and maintain transportation assets prior to 1998, the creation and authorization of the Refuge Roads Program (RRP) through the Transportation Equity Act for the 21st Century (TEA-21) effectively established the modern-day Service transportation program. Through the Federal Lands Highway Program (FLHP) the RRP authorized and funded a yearly base program of $20M from 1998 through August 2005 for maintenance and improvements of public roads within the National Wildlife Refuge System.

The Safe, Accountable, Flexible, Efficient, Transportation Equity Act (SAFETEA-LU) continued the FLHP and Refuge Roads Program with base funding for the FWS transportation program at $29M per year through 2012. In addition, SAFETEA-LU created an eligibility for National Fish Hatcheries to compete for discretionary funds like congressional earmarks and grant programs like the Scenic Byway Program and the Paul S. Sarbanes Transit in the Parks Program (TRIP). Over the years, the FWS transportation program has leveraged an average of $7M/Yr. from these supplemental funding sources.

Moving Ahead for Progress in the 21st Century (MAP-21) took effect October 1, 2012 and was extended through the end of 2015. A transformative transportation authorization, MAP-21 streamlined and consolidated many existing transportation programs and funding sources.

Under MAP-21, the Federal Lands Highway Program was replaced by the Federal Lands Transportation Program (FLTP). Overseen by the Federal Highway Administration, the FLTP is a multi-agency program that includes many other federal lands partners like the National Park Service, the Bureau of Land Management and other federal land management agencies. In addition to being multi-agency, the FLTP program is also multi-modal allowing eligibility for alternative and off-site access networks such as trails, bicycle infrastructure, access improvements and transit linkages.

Under MAP-21, FLTP base funds for the Service were set at $30M/Yr. and could be used for refuges and hatcheries as long as those units are open to the public and are included in the Service's transportation facility inventory. MAP-21 also discontinued some discretionary grant programs (Sarbanes and Scenic Byways) while at the same time creating a number of new programs (like the Federal Lands Access Program, or FLAP) that allow agencies to compete for supplemental funding.

These fundamental changes to transportation funding mechanisms indicate a larger shift toward an outcome-driven and performance based funding environment, for which the FWS transportation program must be ready.

The most recent transportation legislation, Fixing America's Surface Transportation Act (FAST Act), was signed by President Obama in December, 2015. The FAST Act authorizes $30 M/Yr to the FWS transportation program through FY 2020. More detailed direction from the FAST Act will be forthcoming, but it is not expected to change the key components of PLAN 2035.

Beginning with this plan and the policies contained herein, the program is ready to demonstrate quantifiable system improvements to deliver a better connected, dynamic and priority based network of transportation facilities that provide sustainable, safe and resilient access opportunities to and within FWS lands.

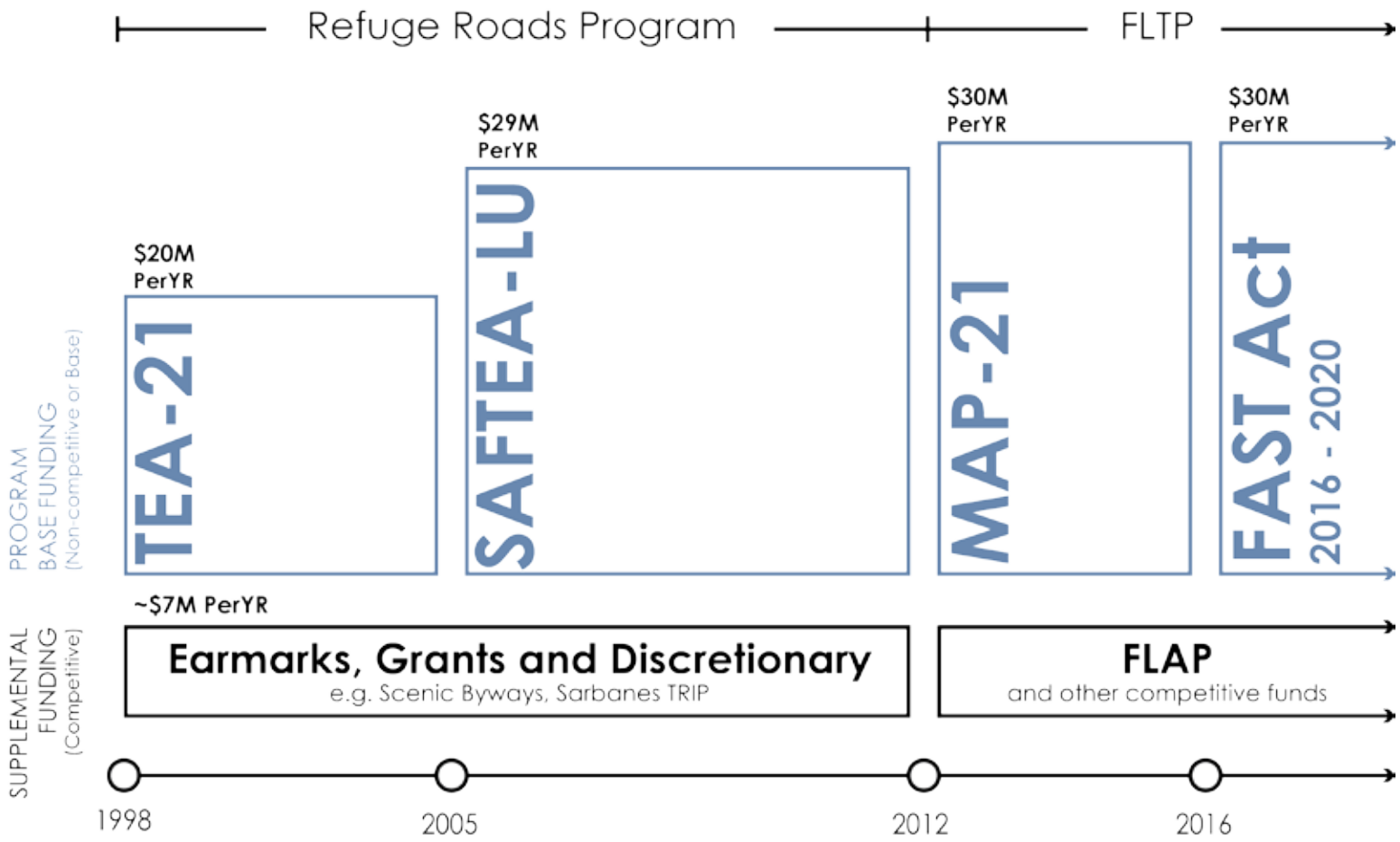
"Our ability to provide support for access to federal lands is contingent on our ability to invest in our nation's infrastructure."

- US Secretary of Transportation Anthony Foxx

Upon presenting Bernalillo County, NM and Valle de Oro NWR With an $8M FLAP Award
October, 2014

Source: Transportation Needs and Planning for the Future 2013

FWS Transportation Funding Timeline



National Level Analysis

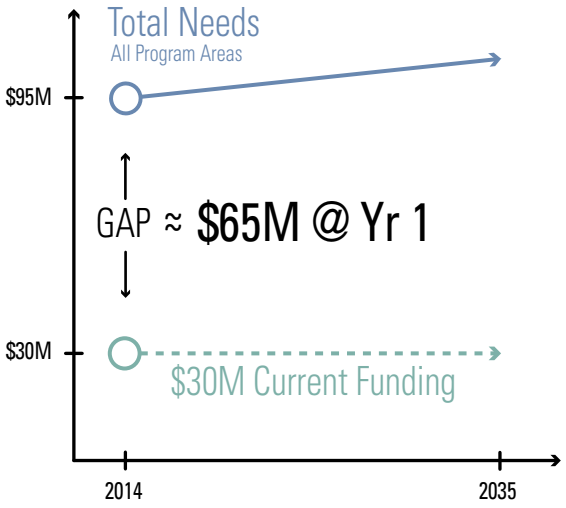
Needs vs. Funding

Soon after MAP-21 was enacted in 2012, FLTP partners were asked by FHWA to prepare an analysis of total system needs based on the size and nature of their transportation networks. The outcome of this extensive effort is summarized here. To address all the needs in the public use transportation system, the program would require $95M/yr. or roughly three times the current funding level.

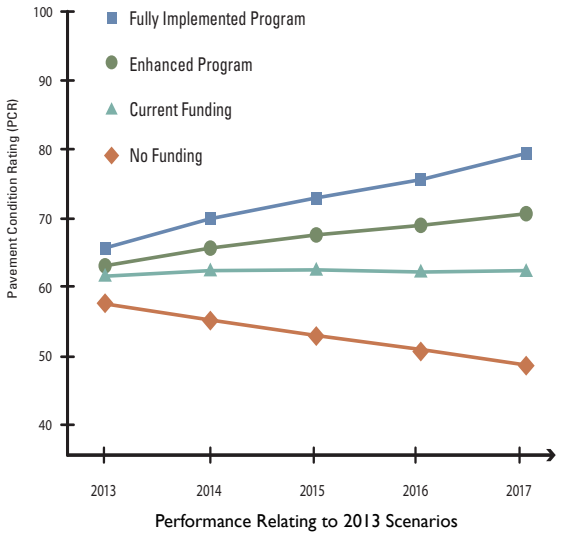
Thus, the gap between current funding levels and the total needs of the program equal approximately $65M at year 1 (2014, plus 3 percent inflation per year). This exercise illustrates the importance of strategic program planning as well as the need to leverage supplemental funding to be able to achieve goals and targets.

Program Area	$30M Current Funding	$60M Enhanced Program	$95M Fully Implemented Address all Needs
Pavement Roads and Parking Lots	$17.5M	$37M	$57M
Bridges	$2M	$4M	$6M
Large Projects	$2.5M	$5M	$15M
Environmental Enhancements	$2M	$4M	$6M
Trails + Transit	$2M	$4M	$5M
Transportation Planning	$1M	$3M	$3M
FHWA Admin.	$3M	$3M	$3M
20 yr Deferred Maintenance	~ 2-3% per yr Reduction ~ 40-60% Reduction in 20 yrs		~ 5% per yr Reduction ~ 95% Reduction in 20 yrs

Funding vs. Needs



Nationwide Pavement Roads and Parking Lots



Sources: Transportation Needs and Planning for the Future 2013, FWS Facilities Branch Annual Report 2013, FHWA Pavement Management Analysis 2013

Allocations vs. Visitation and High-Use Recreation

To determine the extent to which the program is fulfilling the economic generation principle, The Service conducted a national level analysis to determine the extent to which funding allocations were being programmed at high-use recreation sites. These sites are economic generators because they drive tourism and bolster local economic activity.

The top graph shows the percentage of each region's allocation that is programmed at stations with higher than average visitation for that region (6 year totals, Alaska Region 7 omitted). Regional variability is captured in the distribution of the results (Great Lakes Region 3 at over 60 percent, Southeast Region 4 at just over 20 percent).

This analysis gives each region a baseline to inform future programmatic decisions regarding high-use recreation sites and economic generation. A strong work program will balance the economic generation principle with the other two, equally important principles of transportation improvement and resource protection.

The bottom graph shows entire FLTP program spending (all regions totaled, Alaska R7 omitted) at highly visited units over the same six year period. The sawtooth pattern demonstrates the variability of conditions in the field and the response the program makes to manage this reality.

As a small program, the organization must broadly distribute funds year to year to strike a balance between urgent needs brought about by climatic events or safety concerns, priority needs on bridges and auto tour routes and smaller scale, but mission critical, improvements at less frequently visited refuges and hatcheries. This analysis is helpful in establishing a baseline for the program nationally (approx. 40 percent average, all regions, all program funds, over 6 years) and will help guide programmatic recommendations in the future.

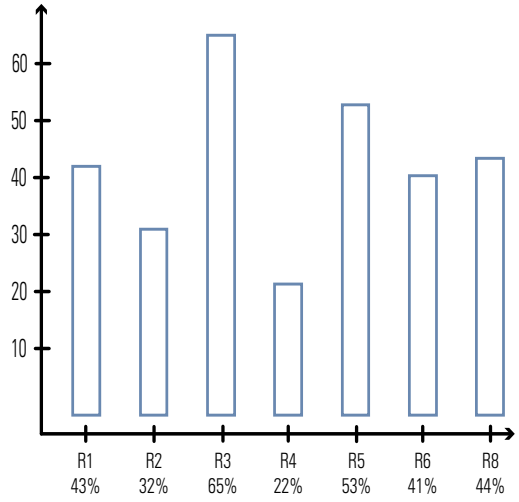
In addition, the red trendline demonstrates the program's success at directing funding towards high-use recreation sites over time.

Net Visitation

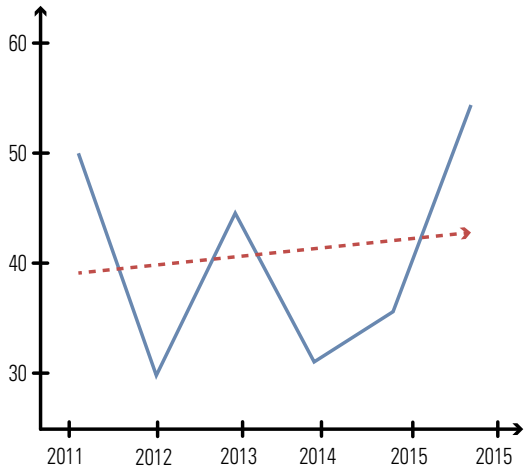
50M
2013
Actual

75M
2035
Projected Given Historic +2% / Yr Increase

% of Regional Allocations Programmed at High-Use Recreation Sites (2011 - 2015)



% FLTP Program Funds Programmed at High-Use Recreation Sites



Sources: Refuge Annual Performance Planning, FWSTP Budget and A Preliminary Analysis of Transportation Program Funds and Highly Visited Field Stations 2014

National Level Analysis

Facilities and Asset Management

SAMMS is the asset management database that the Fish and Wildlife Service uses to provide information on facility and equipment deficiencies, justify budget requests for maintenance needs, track 5-year budget plans, and provide bases for management decision making. Transportation assets are included in SAMMS to aid in completing inspection and maintenance activities and to quantify the complete picture of facilities and equipment owned by the Service.

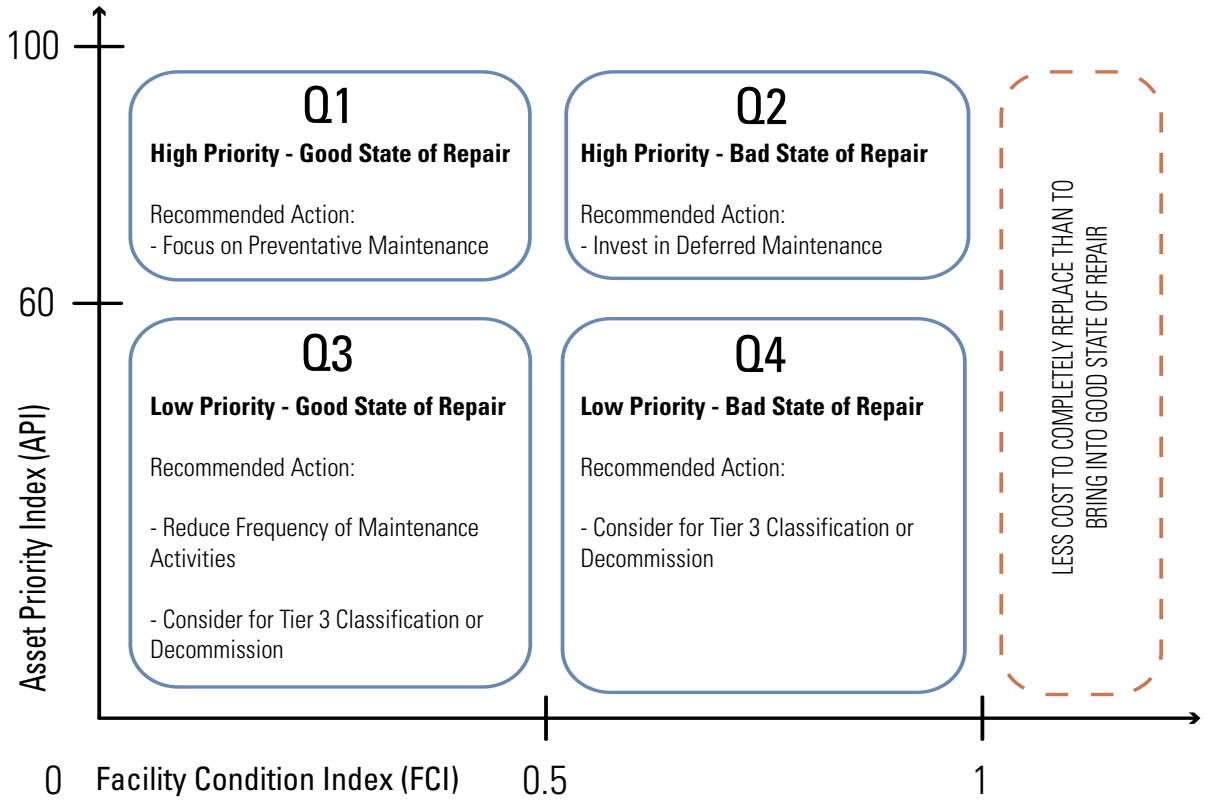
SAMMS uses an Asset Priority Index (API) to rank how important assets are to the Service. The Service's use of API is consistent with the U.S. Department of the Interior (DOI) definition of API as 'an asset evaluation process that quantifies the value of an asset in relation to the mission of the Bureau or Office.'

The API scale is from 1 to 100 (with 100 being the highest score) and is calculated from two variables: mission dependency and substitutability. The Service uses this metric to ensure that maintenance activities focus on the highest-priority assets. Similarly, API is used to identify the lowest-priority assets for less frequent maintenance, or possible decommissioning.

API can be revisited periodically, and should be as part of any CCP or transportation plan development. The Service is contemplating an API revision in 2016-2017.

Sources: SAMMS 2011, NBI

Condition and Priority Matrix



SAMMS also contains a Facility Condition Index (FCI) which is a ratio of the deferred maintenance (DM) costs to replacement value (CRV) The closer to 0 that an asset's FCI score is, the better condition the asset is in. API and FCI numbers can be used to optimize transportation allocations at the regional level. Work programs and project selection processes can be tailored around where assets fall within the 'condition and priority' matrix, supporting the performance management components of MAP-21 and now the FAST Act.

Approximately 57 percent of all FWS transportation assets have an FCI of < 0.10, indicating that no improvements are needed (as of 2011). An FCI greater than 1 indicates that it would cost more to bring the asset to full repair through deferred maintenance than it would be to completely replace the asset. In these situations, replacement is therefore the best course of action, if the asset is mission critical.

Asset Type*		Units	% Of Units in Q1
ROADS †	Paved Roads	2,354 Lane Mi	91%
	Dirt Roads	7,721 Lane Mi	75%
	Gravel Roads	8,449 Lane Mi	83%
TRAILS	Paved Trails	86 Mi	96%
	Unpaved Trails	1,885 Mi	86%
	Boardwalks	47 Mi	76%
BRIDGES	Culvert Road Bridges	175	95%
	Road Bridges	485	89%
	Trail Bridges	139	90%
OTHER	Stationary Docks	207	84%
	Floating Docks	60	99%
	Airstrips	28	95%
	Parking Areas	5,100	65%

According to SAMMS, There are thirteen different types of 'core transportation asset types' that support travel as their primary function.

An analysis of FCI/API scores on all thirteen different asset types revealed that, in all cases, the vast majority of units of measure in that asset class fell in the 'High Priority - Good State of Repair' quadrant (Q1).

This illustrates two important facts:

- The transportation network is the right size for the usage and need of the Fish and Wildlife Service and visiting public.
- The program is very effective in maintaining a state of good repair on the most important, mission critical transportation facilities. As larger repairs are delayed, however, overall condition will slowly decrease.

** Public and admin. assets*

† FWS reports approx. 13,000 linear miles of roadway (5,400 mi. of public, 7,800 mi. of admin.)

A Note on Data:

Since the inception of the multi-partner FLTP, data collection protocols (for assets and real property, deferred maintenance, condition assessments, usage statistics, etc.) have changed substantially. Methods and procedures have been streamlined to not only facilitate the collection of data from the FWS perspective, but many procedures have been standardized to assure quality control between and among FLTP partner agencies. This helps FHWA in planning, designing and delivering transportation projects across the country.

This shift from old to new takes time as many data collection efforts require multiple years to gather an entire national set. In addition, as old data is replaced with new data, discrepancies can emerge due to differing methodologies.

As a program, we recognize that for the data to be meaningful it must be accurate, precise, up to date and collected in a consistent manner. The FWS transportation program is working diligently in this transition period and as the FLTP matures, the overall quality of data collection and analysis will only improve.

Federal Funding Opportunities

Having priority projects scoped and scored with some degree of design and/or engineering will demonstrate the program's commitment to the project and increases chances for securing additional funding.

Some of the funding sources listed are administered by USDOT or the Federal Highway Administration. Other programs channel monies to state agencies for them to administer through their respective departments of transportation or local government representatives (also known as Federal Aid). Programs vary by state and may be housed in more than one agency, including those with a primary focus on transportation, recreation, environment and natural resources, and planning. MPOs and local governments may be another source for funding multi-modal projects, often using funds allocated from the state or USDOT.

Regional transportation coordinators can help individual refuges identify appropriate state and regional funding sources and programs according to applicable investment strategies.

The following programs are good potential sources of Federal funding, but additional funding programs also exist under the FAST Act.

The Federal Lands Access Program or FLAP

The following activities are eligible for consideration under the FLAP, and are similar to those activities allowed under the FLTP:

- Preventive maintenance, rehabilitation, restoration, construction and reconstruction of transportation facilities
- Adjacent vehicular parking areas
- Acquisition of necessary scenic easements and scenic or historic sites
- Provisions for pedestrian and bicycles
- Environmental mitigation in or adjacent to federal land to improve public safety and reduce vehicle-wildlife mortality while maintaining habitat connectivity
- Construction and reconstruction of roadside rest areas, including sanitary and water facilities
- Operation and maintenance of transit facilities
- Research and planning

Proposed projects must be located on a public highway, road, bridge, trail or transit system that is located on, adjacent to, or provides access for a federal land. Additionally, title or maintenance of the facility must be vested in a state, county, town, township, tribal, municipal, or local government.

The FLAP is funded at $250 million annually and its monies are allocated on a state by state basis using the following formula:

- 80 percent of funds to States with at least 1.5 percent of the total acreage of United States' public land
- 20 percent of funds to States with less than 1.5 percent of the total acreage of United States' public land

Within these states, the FLAP further calls for funding allocation based on federal public road miles (55 percent), recreation visitation (30 percent), federal public bridges (10 percent), and federal land area (5 percent) The program also lends preference to projects that are within, adjacent to, or provide access to high-use federal recreation sites or economic generators, as identified by the appropriate FLMA. Programming decisions are made by a committee (Project Decision Committee or PDC) comprised of FHWA, state DOT and local government representatives. Despite the fact that FLAP applications require an FLMA partner's consent, representatives of FLMAs are not yet formally represented in the PDCs.

Partnerships and coordination with state and local governments will be critical to leverage FLAP funds for transportation projects within and surrounding Service lands.

FWS has been successful in leveraging funding from this new program, securing projects in every region in its first year of implementation.

Surface Transportation Block Grant Program or STBGP

Also administered through the FHWA, the STBGP is the successor to many previous programs and includes the Transportation Alternatives Program (TAP). The TAP is intended to promote a balanced and multimodal approach to American transport infrastructure.

Eligible projects could include:

- Pedestrian and bicycle facilities (planning, design and construction)
- Safe routes for non-drivers
- Abandoned railway corridors to trails
- Scenic turnouts and overlooks
- Outdoor advertising management
- Preservation and rehab of historic transportation facilities
- Vegetation management
- Archaeological activities
- Storm water mitigation
- Wildlife management

State DOT's and regional MPO's are given a great deal of flexibility and authority to manage the grant applications and project selection processes.

See https://www.fhwa.dot.gov/fastact/factsheets/stbgfs.pdf for more information on the STBG program.

Coordinated Technology Implementation or CTIP

The Coordinated Federal Lands Highway Technology Implementation Program is a cooperative technology deployment and sharing program between the FHWA Federal Lands Highway office and the various federal land management agencies.

It provides a forum for identifying, studying, documenting, and transferring new technology to the transportation community. Its purpose is to deploy innovative, unique, or under-used transportation technologies that enhance highway safety, access and/or management.

Allocations for the CTIP come from FLTP and Tribal Transportation Programs (TTP) and equal about $2M/Yr.

Eligibility includes:

- Testing, deployment, and impact evaluation of market-ready technologies and innovations.

For more information on CTIP, contact the Service's Transportation Program in Headquarters.

Accelerated Innovation Deployment or AID

Under the AID demonstration program, funds are available to implement an innovation in any aspect of highway transportation including planning, financing, operation, structures, materials, pavements, environment, and construction on any project eligible for assistance under title 23, United States Code. The full cost of the innovation in a project may be awarded up to the maximum amount of $1M.

Awards are limited to up to two projects per State DOT applicant, with up to one project award to a State DOT and up to one project award to a sub-recipient applying through the State DOT, and limited to one project award per applicant for Federal Land Management Agencies and tribal governments, subject to the number of eligible applications and the availability of funds. These funding goals are reviewed annually and may be adjusted to reflect current priorities and needs. Projects eligible for funding include proven innovative practices or technologies, including infrastructure and non-infrastructure strategies or activities (like dust suppression or roadside invasive species management) which the applicant or sub-recipient intends to implement and adopt as a significant improvement from the applicant's or the sub-recipient's conventional practice.

See https://federalregister.gov/a/2014-03452 for more information about application and eligibility.

Implementation

Kanuti NWR

Alaska

Key Actions and Targets

This section is about putting PLAN 2035 into practice. First, this section proposes a performance based project selection framework. The metrics of the framework are directly tied to the strategic goals of this plan. This process will help regions identify their most pressing needs, balance program principles, advance strategic goals and ultimately help achieve the 20 year transportation vision. Second, this section proposes a non-exhaustive starter list of recommended actions derived from the strategic goals in this plan. Under each strategic goal are actionable items that regional staff and program managers can implement at various levels of the organization to advance the ideas and policies in this plan. Third, the section sets performance objectives and targets under each strategic goal that will help the program track progress over time.

Finally, the section offers guidance for the development of the forthcoming regional LRTPs as well as updates to completed ones.

Selection Process

The Service and its partners have developed a national project selection framework that will help Service staff determine improvement programs that align with the policies in this plan. This strategy envisions a usage of best available data to arrive at recommendations and decisions for regional work programs. This framework is intended to establish uniformity in project selection across the Service thereby contributing to stability of the program.

The project selection process is flexible and allows for regions to adapt the framework to fit their needs. Some examples of how regions can adapt the selection process to fit their needs include, but are not limited to:

- The composition and roles of regional project scoring teams
- Methods for submitting project information
- Sub-criteria within the national criteria
- Process for assigning scores to projects
- Weight given to goal categories
- Use of scores in determining final project selection
- Determination of regional priorities
- Schedule for updating the regional project selection processes

Project Selection Cycle Steps:

1 - Solicitation of Projects

Regional transportation coordinators create a pool of candidate projects for consideration, by soliciting input from units and regional leadership. Potential projects must include key data points (such as RIP, SAMMS, RATEs, CCP, road safety audits, SMS, etc.) to verify and explain the need for a project. The project description form, will be used in the solicitation phase.

2 - Preparation for Scoring

Regional transportation coordinators ensure that all proposed projects have sufficient information and best available data to take part in a regional scoring process.

3 - Scoring and Project Scorecard

Regional staff evaluate and score each project using the criteria elements in the project scorecard (P. 50-51) as a guide. This framework gives the transportation program a common baseline to work from to link projects with the strategic goals and principles in this plan. The project scorecard is intended to give guidance the regions, and may be adapted, amended or modified to suit policy, needs and priorities. The best projects will incorporate most, if not all, of the goal areas in the scorecard.

Note on STAT Tool: The forthcoming Station Transportation Analysis Tool or STAT is intended to streamline the scoring process by displaying multiple transportation datasets as they relate to the goal areas in the scorecard and this plan. This provides regional transportation staff a way to both validate improvement plans and a means to facilitate future project programming.

4 - Ranking and Prioritization

Regional staff rank projects according to a scale and process documented in their regional LRTPs.

High scoring projects are then prioritized based on factors to be determined by the region. Such factors can include projects that incorporate a number of LRTP goals, projects that are consistent with the FWS Roadway Design Guidelines, projects that are indicated in a Comprehensive Conservation Plan (CCP) or Landscape Conservation Cooperative (LCC), assets with a high API score, projects that improve a primary access route, indicated as a priority in a regional LRTP or other planning document and/or projects consistent with the national investment strategy.

5 - Determine Regional Work Program

While the ranked project list will guide project decisions, regional leadership will have the final decision on project selection to meet fiscal constraints. Scores are intended to advise the decision makers, but they have flexibility to prioritize projects due to timing, size of projects, funding availability, or shifting regional priorities.

6 - Eligibility Check

Coordinators send list to national transportation program coordinator to confirm project eligibility. After the review, projects are added to the amended 5-year program of projects.

7 - Adapt as Needed

Regional staff will evaluate the regional project selection process and revise it as necessary for following selection cycles.

FWS Project Selection Cycle

1. Region Solicits Projects From Units

Regional Coordinator provides guidance to units for completing project description form.

2. Region Prepares Applications for Scoring

Regional Coordinator ensures forms contain required information and are in proper format.

3. Region Scores Projects

A team evaluates and scores projects based on the information in the project description form. Use criteria elements in the project scorecard as a guide.

4. Projects Prioritized

Regional Coordinator tallies results and determines relative priority of projects. Corresponding FLH field visits to verify data.

5. Determine Projects for Regional Program

Regional leadership evaluates ranked and tiered projects and determines where they fit in the current FLTP work program and available funding.

6. Elegibility Check and Program

Coordinators send list to National Program Manager to confirm project eligibility. After review, projects are added to the amended FLTP 5 year program of projects

7. Adapt for Next Cycle

Regional Coordinator and scoring team evaluates results and makes changes for next cycle

Data, Assistance and Guidance

Key Data Inputs:

- Roads and Trails Inventory Programs (RIP)
- FWS Asset Management Database (SAMMS)
- National Bridge Inventory (NBI)
- Refuge Annual Performance Planning (RAPP)
- Regional Alternative Transportation Evaluations
- Safety and Crash Data

Ongoing: Coordination with FHWA

Throughout the project selection process, transportation coordinators and maintenance staff should maintain open dialogue and collaboration with the appropriate Federal Lands Highway office.

FLH can: corroborate/validate 5 year improvement plans, identify efficiencies and economies of scale and can assist with the scoping and budgeting of projects in the initial phases of programming and development.

Project Scorecard:

Project Scorecard

	Data Inputs	Criteria Elements	Points
Coordinated Opportunities 	• List of partner organizations on regional or national level • Letters of support from partner organizations • State and/or regional transportation plans (STIPs, TIPs, etc.)	• Consider the use of funding or partner expertise for planning, design, construction, and/or operations from a partner organization • Partners can also help manage or operate the completed transportation facility. • Scoring may be on percentage of partner funding: 10% or less of total project cost, 10-50% of total project cost, or greater than 50% of total project cost • Project has a letter of support from a partner agency • Project includes financial support or in-kind support from a partner agency	**10 points**
Asset Management 	• Project description • SAMMS data • RIP data • NBI and other bridge data • FCI/API matrix	• Project will bring an asset with a current condition rating of Fair, Poor, or Failed to a condition of Good or Excellent, or improves an identified deficiency • Project takes into account vulnerability to changing weather patterns and natural disasters • Project extends the remaining service life of an existing asset • Project improves an identified deficiency • Project incorporates cost-savings plan for operations and maintenance to reduce long term costs	**20 points**
Safety 	• Project description • RIP questionnaire • Road safety audit • Crash data • FARS • NBI and other bridge data	• Improves transportation-related safety for visitors, staff, and/or wildlife • Enhancements and countermeasures included in project description: Road safety audits, signs and markings, traffic calming measures and movement restrictions, wildlife crossings, barriers, vegetation control, surface improvements, visiting hours • Project references: Highway Safety Manual, Interactive Highway Safety Design Model, NATCO Bikeway Design Guide, FWS Roadway Design Guidelines, etc. • Project site has documented crash history or is identified as a safety issue 'hot spot' • Project incorporates one or more of the "4Es" of safety (engineering, education, enforcement and emergency medical services)	**20 points**

Environmental	Data Inputs	Criteria Elements	Points
	• RIP/RATE survey • CCP notation of sensitive resources • Project description • Roadway design guidelines • CLIR Tool	• Project includes context sensitive enhancements for wildlife connectivity and reduction of habitat fragmentation • Project will reduce or offset greenhouse gas emissions • Project is designed to avoid negative impacts to fish, wildlife, habitat, cultural and aquatiuc resources through the Roadway Design Guidelines or Adaptive Mitigation principles	**20 points**
Access Mobility and Connectivity			
	• Maps of local transportation systems • Project description • RATE maps and project list • RIP road classification • List of urban refuges	• Project expands modal options or reduces dependency on private automobiles • Project expands on and/or off-site connectivity with increased connections to existing transportation systems, roads, trails and transit (if applicable) • Project expands access to visitor groups that are underrepresented or limited by mobility • Project includes elements that are addressed or identified in other organizations (state DOTs, MPOs, cities/municipalities) long or short term planning documents • Addresses a congestion "hot spot" • Project description includes a measure of the (quantity and/or quality) of existing transportation infrastructure	**15 points**
Visitor Experience			
	• CCP or transportation plan • LRTP or RATE report • RAPP visitation • List of urban refuges • Visitor Service Plans and Assessments • US Census Data	• Addresses a congestion "hot spot" • Project includes access to recreational elements like trailheads, viewing blinds, and/or auto tour routes • Includes internal and external wayfinding for visitor orientation, including multimodal orientation (if applicable) • Project is listed or referenced in a transportation plan/analysis by FWS or partners • Project features enhancements that incorporate environmental education, interpretation and stewardship into the travel experience • Project improves access for underserved or underrepresented visitors	**15 points**

Short and Long Term Actions

Coordinated Opportunities:	Deliverables	Resources and Contacts
Short Term - Next Four Years		
Identify and engage partners, leverage funds and collaborate with local and regional actors such as: NGOs, non-profits, MPOs, local/state government agencies, state DOTs, local landowners, Indian tribes, transit authorities and private transportation providers when interests align with Service and station level needs.	Update of regional transportation partners list due to FWS HQ every 2 years, develop and share accomplishments between regions and NGOs to spur continued collaboration and support.	Local contacts for MPOs, state DOTs and state/municipal governments, National Friends Group Coordinator at FWS HQ office
Literature review of all relevant transportation planning documents (STIPs, LRTPs, etc.) from State DOTs, MPO/RPOs for all metropolitan statistical areas in US.	National database of transportation planning documents	State DOTs, RPOs and MPOs
Long Term - Four Years Plus		
Develop a streamlined method to engage gateway communities, federal land management agencies, tribes, military, state DOTs, and planning organizations to address issues of mutual interest. Focus on priority field stations.	Develop best practice handbook for engaging local governmental and non-governmental actors	Regional transportation program coordinators

Asset Management:	Deliverables	Resources and Contacts
Short Term - Next Four Years		
Improve data interoperability between RIP and SAMMS, including use of Services Application for Material Assessments (SAMI)	Fulfill all transportation condition assessments using refined process and placement into SAMMS using SAMI	Facilities Branch at FWS HQ or Federal Lands Highway Roadway Inventory Program (RIP)
Develop a formal step in planning processes to estimate and consider life cycle costs and emissions when project planning and pursue mitigation strategies	Standardized project description form with climate change elements incorporated	The Roadway Design Guidelines, FHWA Climate Change Tools, Climate Leadership in Refuges tool (CLIR)
Complete and merge road and parking tiering effort, nationwide	Data cleanup in SAMMS	
Develop strategy to inventory and manage non-public use transportation network, ERFO program, and maintenance program	Updates/addenda to PLAN 2035	Transportation at FWS HQ and Volpe Center
Continue to implement non-safety (pavement, congestion and bridge) management systems	Full execution of management systems	The Volpe Center, FHWA
Long Term - Four Years Plus		
Begin a 'pavement preservation' approach to asset management to extend the life of roads	Best practice guides for pavement preservation	The Volpe Center, FHWA
Identify transportation assets at risk due to the impacts of climate change and pursue appropriate adaptation strategies	Nationwide vulnerability study (Expansion of pilot study conducted in Region 4)	Transportation at FWS HQ, FHWA and Consultants
Improve the collection, accessibility, and interpretation of asset management, resource, safety, planning, and other data. For example: the on-going Station Transportation Analysis Tool (STAT) project, planning questionnaire assisted RIP process and safety assessments	Central database for storage of transportation program data. ServCAT is potential repository	Transportation and Natural Resorce Program Center at FWS HQ and FHWA

Short and Long Term Actions

Safety:	Deliverables	Resources and Contacts
Short Term - Next Four Years		
Implement recommendations resulting from the Service's Transportation Program Safety Management System report	Establish connection between FWS data and Safety Management System (SMS) to use data to assess needs	Regional transportation program coordinators and FHWA
Develop Servicewide standard to track and report wildlife/vehicle collisions (WVC)	Develop wildlife collision data collection/ tracking system. Integrate into RIP/RATE surveys to the field	Transportation at FWS HQ and Volpe Center; partners
Implement the safety analysis toolkit. Initiate safety studies and actions in areas believed to have safety problems as identified in unit-level plans, regional LRTPs, and the National LRTP	Determine safety priority improvement areas across the network. Begin to address through studies and needs assessments. Report every 2 years on safety related transportation improvements	Regional transportation program coordinators
Complete transportation safety assessments for all stations with identified needs. Focus on priority field stations	Nationwide list of priority safety issues	Safety assessments and Safety Analysis Toolkit
Long Term - Four Years Plus		
Consider peer-review of the Service's safety approach to improve efficiency and outcomes.	Peer review of documentation of actionable improvements	FHWA and partners

Environmental:

	Deliverables	Resources and Contacts
Short Term - Next Four Years		
Develop a format/process for regions to track wildlife-vehicle collisions and hot-spots, and report annually	Scope of work to assist regional coordinators to begin to focus on priority field stations	The Western Transportation Institute at Montana State University
Implement and monitor the FWS Roadway Design Guidelines for use across the Service	Accountability tracked through the Design Guidelines Project Acknowledgements Worksheet by both FWS and FHWA	The FWS Roadway Design Guidelines
Expand the Service's Climate Leadership in Refuges (CLIR) tool so all stations can use it to track emissions. Encourage/require annual emissions reporting for transportation sources	Full roll-out of CLIR tool to stations with Visitor Surveys and assistance on transportation related items	Transportation at FWS HQ Refuge System and Business Management/Ops.
Follow the principles of Adaptive Mitigation to achieve no net loss when designing, building or restoring transportation facilities including: Avoidance, Minimization, Rehabilitation and Restoration	Develop standard methodology to quantify the environmental impacts of construction activities	501 FW 2 - Mitigation Policy
Long Term - Four Years Plus		
Further study of terrestrial and aquatic organism passage issues as they relate to transportation (e.g. wildlife/vehicle collisions in and around Service lands)	National list of high priority corridors. Best practice guidance for connecting fragmented habitat, roadside maintenance and revegetation practices (e.g. planting of milkweed along roadsides in monarch butterfly I-35 flyway corridor)	FHWA Office of Natural Environment and the Roadway Design Guidelines
Where feasible, reroute high-speed roadways around refuge lands or work with partners to mitigate negative impacts		State and local transportation organizations

Short and Long Term Actions

Access, Mobility and Connectivity:	Deliverables	Resources and Contacts
Short Term - Next Four Years		
Collect and analyze information to characterize access, congestion levels, high use, economic generators and alternative transportation systems (ATS) at Service units. Consider census population projections as a proxy for future visitation	Work with urban initiatives and other access programs to highlight areas of need and projections for future connectivity	Transportation at FWS HQ and The Volpe Center
Determine where multi-modal transportation opportunities are most feasible with priority for Urban Refuges	Compile a National Alternative Transportation Evaluation (NATE) using completed regional surveys. Make suggestions to prioritize needed improvements at key field stations, conduct needs assessments at Urban Refuges	The Volpe Center and the RATE surveys, Urban Implementation Team
Develop online presence for the transportation program. Content should include: data, planning tools, douments, links, projects, etc.	FWS Transportation Program Webpage. Connection to Urban Web Hub	Transportation at FWS HQ and The Volpe Center
Long Term - Four Years Plus		
Incorporate transportation access, mobility, congestion, and connectivity in CCPs, LRTPs, visitor use plans, and unit-level transportation plans, paying particular consideration to underserved, underrepresented, and disadvantaged populations	Official FWS plans, presentations and policy materials	The Volpe Center
Continue to work collaboratively with the NWRS Vision Implementation team and its Urban Refuge initiative	To be determined by Transportation and Urban Implementation teams	Urban Implementation Team at FWS HQ

Visitor Experience:	Deliverables	Resources and Contacts
Short Term - Next Four Years		
Ensure all relevant wayfinding information is on refuge and hatchery websites and printed materials	Carry out regular inspections and conduct as-needed maintenance on all internal and external refuge and hatchery signage	Branch of Communications at FWS HQ
Develop strong working relationships between the Service and local public agencies to encourage connections to transportation providers and inclusion of unit information into ITS databases, displays and signs		Local agencies, non-profits, governmental entities and DOTs/MPOs
Catalog opportunities to develop interpretive/educational elements into transportation facilities		
Work with external mapping providers (such as Google Maps and Garmin) to verify locations of main entrance routes, roads, trails and points of interest		Cartography office at FWS HQ and external data services
Long Term - Four Years Plus		
Adopt and follow Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) compliant standards for static signage design and procurement	FWS standard transportation signage design manual	Facilities and Transportation at FWS HQ
Enlist refuge and hatchery friends groups to assist in wayfinding efforts using innovative information distribution platforms	Mobile apps, QR codes, text alerts, etc.	National Friends Group Coordinator at FWS HQ office
Continue to participate in visitor satisfaction and transportation related questionnaires to the public	Strategic data collection at priority stations	FWS Human Dimensions office

Short and Long Term Actions

Funding:	Deliverables	Resources and Contacts
Short Term - Next Four Years		
Refine the future annual transportation needs within the Service and work with FHWA and other partners to express these needs at strategic times (like during transportation bill reauthorization).	Focus funding on Tier 1 and 2 roads, as classified by the Service Facilities Branch (Tier 3 roadways will still be eligible for FLTP funding, but at low priority)	Regional transportation program coordinators, Facilities Branch at FWS HQ
Develop a Service-wide strategy for accessing funds from new discretionary funding sources (FLAP and Transportation Alternatives Program).	Consider dedicated staff for this effort	Regional transportation program coordinators and Federal Lands Highway offices
Adopt a national project prioritization process with standardized criteria to develop programmatic consistency.	Project selection process	Regional and national transportation program coordinators
Long Term - Four Years Plus		
Determine how to use RIP, SAMMS, and RAPP data consistently for funding decisions. This includes finding ways to consistently report and apply asset priority index, facility condition index scores and visitation counts.		Transportation at FWS HQ
Improve tracking of transportation program expenditures (by funding source, region, year, and unit).	Yearly national roll-up of budgetary expenditures	Regional transportation program coordinators, the Volpe Center

HQ

Headquarters Office:	Deliverables	Resources and Contacts
Short Term - Next Four Years		
Develop centralized repository for transportation related data, initiatives, policy structure and general programmatic information.	Transportation program web portal on FWS.GOV	The Volpe Center
Seek ways to communicate the accomplishments of the transportation program as a means to maintain current funding levels or demonstrate needs.	High quality 'glossy' products that communicate progress and achievements to appropriate audiences	National Wildlife Refuge Association and Transportation at FWS HQ
Develop list of 'national priorities' across ten different elements of the transportation program including: auto tour routes, primary access routes (both FWS and non-FWS owned), parking areas, bridges, safety projects, wildlife/vehicle interaction hot spots, alternative transportation, trails and large (>$3M) projects.	Continued participation in annual data call	All Transportation group staff
Develop a method to track and analyze progress over time of performance targets.	Yearly or biennial report card for national performance based on strategic goal area	
Based on RATE surveys, synthesize a National Alternative Transportation Evaluation (or NATE) to guide long-range alternative transportation programming decisions.		
Develop method to track SAMMS work orders and spending amounts that are charged to FLTP funded projects on FWS transportation assets.		Facilities Branch at FWS HQ
Identify and fill short and long-term staffing needs to add operational capacity to the program.	New staff positions and/or organizational structure	Volpe Center staffing analysis

Performance Targets

Coordinated Opportunities:	Current Performance	20 Year Target Performance
▪ Increase the total number of official Fish and Wildlife partners and friends groups year to year	230 Unique organizations	Plus 10% nationally
▪ Increase the percentage ratio of supplemental funding to base funding for projects and planning	23% or about $7M/yr. (10 yr. avg)	40%
▪ Increase the number of transportation projects that leverage multiple funding sources	Baseline established at year 1	5 per year nationally

Asset Management:		
▪ Increase percentage of road miles in good or excellent condition	62% RIP Cycle 4	80% or higher
▪ Maintain percentage of trail miles in good or excellent condition	84% RIP Cycle 3	Greater than or equal to current performance
▪ Increase percentage of bridges in good or excellent condition	65%	95% or higher
▪ Increase percentage of programmed FLTP projects that have been scored and prioritized via a standardized selection process	None (0%)	50% in 2 years, 100% in 5 years

Safety:		
▪ Complete safety assessments for highly visited refuges	Baseline established at year 1	5 per year nationally
▪ Reduce number of transportation related fatalities that occur on refuges and hatcheries	2 Fatalities in past 5 Years	Zero fatalities
▪ Reduce number of wildlife/vehicle collisions	Baseline established at year 1	Zero collisions

■ Environmental:	Current Performance	20 Year Target Performance
▪ Increase percentage of transportation projects that track the elements of the Roadway Design Guidelines through the Project Acknowledgements checklist	Baseline established at year 1	60% at year 1, 100% by year 5
▪ Increase the number of projects that enhance aquatic or terrestrial organism passage	Baseline established at year 1	5 per year nationally
▪ Complete assessments on existing wildlife crossings and aquatic passages	Baseline established at year 1	2-3 per year nationally
▪ Reduce or offset the carbon footprint of the transportation network (The Climate Leadership In Refuges, or CLIR tool, will provide guidance with this)	Baseline established at year 1	20% below 2010 baseline
■ Access, Mobility and Connectivity:		
▪ Increase the total number of multi-modal connections to refuges and hatcheries (The pending Multimodal Catalog, being drafted by FLH, will provide guidance with this)	Baseline established at year 1	3 projects per year
▪ Increase the number of multimodal transportation options on refuges and hatcheries (Also, see Multimodal Catalog)	Baseline established at year 1	5 projects per year
▪ Increase number of projects that improve access at main ingress/egress points	Baseline established at year 1	2-3 projects per year
■ Visitor Experience:		
▪ Integrate wayfinding and ITS into transportation projects	Baseline established at year 1	2-3 projects per year
▪ Maintain or improve transportation satisfaction ratings (Based on National Visitor Survey)	75% 'Highly Satisfied' with 'Very Important' elements	Greater than or equal to current performance

Performance Management and Planning

MAP-21 set up certain requirements for project selection and parameters for performance management for FHWA and Federal Land Management Agencies. When using programmatic funding with the Federal Lands Transportation Program, transportation improvements are to be considered to the extent that they support:

- Transportation goals, including a state of good repair of transportation facilities, reduction in bridge deficiencies, and improvement of safety.

- High-use federal recreational sites or federal economic generators.

- Resource and asset management goals of the Secretary of the respective Federal Land Management Agency.

It is expected that the same requirements will continue under the current transportation legislation, the FAST Act.

Meeting Performance Management

The policy structure of this plan is consistent with the MAP-21 performance management parameters, namely through the program principles and goals. This plan also adds specific items related to visitor experience and coordinated opportunities, all of which carry through to actions. In addition, the proposed performance measures in the previous section consider draft FHWA performance measures generated in 2013, and add to that list to include items important to the Service and the transportation program.

Actions:

- Starting in FY 2017, develop more robust program applications for the FWS transportation program that propose work plans at various potential funding levels. Applications (funding scenarios and associated work plans) will be consistent with the guidance in this LRTP.

- The transportation program will prepare baseline numbers for the performance measures outlined in this plan and track/evaluate progress over time.

- Elevate the percentage of program funding obligated for transportation improvements at high-use recreational sites. From the historical data and projection over the next few years, FWS has obligated about 40% of its funds at higher use stations (based on overall visitation numbers). As a goal, FWS will work toward targeting expenditure at a majority of field stations (>50%) that meet the FWS definition of high-use.

Future Planning

The national LRTP will be updated every 4 to 5 years. Because the policy structure of the next transportation authorization is unknown, this document will be refined in accordance as needed once the new authorization or reauthorization is signed into law. In future plan revisions, the transportation program may consider additional factors for setting priorities at a national level, including guidance on leveraging supplemental (discretionary or competitive) funds.

Actions:

- Develop Service wide strategies for accessing funds from supplemental funding sources (Federal Lands Access Program, Transportation Alternatives Program, etc.)

- Refine or update the project selection process outlined in this plan to track with performance management and other legislative requirements in any future transportation authorization.

- Quantify the future annual needs for motorized, non-motorized and alternative transportation maintenance and operations both on and off Service lands.

- Seek ways to communicate the accomplishments of the Service transportation program as a means to maintain current funding levels or seek future increases.

- Improve tracking of transportation program expenditures through FBMS and Federal Lands Highway financial systems by funding source, region, year, and unit).

Regional LRTP Development

This plan is intended to provide direction for the development of forthcoming regional LRTPs to further strengthen program stewardship and link Service goals with planning process. This guidance provided for regional LRTPs is intended to provide a common starting point (or update point) for each and will ensure that minimum requirements for regional plans are met.

Regional LRTPs should lay out a clear set of goals, objectives, data collection processes, and recommendations for a project selection process. This guidance allows for wide-ranging flexibility to accommodate unique regional goals, conditions, values, data, performance, action items, and recommendations while remaining consistent with the national plan.

Regional LRTP Compatibility

As regions develop or update their LRTPs, they should integrate and/or expand upon the below elements in the following ways:

- Regional goals should follow or elaborate upon the six strategic goals expressed in the national plan
- Existing conditions (baselines) should be determined to help set regional targets
- Needs and investment strategies must be defined
- Priority projects should be defined based on needs, investment strategies and selection processes
- Transportation planning needs for CCPs, step-down plans and safety studies, must be assessed and clearly documented
- National strategies proposed for addressing annual and deferred maintenance should be considered
- Regional plans should stipulate adherence to the Roadway Design Guidelines
- The project selection criteria and basic process outlined in the national plan will be adopted and refined
- The performance measures outlined in this plan will be calculated on regional levels using best available data

Additional Elements

The majority of the detailed content in regional LRTPs should be unique to that specific region. There are many opportunities to adapt guidelines provided by the national plan to fit a regional context. During the development or update of regional LRTPs, regions should expect to collect or refine data that are not available or not feasibly collected at the national level. The following additional elements should be developed by regions so that they may be incorporated into future planning efforts:

- Additional goals (with measurable objectives) if desired
- Strategies to achieve objectives
- Modifications to Roadway Design Guidelines based on regional conditions
- A method for, and commitment to, report and track wildlife-vehicle collisions
- Regional Climate Change Action Priorities
- Database of partners at the regional level
- Identification of gateway communities, state DOTs, and planning organizations for issues related to access, mobility, and connectivity
- Refinement of strategies for partnerships and priorities for Access Program (FLAP) implementation and new knowledge about partnerships
- Unit-level safety concerns
- Sub-criteria and details for project selection
- Additional performance measures

Final Thought

Nisqually NWR

Washington

Work Today to Conserve for Tomorrow

Natural resource management requires dedicated work from a varied group of professionals, technicians and managers. Ultimately, the FWS transportation network exists to enable these individuals to conserve habitat and wildlife while at the same time facilitating the enjoyment and use of these resources by the visiting public. In other words, there would be no need for a transportation program if there were no natural resources to manage.

At its core, this is a resource management plan, not a transportation plan. Its policies are derived from well established principles and guidelines in the transportation field, yet that guidance had to be adapted in a way that ultimately supports a resource conservation mission.

With the adoption of this plan, the Service is taking an important step in fulfilling its promise to guarantee the long term sustainability of biodiversity in the United States.

List of Acronyms

AID	Accelerated Innovation Deployment	Grant Program
API	Asset Priority Index	Mission Dependency Calculation
ATS	Alternative Transportation System	Non-Private Vehicle Transportation
CCP	Comprehensive Conservation Plan	Refuge Management Document
CIP	Capital Improvement Program	5 Year Improvement Plans at Region
DOE	Department of Energy	Federal Department
DOI	Department of Interior	Federal Department
DOT	Department of Transportation	Federal Department
ERFO	Emergency Relief Federally Owned	Disaster Relief Program
FARS	Fatality Analysis Reporting System	Data Gathering
FAST Act	Fixing America's Surface Transportation Act	Transportation Act
FBMS	Financial and Business Management System	Asset Management System
FCI	Functional Class Index	State of Repair Calculation
FHWA	Federal Highway Administration	USDOT Agency
FLAP	Federal Lands Access Program	Funding Mechanism
FLHP	Federal Lands Highway Program	Program (Past)
FLTP	Federal Lands Transportation Program	Current Program
FWS	U.S. Fish and Wildlife Service	Federal Agency
FWSTP	U.S. Fish and Wildlife Service Transportation Program	Program
LRTP	Long Range Transportation Plan	Planning Document
MAP-21	Moving Ahead for Progress in the 21st Century	Transportation Act
NBI	National Bridge Inventory	Data Gathering
NWRS	National Wildlife Refuge System	Agency Program
RAPP	Refuge Annual Performance Planning	Data Gathering
RATE	Regional Alternative Transportation Evaluation	Data Gathering
RIP	Roads Inventory Program	Data Gathering
RRP	Refuge Roads Program	Program (Past)
SAMMS	Servicewide Asset Maintenance Management System	Asset Management System
SMS	Safety Management System	Data Gathering
TAP	Transportation Alternatives Program	Grant Program
USDOT	US Department of Transportation	Federal Department

U.S. Fish & Wildlife Service
http://www.fws.gov

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U.S. Fish & Wildlife Service

Roadway Design Guidelines

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Cover: A Great Blue Heron flies off with its catch at William L. Finley NWR in Oregon. Roadways on National Wildlife Refuges provide opportunities for wildlife viewing and photography, two of the Big Six activities supported by the National Wildlife Refuge System.

Photo: George Gentry, USFWS

Purpose

The U.S. Fish & Wildlife Service (FWS) is the world's premier conservation agency, managing over 150 million acres of wildlife habitat on National Wildlife Refuges alone. FWS is in a unique position to demonstrate the land ethic so deeply interwoven in the rich fabric of our national heritage.

This guide highlights state of the art ecological, planning, design and engineering considerations for roadway projects that heed both the significant benefits and impacts these projects present. Roadway projects on FWS managed lands should conform to planning and design criteria that have been established to support the FWS mission. This document provides such criteria in the form of guidelines. These guidelines are summarized in a table of contents that serves as a project checklist.

The Roadway Design Guidelines are a wayfinding tool intended to facilitate dialog and decision making among project teams. The guidelines have been crafted to support the interdisciplinary team typically involved with decision making regarding a roadway project: Project Leaders, Project Managers, and technical experts from various disciplines.

This document includes 30 individual project planning and design guidelines, organized around 6 major themes. The project checklist serves as an overview of these guidelines, and has been provided as a tool to assist in project planning, design and implementation.

In the pages that follow you will find information and resources that will be useful in your work on roadway projects. Using these guidelines is not an end in itself. Rather, the guidelines are a starting point from which to explore solutions to implement a roadway project of the highest standard. Every guideline begins with a brief discussion of the intent for presenting a particular topic, followed by supporting principles central to honoring the guideline, as well as associated metrics. Selected resources are provided to gain a deeper understanding of the topic.

Brian Bainnson

Eva Paredes/USFWS

Visitor contact facilities are often located in close proximity to roadways like this one at McNary National Wildlife Refuge (NWR) (top). Bison herd as viewed from roadway at the National Bison Range (bottom).

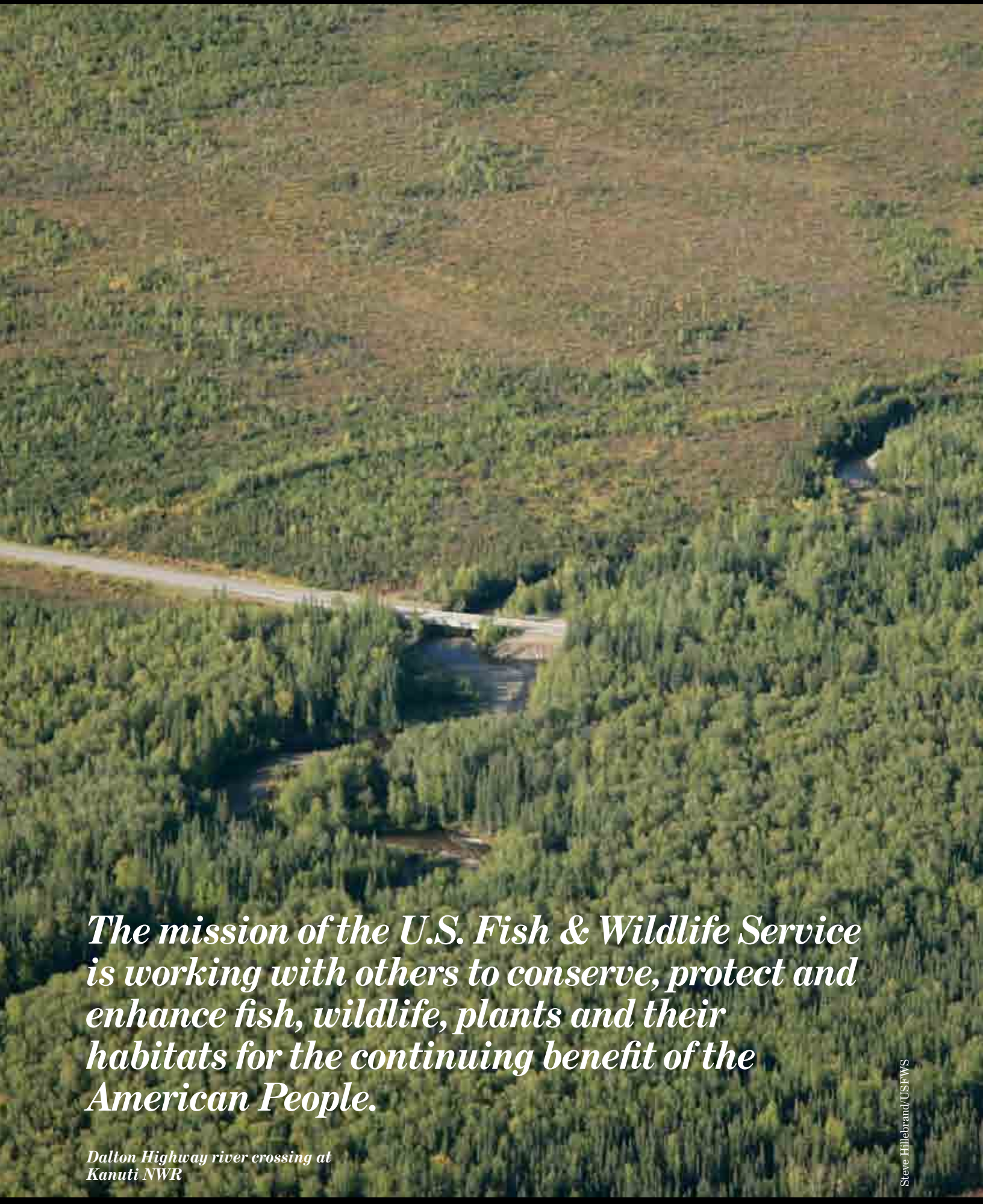
More Than Just A Road

A 'roadway' as referred to in these guidelines encompasses not only the suite of typical improvements associated with a vehicle-focused transportation project, but also related facilities such as parking, overlooks and the zone of ecological impacts from a road. These can be summarized as follows:

- **Typical transportation improvements** extend from the centerline of an existing or proposed road outward and include associated infrastructure components, such as paving, utilities, grading, drainage and planting.
- **Other facilities and infrastructure** commonly associated with vehicular transportation, include parking, visitor contact facilities, and pullouts.
- **Ecological connections and impacts** beyond the edge of the physical road or right of way, such as habitat fragmentation, habitat disturbance, pollution and aquatic and terrestrial species conflicts.

Moving Ahead for Progress in the 21st Century

Effective October 1, 2012, the existing Refuge Roads Program funded through previous Federal transportation authorizations is now called the FWS Transportation Program within the new Federal Lands Transportation Program. These new program details are described in the new transportation legislation called Moving Ahead for Progress in the 21 st Century (MAP-21). While still applicable to all refuge roads, these guidelines are generally applicable to all FWS transportation infrastructure and future improvements performed on this system of facilities and assets.



The mission of the U.S. Fish & Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American People.

Dalton Highway river crossing at Kanuti NWR

Steve Hillebrand/USFWS

Project Checklist

LE – Landscape Ecology

- ☐ LE-1 Improve habitat connectivity
- ☐ LE-2 Reduce impacts to wildlife and habitat
- ☐ LE-3 Understand hydrologic processes of regional landscape
- ☐ LE-4 Respond to intrinsic qualities of regional landscape
- ☐ LE-5 Address climate change

PC – Planning Context

- ☐ PC-1 Review relevant planning, policy and regulatory information
- ☐ PC-2 Define level of service for the project
- ☐ PC-3 Evaluate multiple siting and alignment alternatives
- ☐ PC-4 Assess full costs and impacts of transportation system
- ☐ PC-5 Communicate with team and stakeholders

DE – Design and Engineering

- ☐ DE-1 Preserve and restore native vegetation and other natural resources
- ☐ DE-2 Consider and plan for invasive species management
- ☐ DE-3 Minimize cut and fill to fit with existing landscape
- ☐ DE-4 Consider road geometries for lower speeds, safety and alertness
- ☐ DE-5 Consider construction impacts and best practices
- ☐ DE-6 Consider range and sources of materials for sustainable construction
- ☐ DE-7 Consider maintenance

OP – Organism Passage

- ☐ OP-1 Develop your corridor plan for crossing
- ☐ OP-2 Provide and enhance aquatic organism crossings
- ☐ OP-3 Provide and enhance terrestrial wildlife crossings
- ☐ OP-4 Evaluate the need for wildlife fencing and other guiding features
- ☐ OP-5 Consider warning and safety systems for drivers

SM – Stormwater Management

- ☐ SM-1 Buffer habitat from polluted runoff
- ☐ SM-2 Protect habitat from erosive flows and flooding
- ☐ SM-3 Monitor and maintain stormwater facilities
- ☐ SM-4 Promote stewardship of aquatic resources

VE – Visitor Experience

- ☐ VE-1 Preserve and highlight scenic value
- ☐ VE-2 Promote and facilitate multiple modes of transportation
- ☐ VE-3 Comply with accessibility standards and guidelines
- ☐ VE-4 Facilitate compatible wildlife dependent recreation and education

Highway through Siletz Bay NWR provides travelers with visual access to the Refuge. The highway affects habitat connectivity and the landscape's hydrology.

David Pitkin/USFWS

Landscape Ecology

Landscape Ecology
Overview

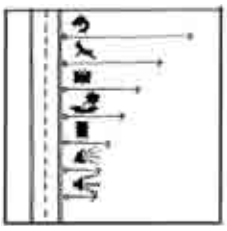
Pattern and Process
Roads and ecological function are intrinsically intertwined. Roadways on FWS managed lands in particular are frequently located in areas of high ecological importance.

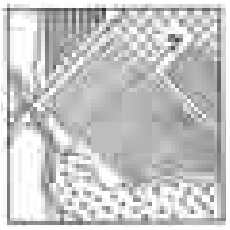
This section, Landscape Ecology, is intended to help you consider the broad-scale environmental impacts of your decisions regarding roadways and transportation infrastructure. It addresses a range of issues, providing you with a set of tools for decision-making.

Any new roadway construction or improvements to existing roadways on FWS managed lands requires unique treatment, consistent with the mission of the Service and supported by a detailed understanding of refuge management goals. Improvements need to be made in a manner consistent with applicable laws such as the Migratory Bird Treaty Act (MBTA), Fish and Wildlife Coordination Act (FWCA), Bald and Golden Eagle Protection Act (BGEPA) and Endangered Species Act (ESA). While the guidelines in this section cover principles which are, in general, applicable across a broad range of environments, take time to consider the guidelines and their specific implications within the unique bioregional context in which your projects will occur.

Research in the field of road ecology demonstrates that the multitude of adverse impacts of roads on landscapes, and the healthy function of the natural systems they traverse, are reduced by designing for slower travel speeds and lower traffic volume.

A significant component of a roadway project may be to remove roads from ecologically sensitive areas and restore those areas.





Landscape Ecology 101

Landscape ecology is the study of the relationship between spatial pattern and ecological processes on a wide variety of landscape scales and organizational levels. Some key landscape ecology concepts are:

Patch - Distinct area of a particular habitat or landscape type. Key considerations include size, number, location, and composition/contents. Small patches have a higher edge-to-interior ratio; some species thrive on edges, while others strictly prefer the qualities of a patch interior.

Edge - The shape, width, straightness, and other qualities of habitat or patch edges affects their performance and utility for various species.

Connectivity - This depends on distance, as well as other factors that may promote or inhibit movement between patches. A roadway may seem relatively narrow, but constitute a greater barrier than a broad field for some species.

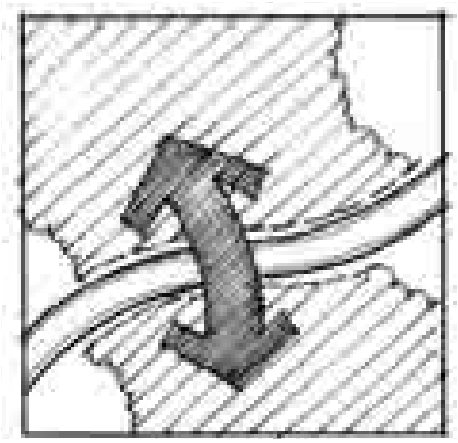
Mosaic - The bigger picture that includes the various patches and the matrix that contains them (e.g. areas of remnant woodland and wetlands, within a matrix of agricultural fields). Key elements include scale, grain (coarseness), patch diversity, and degree of fragmentation.

Roads form a **network**, which may be viewed as a **matrix** that contains a variety of habitat patches. They significantly affect connectivity, creating abrupt and harsh edge conditions, whose effects (such as light, noise, air quality, temperature, hydrology) can extend well into the adjacent habitat patches.

LE-1 Improve Habitat Connectivity

Intent

Roadways should be examined for their potential to impact habitat connectivity. Wherever possible such impacts should be minimized and/or mitigated. When a contiguous habitat area is bisected by a roadway, abrupt edge conditions are created. Such habitat fragmentation is generally undesirable. Hydrologic and soil community connectivity are also affected. Native plantings and other restoration activities associated with roadway improvements can be designed to support multiple habitat objectives, including buffering patch interiors and mitigating roadway impacts. In rare instances, roadway corridors may also serve as habitat connectors, linking otherwise fragmented communities.



Habitat connectivity is disrupted along any road corridor

Principles

- Identify and prioritize habitat restoration and connectivity opportunities at the landscape scale
- Review state habitat connectivity plans as well as applicable recovery plans for listed species
- Consider impacts and footprint of the entire roadway as defined in these guidelines
- Develop partnerships among land management agencies and the local FWS Ecological Services (ES) office
- Partner with neighbors
- Identify opportunities for individual projects to minimize impacts to wildlife and restore habitat connectivity

Metrics

- Trends in species mortality, avoidance, low population survival, sensitive or endangered species populations
- Decreased wildlife-vehicle collisions and/or roadway avoidance
- Distance between habitat patches
- Distribution of species/population along and across roadway

Resources

Overview of road ecology and guidelines for ecological road planning and design.

Forman, Richard, et al. 2003. Road Ecology: Science and Solutions.

Graphic explanations of landscape ecology principles.

Dramstad, Olson, and Forman. 1996. Landscape Ecology Principles in Landscape Architecture and Land-Use Planning.

Discussion of positive and negative impacts of roadways on adjacent vegetation.

Forman, Richard. 2002. "Roadsides and Vegetation." In Proceedings of the International Conference on Ecology and Transportation, Keystone, CO, September 24-28, 2001.

Roadway design guidelines from applied ecology and experiential perspective.

Jones, Grant R., et al. 2007. Applying Visual Resource Assessment for Highway Planning (pp.130-139) and Road Alignment (pp.330-341). In Landscape Architecture Graphic Standards.

Effects of roadways on wildlife (see also entire February 2000 Conservation Biology issue).

Trombulak, Stephen and Christopher Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities.

Wildlife conservation and planning efforts among the western states.

Western Governors' Wildlife Council. http://www.westgov.org/. Resources include the Wildlife Corridors Initiative Report (2008) and Wildlife Sensitivity Maps.

Habitat Connectivity

Habitat connectivity is a term commonly used in landscape ecology to describe the degree of connection between nearby or adjacent habitat areas. Distinct habitat areas are frequently referred to as 'habitat patches'. If the connection between these patches is not good, the resultant fragmentation can lead to loss of diversity within a given population of a species and potentially local extinction of that species from one or both patches. Even for fairly mobile species, a roadway can present a significant barrier to movement between patches.

Terrestrial under-crossing facilitates wildlife movement across a landscape fragmented by a highway in Banff NP, Canada

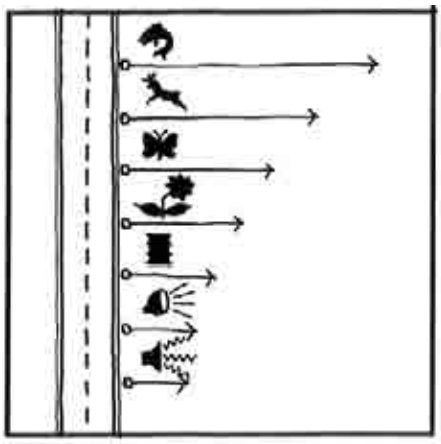
Patricia White/Flickr.com

LE-2 Reduce Impacts to Wildlife and Habitat

Intent

Roads have a significant impact on wildlife populations and habitat. Roads can directly impact wildlife through mortality (e.g. wildlife-vehicle collisions), roadway avoidance, habitat loss and habitat fragmentation. Wildlife-vehicle collisions are a safety concern for motorists. Traffic volume and roadway type directly relate to the severity of wildlife impacts. Roadkill data alone is not an accurate indicator of roadway impacts to wildlife, due to avoidance behavior and other issues. Mortality and avoidance are two species-dependent outcomes that may result from the barrier effect a roadway has on wildlife. In addition, maintenance practices, in combination with abundant edge habitat, can attract certain species of wildlife to a roadway, increasing the potential for conflict.

Consider roadway alignment, design, construction, and future maintenance methods that create the least detrimental impact to wildlife and habitats. Section OP (Organism Passage) discusses terrestrial and aquatic organism passage in more detail.



Impacts to wildlife and habitat extend outward from the roadway in various degrees, creating the 'road-effect zone'.

Principles

- Identify and limit the 'road-effect zone' and determine the potential exposure of ESA listed species and critical habitat to road effects within that zone. Minimize adverse effects to ESA listed species and critical habitat, and ensure any such effects are addressed through the ESA section 7 compliance process, as appropriate.
- Design for lower speeds, in order to minimize disturbance
- Consider management techniques to minimize disturbance to wildlife on auto tour routes
- Examine how road alters wildlife use patterns
- Examine how future effects on wildlife could make a project compatible (or not) with management goals
- Consider effects of noise, light and chemical pollution on habitats and wildlife

Metrics

- Reduction of wildlife-vehicle collisions
- Health of wildlife populations with habitats fragmented by or in proximity to roadways
- Road density (landscape ecology metric, see Definitions)
- Mesh size (landscape ecology metric, see Definitions)

Resources

Overview of road ecology, guidelines for ecological road planning and design. See especially discussion of road-effect zones, pp. 306-16.

Forman, Richard, et al. 2003. Road Ecology: Science and Solutions.

Latest information on road ecology as it relates to mitigating interactions between roads and wildlife.

Beckmann, J. P., et al. 2010. Safe Passages.

Identifying & prioritizing habitat connectivity zones, and guidelines for design solutions.

FHWA. 2008. Best Practices Manual, Wildlife Vehicle Collision Reduction Study (Report to Congress).

Effects of roadways on wildlife (see also entire February 2000 Conservation Biology issue).

Trombulak, Stephen and Christopher Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities.

Buffer design guidelines.

Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. Access at: http://www.unl.edu/nac/bufferguidelines/

See also:

Section OP - Organism Passage

Roadways have significant impacts on both individuals and populations.

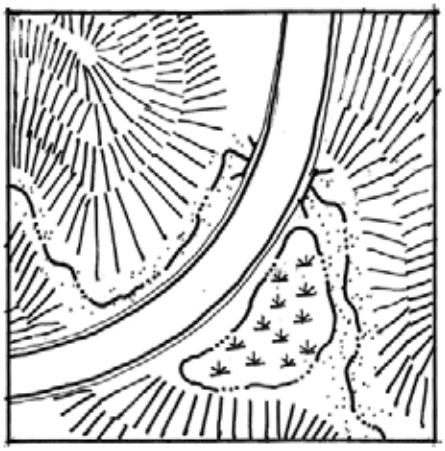
Mac Danzig Photography

Florian Schulz

LE-3 Understand Hydrologic Processes of Regional Landscape

Intent

Roadways can have dramatic impacts on hydrology at local, regional, and watershed scales. Disturbance to local hydrology is one negative impact to habitat caused by roadways. Impervious surfaces have a cumulative effect across a watershed, altering its hydrology and often creating detrimental consequences for wildlife. In some cases, the effects of a roadway on hydrology may be desired as part of a field station's approach to habitat management. Project teams should consider carefully how a roadway will impact local hydrology, or conversely how hydrologic processes can inform design decisions. Roadway improvements might support FWS management goals by addressing known issues and/or restoring historic hydrologic processes.



Roadways disrupt natural hydrology.

Principles

- Consider how road design may protect hydrologic processes
- Consider how to adapt an existing roadway for greater permeability
- Consider what effects the roadway might have on subsurface flows, water tables, and nearby aquifers, as well as how these elements affect construction options and feasibility
- Consider balance between restoring to pre-development conditions and maintaining historic alterations to hydrology
- Consider how development and roadway work will support current hydrologic and habitat management goals

Metrics

- Hydrologic modeling showing potential changes from roadways
- Stream flow data
- Changes in species composition (invasives vs. natives)

Resources

General reference on road ecology. See in particular overview of roadway effects on hydrology in Chapter 7.

Forman, Richard, et al. 2003. Road Ecology: Science and Solutions. Island Press. Washington D.C.

Guidelines that address hydrology impacts of roadways.

Smith, Stacy (Idaho Technology Transfer Center, Univ. of Idaho). 2005. BMP Handbook: Best Management Practices for Idaho Rural Road Maintenance.

Design guidelines for low-use roads, focusing largely on hydrology.

Weaver, William and Danny Hagans. 1994. Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads.

Roadway design guidance for lower impact to hydrology.

Dashiell and Lancaster. Undated. Road Design Guidelines for Low Impact to Hydrology. Five Counties Salmonid Conservation Program. Weaverville, CA.

Guidebook on design and best practices for providing aquatic organism passage.

USDA Forest Service. 2008. Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings.

See also:

Section SM - Stormwater Management

Roads both affect and are affected by hydrology. Floodwaters wash out a road at Flint Hills NWR (top); levee road at Blackwater NWR (bottom).

Eva Paredes/USFWS

Leon Reed/Flickr.com

LE-4 Respond to Intrinsic Qualities of Regional Landscapes

Intent

Every landscape has a rich natural and cultural history, a distinct composition of flora and fauna, unique weather, drainage patterns and views. Such intrinsic qualities contribute to each location's "sense of place," or context, which should be a guiding factor in work there. A contextual approach should be taken when planning and designing all roadways on FWS lands, and should be used for such decisions as road alignment and location of visitor facilities. Consider local vernacular architecture and land management traditions (e.g. local historic and sustainable agricultural practices), aesthetic issues such as viewsheds and practical issues such as seasonal access to recreational opportunities.

Principles

- Consider Context Sensitive Solutions (CSS) for general design guidelines and engage a landscape architect
- Develop benchmarking tools for ecological performance
- Consider what local land use traditions are consistent with FWS goals and management activities
- Respond to visual appearance of regional landforms, vegetation, and other natural features
- Review historic land use patterns and cultural practices
- Consider visitor experience and potential educational and interpretive benefits of road and visitor facility designs

Metrics

- Visitor satisfaction
- Ecological literacy of visitors
- Documentation of visual analysis (visual resource assessment) process (see Resources below)

Resources

Context-sensitive highway planning and design case study.

Kentucky Transportation Center. Undated. Context-Sensitive Design Case Study No. 1: Paris Pike - Kentucky.

Performance metrics for CSS design.

TransTech Mgmt., Oldham Historic Properties Inc., and Parsons Brinckerhoff Quade & Douglas for National Cooperative Highway Research Program. 2004. Performance Measures for Context Sensitive Solutions - A Guidebook for State DOT's.

Items to address or consider.

ODOT. 2006. Roadside Development Design Manual - Guidelines for Visual Resource Management, Landscaping, and Hardscaping (DRAFT).

Roadway design guidelines from applied ecology and experiential perspective.

Jones, Grant R., et al. 2007. Applying Visual Resource Assessment for Highway Planning (pp.130-139), and Road Alignment (pp.330-341). In Landscape Architecture Graphic Standards. Available at: http://www.jonesandjones.com/news/publications.html.

Guidelines for visual and context considerations for roadway design.

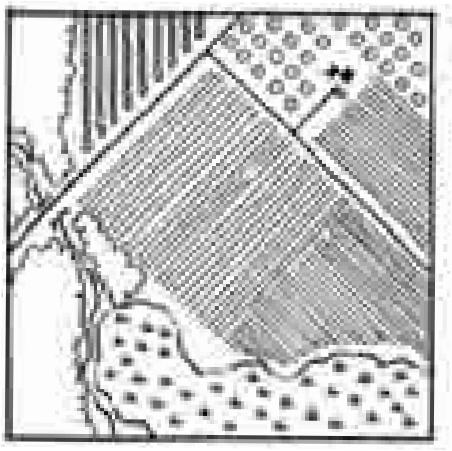
USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

Transportation Research Board of The National Academies. 2002. A Guide to Best Practices for Achieving Context Sensitive Solutions (NCHRP Report 480).

Regional design guidelines.

New Mexico Department of Transportation. 2006. Architectural and Visual Quality Design Guidelines for Context Sensitive Design and Context Sensitive Solutions.

Nevada Department of Transportation. 2002. Pattern and Palette of Place: A Landscape and Aesthetic Master Plan for the Nevada State Highway System.



Historic land use patterns and natural features can help drive design.

Context Sensitive Solutions

The term Context Sensitive Solutions (CSS) refers to a decision-making process used by roadway designers and transportation engineers that accounts for many factors of a site's context—from topography and geology to cultural history and the intended users—during the planning, design, and maintenance of transportation facilities. Landscape architects played a leading role in developing this concept and are valuable team members for their expertise in determining how a project can appropriately respond to its context. Fundamental landscape architecture capabilities include identifying and expressing in built form the intrinsic qualities of a project's regional landscape.

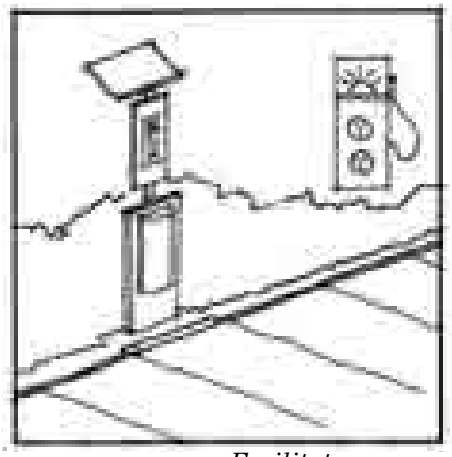
Leota Butte overlook at Ouray NWR provides an excellent landscape view.

Eva Paredes/USFWS

LE-5 Address Climate Change

Intent

Responding to climate change is a growing imperative for land managers and natural resource professionals, as well as the transportation and infrastructure sectors. Roadways on FWS managed lands may be particularly impacted because many are often in or near tidal zones, wetlands and floodplains. Factors to consider include how might roadways and visitor facilities be planned to reduce vehicle miles traveled (for visitors and staff); how will the roadways likely be impacted by changing weather and hydrologic patterns; and how might roadways be designed in a resilient and multifunctional manner that serves not only transportation, but perhaps other purposes such as protecting valuable facilities or habitat.



Facilitate greener transportation options.

Principles

- Provide alternative modes and means of access to FWS managed lands
- Consider potential climate change impacts when making decisions on location, scale and design life of infrastructure investments
- Consider construction materials and methods that have lower carbon footprints and climate impacts consistent with FWS and Department of the Interior (DOI) policies
- Use climate change research to inform transportation planning efforts at the landscape scale

Metrics

- Regional trends in weather-related damage and maintenance needs
- Vehicle miles traveled (VMT) on FWS roadways and associated greenhouse gas emissions
- Transportation modes used by visitors to reach and use FWS facilities
- Reports and data from the Emergency Relief for Federally Owned Roads (ERFO) program

Resources

Overview of transportation industry connection with climate change.

Transportation Research Board. 1997. Toward A Sustainable Future: Addressing the Long-Term Effects of Motor Vehicle Transportation on Climate and Ecology (SR 251).

Potential climate impacts of transportation sector and work towards reducing them.

Sperling, Daniel and Deborah Gordon. 2008. Two Billion Cars: Transforming a Culture. In: TR News, No. 259 (Nov-Dec).

Overview of general impacts of climate change on transportation infrastructure.

Transportation Research Board. 2008. Potential Impacts of Climate Change on US Transportation (TRB Report 290).

Regionally specific climate change impact information.

Climate Impacts Group. 2009. The Washington Climate Change Impacts Assessment.

Information, resources and organizations relating to sustainable transportation systems.

Green Highways Partnership. http://www.greenhighwayspartnership.org.

Assistance with emergencies and data on federally owned roads.

Emergency Relief for Federally Owned Roads (ERFO). http://flh.fhwa.dot.gov/programs/erfo/.

Official FWS climate change information and strategy.

http://www.fws.gov/home/climatechange/.

Climate change will impact roads on FWS managed lands. Road damage due to flooding at Arrowwood NWR (top); washed out bridge at Flint Hills NWR (bottom).

Eva Paredes/USFWS

Eva Paredes/USFWS

Planning Context

Planning Context
Overview

Planning the Process

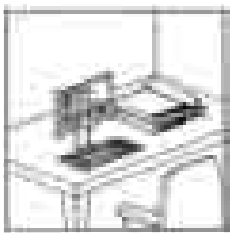
Guidelines in this section are intended to help you consider a roadway project in a broad context before advancing to the specifics of site design and engineering presented in sections DE, OP, SM and VE of these guidelines. It is important to consider how a particular project fits into the region's infrastructure, management and public access priorities, and how it might be most compatible with the conservation of listed species, the recovery function of critical habitat, and/or the conservation of FWS trust resources. Consider how the access a roadway enables and the impacts a roadway creates will fit into the management goals for the FWS managed lands it serves. The planning process can also help ensure that all applicable laws (e.g., FWCA, ESA, etc.) are appropriately addressed.

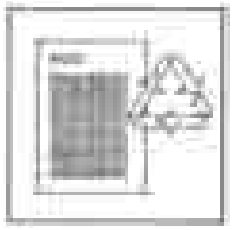
This section will help guide you to resources that will aid with or inform the planning process, as well as relevant documents that should be reviewed. It also serves as a reminder for project elements that are sometimes overlooked, such as developing a communications plan that addresses both internal and external communications about the project. Information regarding project prioritization, selection, and delivery is discussed in the Region's Long Range Transportation Plan (LRTP). Contact your Refuge Roads/FWS Transportation Coordinator for more information.

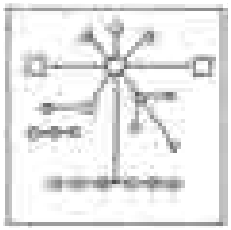
Selected project phases where the Roadway Design Guidelines are used by the project team

- Project identification and establishment
- Project scoping meeting(s)
- Establishing goals for the project
- Establishing scope, schedule, and budget for the project
- Establishing roles and responsibilities for the project
- Preliminary / schematic design phase
- Completed project assessment and monitoring

* Contact your Refuge Roads/FWS Transportation Coordinator for more information regarding how projects are planned and delivered in the region.







PC-1 Review Relevant Planning, Policy and Regulatory Information

Intent

Take advantage of lessons learned and research in relevant fields. Reviewing relevant background information ensures your project team is considering the most advanced and applicable contextual information related to a specific project. Consider what applicable legal and FWS policy requirements your project must respond to in order to be successful.

Principles

- Review local, regional and state transportation plans to determine how efforts by other agencies may inform your project planning and design
- Contact GIS staff to initiate data gathering and discuss mapping and analysis needs
- Review your Comprehensive Conservation Plan (CCP) and step down plan sections on transportation planning
- Conduct survey work and geotechnical investigations
- Review the Regional Long Range Transportation Plan (LRTP)
- Review existing asset management data and any asset management plans
- Review requirements of NEPA as well as other applicable state and local regulations
- Address ESA requirements as applicable
- Ensure consistency with applicable environmental laws such the FWCA, MBTA, and BGEPA.

Metrics

- List of related documents or case studies reviewed
- Concurrence from project team and stakeholders that relevant information has been reviewed and is ready to be applied to future phases of work

Resources

Overview of various systems of performance metrics.

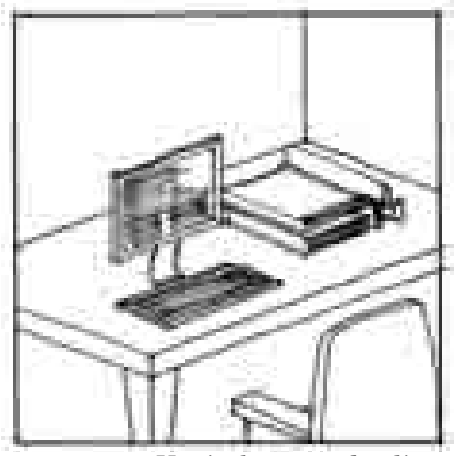
AASHTO. 2008. Guidelines For Environmental Performance Measures. NCHRP 25-25, Task 23. Prepared by Cambridge Systematics, Inc. Cambridge, MA.

NEPA information for EPA Region 10 (Pacific NW).

http://yosemite.epa.gov/R10/ECOCOMM.NSF/webpage/national+environmental+policy+act.

Guidelines for developing projects that work for local communities.

WSDOT. 2003. Building Projects that Build Communities: Recommended Best Practices.



Use in-house and online resources to find relevant case studies and up-to-date regulatory requirements.

Documents are shared and discussed during a project kickoff meeting at Umatilla NWR (top); a multidisciplinary team reviews resource documents during a project meeting in the Regional Office (bottom).

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Brian Bainson

PC-2 Define Level of Service for the Project

Intent

Your project team should identify what level of service (LOS) will be provided by roadways. This will help to adequately size facilities and ensure facility compatibility with current and anticipated demand. Designing for an appropriate LOS helps avoid over-building facilities, which can be costly. Plan to balance roadway improvements with wildlife conservation and habitat maintenance goals. Good phasing plans and cost estimates should be developed, keeping in mind that these may change over time, in response to changing visitor patterns, management priorities, or adjacent land use.

Principles

- Develop performance based, rather than prescriptive, goals and objectives
- Avoid unnecessarily over-designing facilities
- Consider utilizing partnerships and alternative transportation to accommodate special events that generate traffic or atypical demands on roadways
- Determine jurisdiction
- Decide whether roadways should enable more direct access to facilities or amenities
- Balance needs with resources and intended capacity and vehicle or user types
- Decide if and how it may be appropriate to promote lower design speeds
- Consider seasonal and multi-modal issues
- Examine case studies for other similar facilities in order to "right size" your facility for current and anticipated demands
- Consider Intelligent Transportation Systems (ITS) or other means of sharing traveler information to distribute traffic, inform visitors of seasonal closures and provide more trip planning
- Consider how the roadway can serve as a link to communities – gateways, access, etc.

Metrics

- Visitor use statistics (vehicle and trailhead)
- Visitor satisfaction
- Traffic and parking violations
- Traffic or congestion statistics
- Existing parking and roadway capacity

Resources

Design recommendations for various road types.

National Park Service. 1984. Park Road Standards.

Design recommendations for various road types.

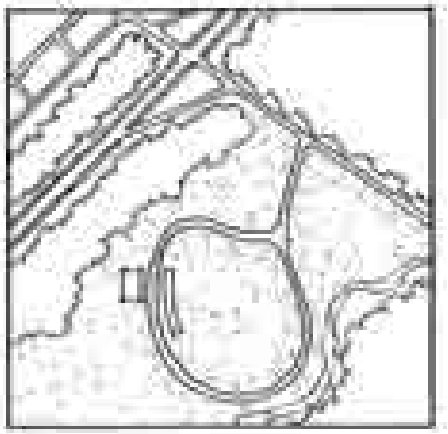
USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

Regional guidelines for roadside development.

ODOT. 2006. Roadside Development Design Manual - Guidelines for Visual Resource Management, Landscaping, and Hardscaping (DRAFT).

Public involvement may help clarify visitor needs.

Peaks, Harold E. and Sandra Hayes. 1999. "Building Roads in Sync With Community Values." In Public Roads (Mar./Apr. 1999).



Determine the intended vehicles and traffic volumes for the roadway.

Level of Service

The term Level of Service (LOS) is commonly used among transportation planners to refer to the number of vehicles served. However users of these guidelines should also consider the term to include other elements, such as types of users, seasonality of use and modes of transportation that a particular roadway serves. Multimodal access refers to the ability of a transportation facility to provide access via a variety of modes, such as car, bicycle, public transit or walking. In keeping with the FWS mission, consider where it is possible and appropriate to provide multimodal access to FWS facilities, and whether the scale and type of roadway is in line with local management objectives.

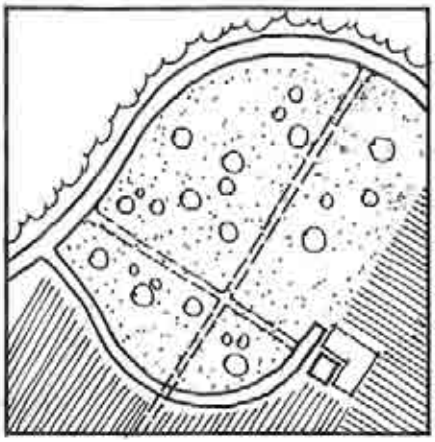
Wide gravel shoulder allows visitors to pull off of a 2-lane highway to view wildlife.

USFWS

PC-3 Evaluate Multiple Siting and Alignment Alternatives

Intent

Project teams should explore multiple design alternatives for roadway projects. A systematic alternatives evaluation process can be effectively used to arrive at a preferred alternative for further development. Alternatives development can reveal opportunities for projects to enhance visitor experience, protect wildlife, reduce ecological impacts to landscapes, minimize habitat fragmentation and provide alternative transportation methods. Reviewing a suite of alternatives will ensure that roadway decisions are compatible with the Service's mission and are made using the best possible information. The evaluation of alternatives will also support your NEPA process.



Explore and assess the effects of alternative road alignments.

Principles

- Determine if a roadway or road improvement is necessary
- Consider whether the roadway is in the right place
- Consider physical elements (e.g. hydrology), ecological effects (e.g. habitat fragmentation) as well as experiential factors (e.g. views, openness, arrival experience)
- Consider appropriateness of existing alignments versus potential alternatives
- Consider benefits or drawbacks of decommissioning existing facilities
- Determine how and when vehicles and people will move through the FWS managed lands
- Consider alternative modes of travel and potential for facility conversion, such as road to trail, trail in lieu of road, etc.
- Determine whether funding is tied to existing facilities

Metrics

- Comparison of road density for options considered
- Analysis of potential habitat fragmentation (e.g. vegetation or habitat mapping, wildlife tracking)

Resources

Case Studies.

Conboy Lake NWR, Visitor Experience Site Plan. Evaluated multiple vehicular and pedestrian circulation routes at HQ site. Contact Alex Schwartz, Project Manager (503/736 4723) for more information.

Umatilla NWR, McCormack Unit, Quarters Area Site Plan. Evaluated multiple roadway realignment concepts in conjunction with a new bunk house and residence. Contact Alex Schwartz, Project Manager.

Roadway design guidelines using applied ecology and experience.

Jones, Grant R., et al. 2007. Applying Visual Resource Assessment for Highway Planning (pp.130-139) and Road Alignment (pp.330-341).

A decommissioned roadway is restored with native vegetation.

SvR Design

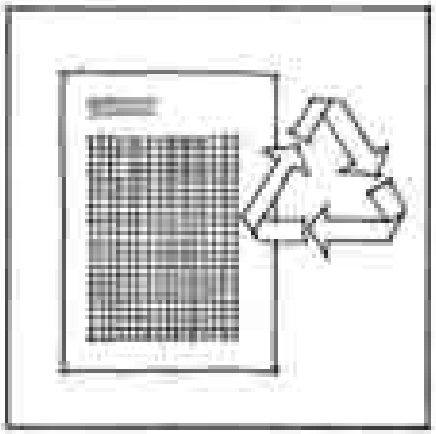
Evaluate Alternatives

Conceptual site planning at Conboy Lake NWR evaluated three different alternatives for roadways on the site.

PC-4 Assess Full Costs and Impacts of Transportation System

Intent

Examine the full suite of costs associated with a roadway project in addition to the traditional design and construction costs. Consider the environmental impacts of the construction process and materials used, as well as future maintenance needs and costs. Projects that make sense in the near-term may not be environmentally beneficial or economically tractable in the long-term. Consider both environmental and monetary costs. Check resources for assigning monetary value to environmental costs.



Examine the characteristics of materials used in a project, including embodied energy and recyclability.

Principles

- Environmental impacts should be considered
- Evaluate the embodied energy of materials used
- Minimize externalization of environmental impacts through emissions and materials used
- Include comparison of costs of facilities for alternative modes of transportation in analysis
- Consider projected maintenance costs (often 65% of life cycle cost of an asset)

Metrics

- Carbon footprint (or ecological footprint)
- Vehicle miles traveled
- Long-term maintenance costs
- Life of pavement and other materials
- Greenroads rating system
- Life cycle costing (of total costs for construction and maintenance of a proposed transportation alternative)

Resources

Overview of various systems of performance metrics.

AASHTO. 2008. Guidelines For Environmental Performance Measures. NCHRP 25-25, Task 23.

Performance metrics for CSS.

TransTech Mgmt., et al. 2004. Performance Measures for Context Sensitive Solutions - A Guidebook for State DOT's.

Info & data on sustainable material.

Calkins, Meg. 2009. Materials for Sustainable Sites.

Overview of climate change impacts on transportation infrastructure.

Transportation Research Board. 2008. Potential Impacts of Climate Change on US Transportation.

Sustainability metrics.

University of Washington and CH2MHill. 2009. Greenroads Rating System, v1.0. http://www.greenroads.us/.

Example of triple bottom line assessment of infrastructure.

Stratus Consulting. 2009. A Triple Bottom Line Assessment of Traditional and Green Infrastructure ... in Philadelphia's Watersheds.

Triple Bottom Line in Transportation Management

The triple bottom line concept originates in business and accounting practices. It stipulates three key areas or 'resources' that should be addressed in measuring sustainability:

- Society (human capital)
- Environment (natural capital)
- Economy (financial capital)

This concept, also known as "people, planet, profit," offers an expanded spectrum of values and criteria for measuring a project or organization's success. Using this perspective in transportation management means that you would not only consider the long-term economic costs and benefits of a project, but also account for potential environmental and social costs and benefits over time.

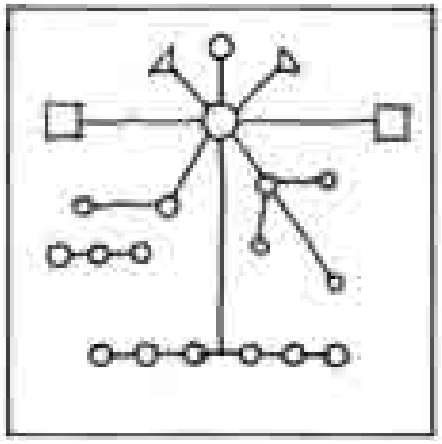
Road construction at Flint Hills NWR.

USFWS

PC-5 Communicate With Team and Stakeholders

Intent

Craft and document your approach for communications among your project team and with stakeholders. Ensure that roles and responsibilities are clearly defined in a project management plan. Carefully coordinate communications to help ensure consideration of a broad range of solutions in support of the best possible design outcome. Interdisciplinary project teams are the modern standard to ensure that work products are comprehensive and meet multiple objectives. Ensure that various elements of design are not overlooked and that there is organizational and public buy-in. Provide appropriate opportunities for involvement and review among your project team and stakeholders.



Develop a communications strategy and network.

Principles

- Address both internal and external communication needs in your project management plan
- Define clear roles and responsibilities for members of the project team
- Designate key agency contact(s) for all agencies/organizations involved
- Create a cross-functional (multi-disciplinary) team
- Develop design visualization and communication tools, such as graphics, plans, models, newsletters, web pages
- Identify the audience and develop solutions for communicating with people who don't read plans or technical documents
- Coordinate with transportation planning partners
- Contact Transportation Biologists in Ecological Services (ES) State Field Office to ensure project delivery is consistent with the mission of the Service
- Schedule project team meetings at regular intervals

Metrics

- Character and amount of public feedback on project
- Level of support and understanding of project within the organization
- Achievement of project goals

Resources

Guidelines for community and interdisciplinary planning process.

Lennertz, Bill, and Aarin Lutzenhiser. 2006. The Charrette Handbook. American Planning Association.

Case studies in collaborative management of wetlands and wildlife areas.

Porter, Douglas, and David Salvesen, eds. 1995. Collaborative Planning for Wetlands and Wildlife: Issues and Examples.

Public involvement for CSS.

Myerson, Deborah L., AICP, 1999. Getting It Right in the Right-of-Way: Citizen Participation in Context-Sensitive Highway Design. Scenic America. Available at: http://www.scenic.org/.

Public involvement for transportation projects.

Florida Department of Transportation. 2003. Public Involvement Handbook. Available at: http://www.dot.state.fl.us/EMO/pubs/public_involvement/pubinvolve.htm.

Members of Your Team

There are many professionals and stakeholder groups that you may want to include as part of your project team. Some possibilities include:

- Professional Engineers (PE)
- Landscape Architects (RLA)
- Transportation and Natural Resource Planners
- Field Biologists
- Project Leaders and Refuge Managers
- Refuge Roads Coordinators
- ES Transportation Biologists
- Representatives of other jurisdictions and agencies with local involvement

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Project staff and stakeholders meet in the field at Pelican Island NWR (right).

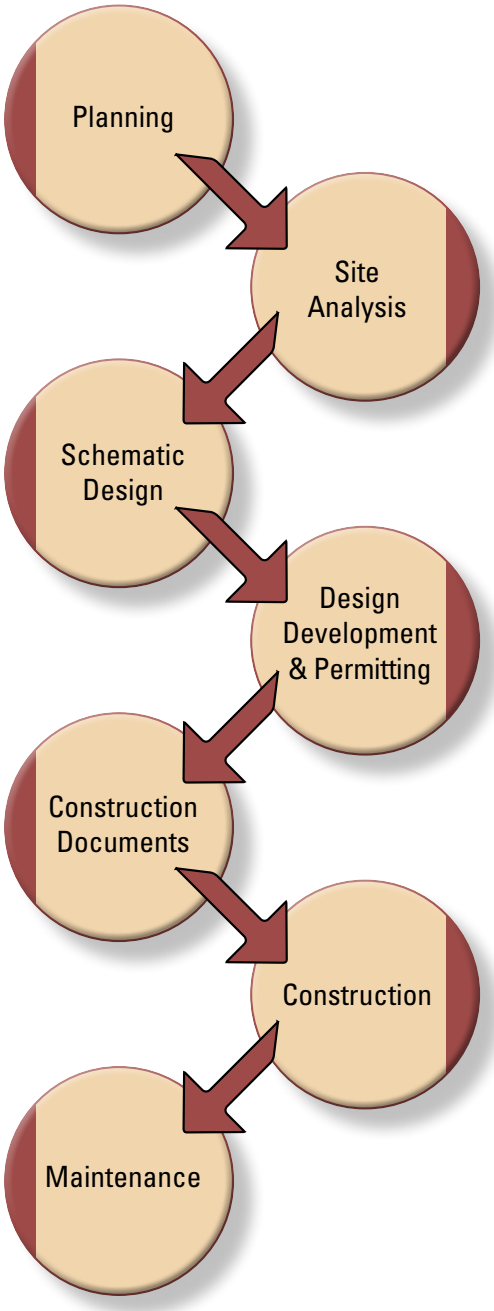
Design and Engineering

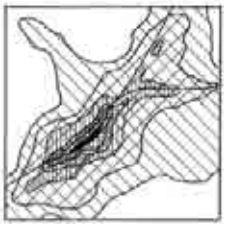
Design and Engineering
Overview

From Concept to Construction
This section recognizes that embedded in the technical aspects of a roadway project is the ability to directly support the mission of the Service. This section will guide you though a suite of considerations regarding the nuts and bolts of a roadway project, such as earthwork, alignment, safety, materials selections, vegetation preservation and management, construction practices and maintenance considerations.

Designing a complete roadway project includes using methods and materials that minimize the environmental impacts of the roadway and associated construction work. It also involves developing a design that leads the roadway to function more often as a restorative system, helping to heal previously impacted or damaged natural environments. Working with an interdisciplinary team can greatly facilitate a holistic design and engineering process. Early coordination through the FWCA, and the ESA can provide valuable insight and expedite permit processes. A roadway design process can be approached methodically, beginning with a broad vision and narrowing down to the technical details and ultimately construction activities to make it happen. In the end, the project should be implemented in a manner consistent with FWS goals, applicable laws, and ideally, such that there is a benefit to the conservation of listed species and other FWS trust resources.

Process - Design to Construction



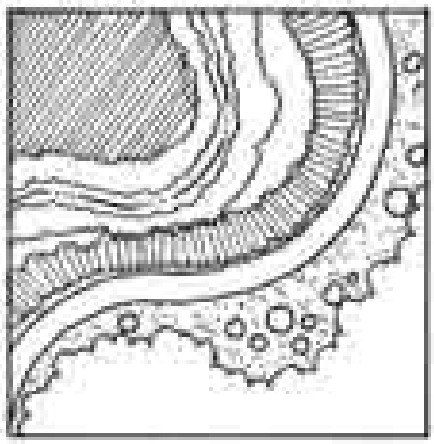






DE-1 Preserve and Restore Native Vegetation and Other Natural Resources

Intent

Roadway projects present opportunities to protect and restore native vegetation. Roadways commonly represent a barrier to wildlife and fragment habitat. However, roadway projects can represent an opportunity to heal historic wounds to a landscape and to ensure no further damage is done. Select roadway sites and alignments that avoid impacts to significant stands of existing vegetation. Look for restoration opportunities and consider what types of vegetation along roadway corridors are compatible with management goals.



Restored vegetation along road corridor can help support management goals.

Principles

- Explore ways to integrate restoration opportunities into project
- Consider how road surface conditions will affect nearby vegetation (e.g. dust, heat, other pollutants generated)
- Consider what types of vegetation and habitat along roadways will be compatible with management goals
- Use site prep and construction methods that protect and conserve existing native vegetation and natural resources
- Protect or stockpile and re-use healthy existing/native soils on site
- Protect heritage and other significant trees during and after construction (e.g. provide fencing, do not dig in or store material on top of root zones)
- Consider irrigation needs for establishing roadway vegetation
- Consider how invasive species will be managed during native vegetation establishment periods

Metrics

- Amount of post-construction restoration planned
- Vegetation surveys
- Reduced invasive species control needs

Resources

Regional guidelines for roadside development.

ODOT. 2006. Roadside Development Design Manual - Guidelines for Visual Resource Management, Landscaping, and Hardscaping (DRAFT).

Comprehensive guidebook on roadside revegetation.

FHWA. 2007. Roadside Revegetation: An Integrated Approach to Establishing Native Plants.

New technology to minimize pile-driving construction impacts to aquatic organisms.

Reyff, James. 2009. Reducing Underwater Sounds with Air Bubble Curtains.

Road alignment at Nestucca Bay NWR preserves upland vegetation and forest.

Alex Schwartz/USFWS

Brian Bainnson

This roadway project at Steigerwald NWR required integration of native vegetation restoration (right). The planting plan was prepared by a registered landscape architect. The plants were installed by a licensed landscape contractor. Work included a temporary irrigation system and a 1-year maintenance and warranty period.

DE-2 Consider and Plan for Invasive Species Management

Intent

Invasive species are a major issue for habitat restoration and wildlife management efforts. Roadways often serve as a significant vector for the spread of invasive species. Thus, particular attention must be paid to this issue in the planning, design and maintenance of road corridors and road networks.

Principles

- Inventory invasive species in the region that are already present and what steps have been taken to combat their spread
- Ensure that planting plans feature plant species and densities, as well as establishment techniques to limit future invasive establishment
- Consider latest tools and techniques available to combat spread of invasive species
- Examine relevant state and regional lists of invasive species threats
- Search for and consider lessons from other relevant projects, based on similar ecosystems and/or similar project types
- Develop pre-project baselines to measure success of future management goals
- Address and plan for invasive species management during construction and general use
- Create an invasive species management plan following local Best Management Practices (BMPs), addressing both roadside and adjoining habitats
- Minimize disturbance and project footprint, including mobilization and staging areas

Metrics

- Invasive species survey data
- Staff time dedicated to invasive species management (and how that changes over time)

Resources

Invasive species along roadways from the perspective of road and landscape ecology (see Chapter 4, pp. 75-111).

Forman, Richard, et al. 2003. Road Ecology: Science and Solutions.

Establishment and maintenance of native plants along roadways.

Harper-Lore, Bonnie and Maggie Wilson, editors. 2000. Roadside Use of Native Plants. Available online at: http://www.fhwa.dot.gov/environment/rdsduse/index.htm.

FHWA. 2007. Roadside Revegetation: An Integrated Approach to Establishing Native Plants.

Guidance on roadside weed management.

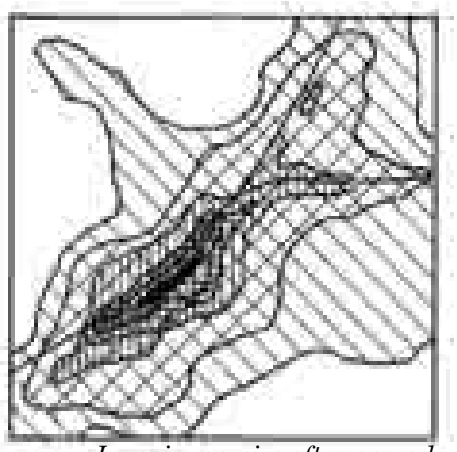
Ferguson, Leslie, C. L. Duncan and K. Snodgrass. 2003. Backcountry Road Maintenance and Weed Management.

Comprehensive list of roadside vegetation management resources.

Center for Environmental Excellence by AASHTO - Invasive Species/Vegetation Management, Reseach, Documents & Reports web page. See: http://environment.transportation.org/environmental_issues/invasive_species/docs_reports.aspx.

List of many resources on controlling invasive species, from construction best practices to ongoing maintenance.

Wisconsin Department of Transportation (WisDOT). 2003. Best Practices for Control of Invasive Plant Species.



Invasive species often spread outward from roadways.

Selected Steps for Invasive Species Management

- Post-construction maintenance plan
- Minimize disturbance
- Retain shade to the extent possible
- Know the quality of topsoil and mulch; avoid importing contaminated topsoils
- Know the quality of seed sources
- Clean equipment that has had contact with weed sources
- Over-sow disturbed areas with native seeds
- Avoid nitrogen fertilizers in the first year

List adapted from FHWA Roadside Revegetation Manual. See section 5.8 in manual.

Ryan Hagerty/USFWS

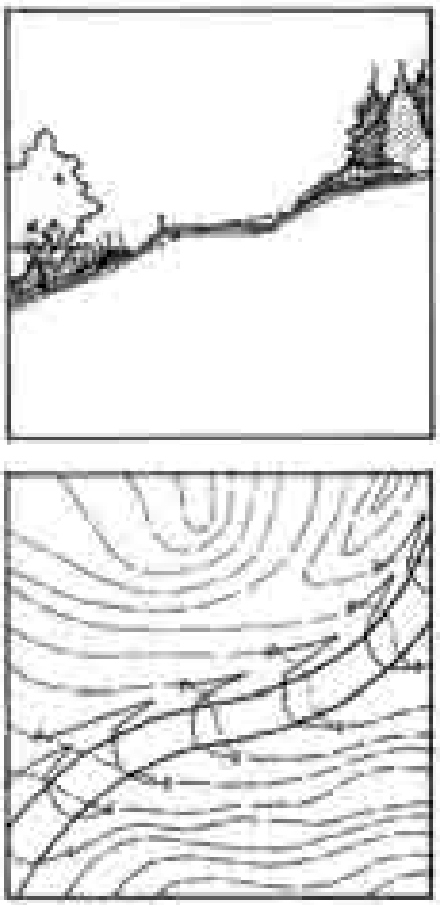
Controlling invasive species after their spread can be labor-intensive; spraying melaluka in FL (right).

DE-3 Minimize Cut and Fill to Fit With Existing Landscape

Intent

Roadways can be designed to fit with natural topography and seamlessly integrate with the landscape character. By studying the natural topography, designers can attempt to select a road alignment that will take advantage of views, while also minimizing the visual impact of the road itself. Conforming to the natural topography can minimize interruptions to the natural hydrology, and may help to preserve other important natural features, vegetation and habitat.

Elevated structures are often preferable for wildlife and habitat connectivity, and should be considered where possible. If that results in a cut/fill imbalance then seek innovative ways to use fill material. Examples include using excess fill material to construct pullouts, scenic viewpoints, and trailheads. Earthwork considerations discussed in this guideline are appropriate for both new construction projects and alterations or improvements to existing roadways.



Fitting in with existing topography is key to minimizing impacts.

Principles

- Consider roadway alignments that will minimize and balance cut and fill volumes
- Consider alternative structures to reduce fill volumes (e.g. bridge vs. culvert, etc.)
- Use roadways to highlight Refuge habitats as they follow existing terrain
- Look for continued opportunities to minimize and improve "aesthetic wounds"

Metrics

- Earthwork volumes per mile (compare to similar projects)
- Balanced cut and fill volumes
- Visual resources assessment

Resources

See cut and fill guideline on page 83.

USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

Case study on context sensitive solutions (CSS) for scenic highway.

Kentucky Transportation Center. Undated. Context-Sensitive Design Case Study No. 1: Paris Pike - Kentucky. College of Engineering, University of Kentucky. Lexington, KY.

Guidelines on appropriate lower-impact road alignment.

Jones, Grant R., et al. 2007. Applying Visual Resource Assessment for Highway Planning (pp.130-139) and Road Alignment (pp.330-341). In Landscape Architecture Graphic Standards. Hoboken, New Jersey: John Wiley & Sons. Available at: http://www.jonesandjones.com/news/publications.html.

Road design guidelines.

FHWA. Undated. Flexibility in Highway Design. FHWA Pub. No. FHWA-PD-97-062. Found at: http://www.fhwa.dot.gov/environment/flex/index.htm.

Common standard on roadway design.

AASHTO. 2004. AASHTO A Policy on Geometric Design of Highways and Streets, 5th Edition (aka 'Green Book). Washington, D.C.

Guidelines for design of very low volume roadways.

AASHTO. 2001. Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400), 1st Edition. Washington, D.C.

Gravel roads maintenance and design.

Skorseth and Selim. 2000. Gravel Roads Maintenance and Design Manual. South Dakota Local Transportation Assistance Program (USDOT - FHWA).

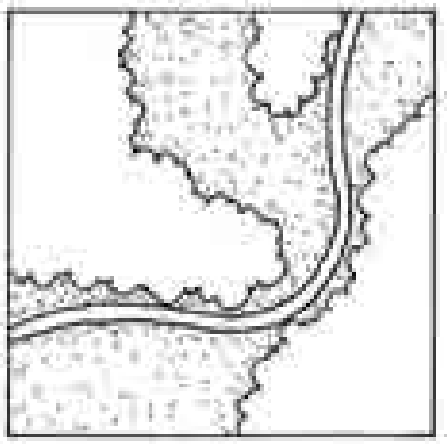
Roadway terraced along hillside at Hart Mountain NWR responds to opportunities and constraints of the topography

Fort Photo/Flickr.com

DE-4 Consider Road Geometries for Lower Speeds, Safety and Alertness

Intent

Low speeds can help protect wildlife, increase the value of roadside habitat and provide a greater degree of safety for all roadway users. In addition to improved safety for wildlife and roadway users, low travel speeds are compatible with the Big Six public uses. Low road speeds help to encourage alternative modes of transportation, including walking and bicycling. Lower actual speeds are achieved through deliberate roadway geometry and design, not simply signage.



Curving roads with varying views can promote alertness and lower speeds.

Principles

- Road alignments may include continuous curves, spiral curves, curving alignment, etc. in order to support safety and alertness
- Consider how curvilinear road geometries achieve multiple objectives and can specifically support habitat and wildlife management goals
- Consider the effect of road surface on travel speeds
- Determine and design around a roadway 'design speed' so that people will *want* to drive slower
- Consider safety and engineering standards that are applicable to the roadway's context

Metrics

- Road speed and volume study
- Accident reports
- Visual resources assessment
- Balanced cut and fill volumes
- Protection of vegetation and habitat
- FHWA Road Safety Audit

Resources

Design guidance based on human behavior patterns.

Transportation Research Board of The National Academies. 2008. Human Factors Guidelines for Road Systems.

Guidelines on appropriate lower-impact road alignment.

Jones, Grant R., et al. 2007. Applying Visual Resource Assessment for Highway Planning (pp.130-139) and Road Alignment (pp.330-341). In Landscape Architecture Graphic Standards. Hoboken, New Jersey: John Wiley & Sons. Available at: http://www.jonesandjones.com/news/publications.html.

Road design guidelines.

FHWA. Undated. Flexibility in Highway Design. Access at: http://www.fhwa.dot.gov/environment/flex/index.htm.

Standards for roadway design.

AASHTO. 2004. AASHTO A Policy on Geometric Design of Highways and Streets, 5th Edition (aka 'Green Book).

Handbook with design guidance on appropriate construction techniques for low traffic volume roads.

Weaver, William and Danny Hagans. 1994. Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads.

Curving roadway at Nestucca Bay NWR highlights scenery and discourages high speeds (top); emergency personnel respond to an accident at Ridgefield NWR (bottom).

Alex Schwartz/USFWS

USFWS

DE-5 Consider Construction Impacts and Best Practices

Intent

Roadway construction can have major impacts to terrestrial and aquatic organisms, as well as to environmental quality. Appropriate project planning, project management and construction management should be applied to ensure that impacts from construction activities are minimized and acceptable. The overall project footprint should be minimized as much as possible, especially with regard to construction activities such as staging materials and equipment.

Principles

- Consider appropriate season for construction
- Minimize construction impacts to terrestrial and aquatic organisms
- Implement construction best practices, such as dust and erosion control
- Look for staging opportunities that use existing developed sites and minimize impact to adjacent habitat areas
- Consider impacts of construction needs, such as water, on the surrounding environment
- Consider how construction elements, such as water wells, could be used for staff and visitor services in the future

Metrics

- Changes in population counts or behavior (e.g. breeding) of local organisms
- Visible signs of disturbance beyond limits of work
- Compliance with erosion control plan elements

Resources

Handbook with design guidance on appropriate construction techniques for low traffic volume roads.

Weaver, William and Danny Hagans. 1994. Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads.

Good checklist for items to address or consider.

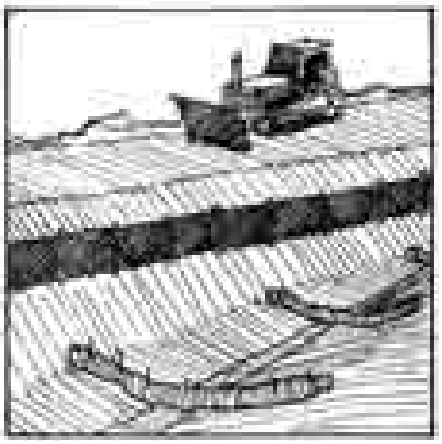
ODOT. 2006. Roadside Development Design Manual - Guidelines for Visual Resource Management, Landscaping, and Hardscaping (DRAFT).

Guidelines with resources on environmentally-friendly construction practices.

University of Washington and CH2MHill. 2009. Greenroads Rating System, v1.0. http://www.greenroads.us/.

New technology to minimize pile-driving construction impacts to aquatic organisms.

Reyff, James. 2009. Reducing Underwater Sounds with Air Bubble Curtains.



Standard practices such as using silt fencing help reduce construction impacts to adjacent habitat.

Construction on an entry road, parking lot, and trailhead project at Steigerwald NWR, in partnership with FHWA's Federal Lands Highways program. Project required extensive multidisciplinary planning, design, and construction expertise to ensure implementation of best construction practices and minimization of habitat and scenic area disturbance.

FHWA

BMPs: Best Management Practices

Best management practices are methods that have been determined to be the most effective and practical means of preventing or reducing a project's short- and long-term environmental impacts. BMPs focus on prescriptive measures, typically in the construction and maintenance phases of a project. Design Guidelines are more general and require interpretation and adaptation.

BMPs available for roadway construction projects include:

- Erosion control
- Equipment and operation
- Noise and emissions
- Spill and Pollution Prevention
- Safety

DE-6 Consider Range and Sources of Materials for Sustainable Construction

Intent

There are numerous options available for materials that have sustainable characteristics. Consider selecting materials with lower embodied energy and carbon footprints, recycled content, high durability, and which have a high level of environmental performance. Using sustainable materials can achieve compliance with the Service's environmental and performance goals, as well as save money in the long term. Even existing roadway materials can be effectively recycled into a new project, including asphalt, aggregates and fill material.

Principles

- Identify range of materials that would be suitable or possible to use in a given project
- Consider various qualities of material options, including environmental performance, longevity, maintenance needs and aesthetic fit
- Study past performance and success of materials in other sites (case studies)
- Consider using materials that are certified for sustainability
- Consider paying more for a more durable material that may save money (through performance and maintenance) in the long run
- Source materials locally where possible

Metrics

- Embodied energy calculations
- Runoff discharge rates

Resources

See materials listed in Greenroads Guidelines.

University of Washington and CH2MHill. 2009. Greenroads Rating System, v1.0. http://www.greenroads.us/.

Check on embodied energy of proposed materials at University of Bath's Inventory of Carbon & Energy (ICE) Wiki.

See: http://wiki.bath.ac.uk/display/ICE/Home+Page.

The Sustainable Sites Initiative (SSI) provides resources and guidelines for materials and site development.

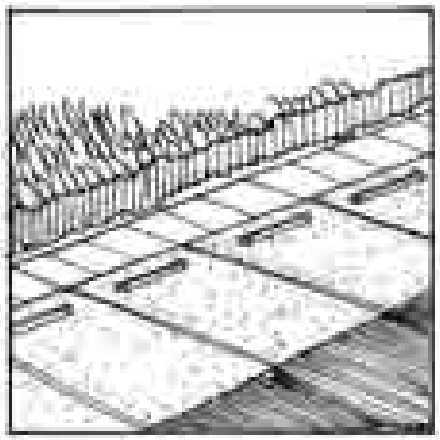
See: http://www.sustainablesites.org/.

For sites that include buildings, calculate the project's carbon footprint at BuildCarbonNeutral.

See: http://buildcarbonneutral.org.

Information and data on sustainable materials.

Calkins, Meg. 2009. Materials for Sustainable Sites.



Materials may vary for travel lanes, parking stalls and pedestrian pathways.

A parking lot at Tualatin River NWR used warm mix asphalt for main travel ways, pervious pavers in parking stalls and features a bioswale with amended soils and native plants to cleanse stormwater in order to protect habitat (top); local and sustainable materials were used to construct an Auto Tour pullout / wildlife viewing area at Modoc NWR (bottom).

Brain Baimson

Steve Clay/USFWS

Embodied Energy and Carbon Footprints

Embodied energy is generally defined as the energy (commercial and industrial) that was used to make a product. It generally includes the energy used to deliver the product to its point of use or consumption, and may also include any energy needed for the deconstruction and disposal of the product. It is commonly measured in megajoules of energy per kilogram of product (MJ/kg).

A carbon footprint is a similar metric, which measures the total amount of greenhouse gas emissions caused by a product. It is often expressed in terms of tons of CO_2 produced per kilogram of product (tCO_2/kg).

DE-7 Consider Maintenance

Intent

When planning a new roadway or retrofits to existing facilities, it is important to anticipate both short- and long-term maintenance needs. During the design phase, consider whether anticipated maintenance of potential designs is realistic, given existing or likely future budgets, staff training and skills, and other related factors. To be successful in their purpose, new types of materials (e.g. pervious paving) or facilities (e.g. wildlife underpasses or signals) may have new maintenance needs requiring staff training. Consider also that regular maintenance practices can extend the life of a facility. Weigh the pros and cons of potentially higher first costs with the benefit of lower life cycle maintenance costs for durable projects.

Consider trade-offs between longevity and maintenance needs.

Principles

- Examine current maintenance budgets, responsibilities and staff availability in concert with partners
- Estimate increase or reduction of maintenance needs for new facilities
- Consider current skills of maintenance staff and what types of training may be needed
- Consider whether contractors would be required to complete maintenance activities
- Be aware of concerns about adopting new practices, and be prepared to understand and address the concerns of operations and maintenance staff
- Provide achievable and responsive BMPs
- Discuss early in project who is responsible for repairs and maintenance to wildlife-specific facilities such as fencing
- Consider maintenance partnerships with State and County Transportation Dept's to leverage their transportation resources and expertise
- Consider the impacts of chemicals or other products that are used in roadway maintenance

Metrics

- Historic vs. current maintenance costs
- Road closure data
- BMPs correctly applied in field

Resources

Handbook with design guidance on construction and maintenance techniques for low traffic volume roads.

Weaver, William and Danny Hagans. 1994. Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads.

Good checklist for items to address or consider.

ODOT. 2006. Roadside Development Design Manual - Guidelines for Visual Resource Management, Landscaping, and Hardscaping (DRAFT).

Gravel roads maintenance & design.

Skorseth and Selim. 2000. Gravel Roads Maintenance and Design Manual. South Dakota Local Transportation Assistance Program (USDOT - FHWA).

BMPs for rural road maintenance.

Smith, Stacy (Idaho Technology Transfer Center, Univ. of Idaho). 2005. BMP Handbook: Best Management Practices for Idaho Rural Road Maintenance.

Roadside vegetation management.

WSDOT. 1997. Integrated Vegetation Management for Roadsides.

Maintenance guidelines for sensitive areas.

Crane, Bill. 2006. Road Maintenance with Threatened, Endangered, or Sensitive Plants: Finding Solutions.

Maintenance guidelines.

Ruiz, Leo. 2005. Guidelines for Road Maintenance Levels.

Fire being used for maintenance of roadside vegetation

USFWS

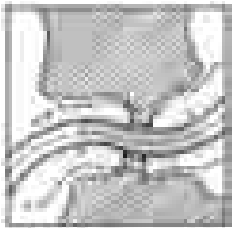
Organism Passage

Organism Passage
Overview

Terrestrial and Aquatic Passage
The conservation of fish, wildlife, plants and their habitats is the primary FWS mission. Roadways have major impacts on terrestrial and aquatic organisms. Roadways create barriers to wildlife movement and fragment habitat. Ensuring that organisms are able to safely move across (either over or under) roadways to meet basic life requisites is imperative to meeting the Service's mission.

This section is intended to help direct you to guidance and resources for improving terrestrial and aquatic organism passage. The guidelines in this section reflect the growing body of science that documents the need for wildlife-sensitive planning, design, engineering, and construction of roadways. Recognizing the highly site- and species-specific nature of aquatic and terrestrial passage issues, you are particularly encouraged to seek out resources on regionally-appropriate techniques to facilitate passage of terrestrial and aquatic organisms. In areas where ESA listed species or critical habitat may benefit from a passage improvement, additional conservation measures may be warranted during both the design and construction phases.

Addressing organism passage issues on FWS managed lands is an emerging priority for the Service which these guidelines are intended to support. At present, addressing organism passage issues on FWS lands is most realistic in conjunction with high priority infrastructure projects such as bridge replacements. A future possibility is that projects intended to specifically address organism passage will be eligible for Refuge Roads funding.



OP-1 Develop Your Corridor Plan for Crossing

Intent

It is important to develop a comprehensive plan to address aquatic and terrestrial connectivity along a roadway. Corridor level plans are necessary to document habitat fragmentation, lack of stream continuity, population level roadway avoidance effects and wildlife-vehicle collisions (WVC). In addition to identifying the ecological impacts a roadway is having on organisms, plans should identify funding opportunities and partnerships in support of recommended mitigation measures. Successful plans identify target species and crossing "hot spots". Prioritize your specific individual crossing projects and include conceptual design documentation for crossing structures and supporting mitigation measures.

Principles

- Develop organizational partnerships
- Solicit expert review and input; wildlife crossing structures require expert design and review
- Monitor to locate roadkill hotspots but consider how roads change animal movements (avoidance)
- Identify target species based on management objectives
- Consider how crossing needs align with other transportation priorities and budgets
- Consider species' home range size and seasonal movements to determine extent of passage needed
- Consider how current or future roadway design speed and traffic volumes may impact wildlife

Metrics

- Safety (animal/vehicle collision reductions)
- Species population health
- Dispersal capability
- Daily/seasonal movement necessary to meet life requisites

Resources

Latest information on road ecology as it relates to mitigating interactions between roads and wildlife.

Beckmann, J. P., A. P. Clevenger, M. P. Huijser, and J. A. Hilty. 2010. Safe Passages.

Coordinating aquatic and terrestrial passage opportunities.

Jacobson et al. 2007. Combining Aquatic and Terrestrial Passage Design into a Continuous Discipline.

Effectiveness of various wildlife crossing facilities.

Transportation Research Board of The National Academies. 2008. Evaluation and the Use and Effectiveness of Wildlife Crossings (NCHRP Report 615).

Best practices for reduction of WVC.

FHWA. 2008. Wildlife-Vehicle Collision Reduction Study, Best Practices Manual. Access at http://www.fhwa.dot.gov/environment/hconnect/wvc/index.htm.

Guidance on reduction of WVC.

FHWA. 2008. Wildlife-Vehicle Collision Reduction Study, Report to Congress. Access at http://www.fhwa.dot.gov/publications/research/safety/08034/index.cfm.

Effects of roadways on wildlife (see entire Conservation Biology issue).

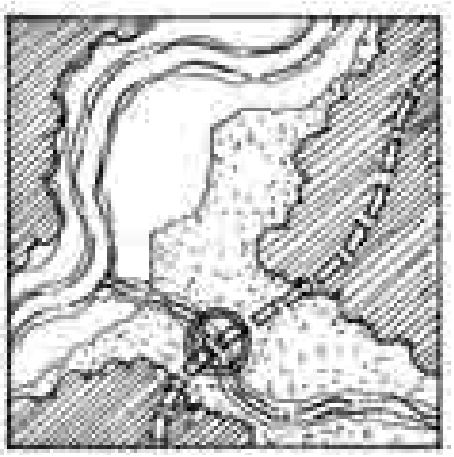
Trombulak, Stephen and C. Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities.

Background research on roadway impacts to wildlife.

Mader, Sharon. 2006. Comparing the Ecological Effects of Linear Developments on Terrestrial Mammals.

See list of crossing issues by state, by FWS national Refuge Roads Coordinator (unpublished).

Wildlife Crossing and Aquatic Organism Passage Issues by State.



Examine the roadway corridor for locations where organisms would prefer to cross in the absence of a roadway. Study topography, vegetation patterns and hydrology along the corridor.

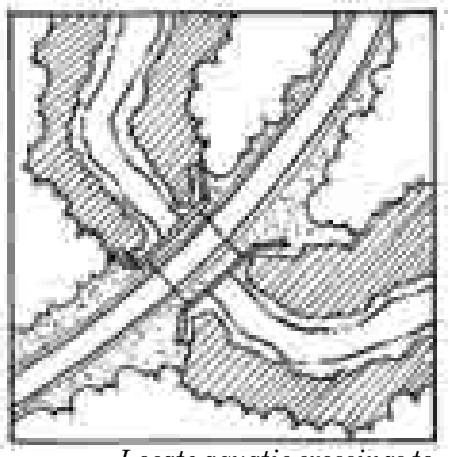
A corridor management and wildlife crossing plan is a critical tool to plan and fund projects; map showing monitoring locations for crossing plan study (below).

Robert Henke et al.

OP-2 Provide and Enhance Aquatic Organism Crossings

Intent

Roads, streams and rivers are similar systems in that they all transport material and organisms across the landscape in a linear fashion. Stream and river functions, such as the movement of woody debris, sediment transport and fish and wildlife passage have historically been impeded by engineering solutions intended to minimize disruptions to roadway infrastructure. Recognizing the importance of aquatic resources on FWS managed lands, an ecosystem-based approach to aquatic organism passage focuses on maintaining the continuity of a stream or river's characteristics where that system intersects a roadway.



Locate aquatic crossings to minimize interruption to normal stream flow and channel migration.

Principles

- Consider and design for long-range traffic volume projections for road
- Consider seasonality of wildlife movement and stream flows
- Develop list of target species for aquatic organism passage and focus planning and design efforts on supporting overall ecosystem health
- Consider range of stream crossing solutions and techniques
- Culverts or bridges that mimic the slope, structure and dimensions of the natural stream bed can allow aquatic species to freely move under roadways
- Plan for appropriate post-construction riparian and streambed restoration work
- Consider maintenance needs for various stream crossing designs
- Plan for appropriate in-water work windows
- Consider how to best complete road maintenance activities at or near stream crossings in order to avoid impacts to water quality

Metrics

- Surveys to show healthy passage of aquatic organisms
- Water quality measurements (upstream vs. downstream)
- Re-colonization of upstream habitat by aquatic organisms (in cases of improving/upgrading existing crossings)

Resources

Analysis & costs of culvert design and aquatic organism passage.

MN Dept. of Transportation. 2009. Cost Analysis of Alternative Culvert Installation Practices in Minnesota.

Design guidelines and best practices for aquatic organism passage.

USDA Forest Service. 2008. Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings.

Bridge construction guidance.

AZ Game and Fish Dept., Habitat Branch. 2008. Guidelines for Bridge Construction or Maintenance to Accommodate Fish & Wildlife Movement and Passage.

Riparian restoration guidance.

USDA Forest Service. 2002. Management Techniques for Riparian Restorations (Roads Field Guide, Volume II).

Design guidelines for stream crossings and proper road drainage.

William Weaver and Danny Hagans. 1994. Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads.

See list of crossing issues by state, by FWS national Refuge Roads Coordinator (unpublished).

Wildlife Crossing and Aquatic Organism Passage Issues by State.

See aquatic organism passage in:

Proceedings of International Conference on Ecology and Transportation (ICOET). Access online at: http://www.icoet.net/.

Site visit to a new aquatic crossing structure during a Refuge Roads coordination meeting at Kenai NWR (top); viability for many aquatic species, such as salmon, depend on their ability to move through river and stream ecosystems (bottom).

John Sauer/USFWS

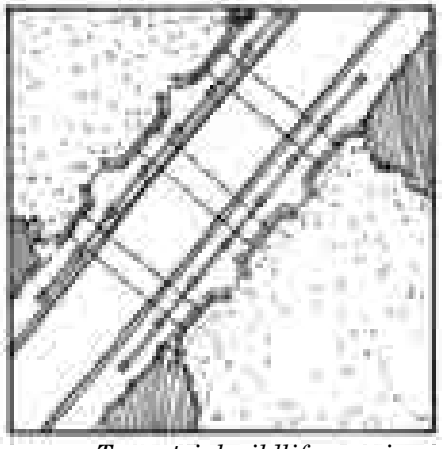
Florian Schulz

OP-3 Provide and Enhance Terrestrial Wildlife Crossings

Intent

Roadways are a significant barrier and danger for terrestrial organisms. When terrestrial organisms attempt to cross roadways in order to meet life requisites, fatalities and injuries can result for both wildlife and humans. If wildlife-vehicle collisions (WVC) regularly take place along a roadway, this is a good indicator of the need for mitigation. Another less visible effect of habitat fragmentation caused by roadways is avoidance behaviors that can have significant effects on populations.

The most effective mitigation measure to reduce WVC and to enhance terrestrial organism passage across roadways is to design and construct suitable crossing structures, in combination with barrier and diversion fencing, where appropriate. It is important to remember that every species is impacted by roadways in different ways. Terrestrial crossing projects can seek to meet multiple ecosystem connectivity objectives simultaneously.



Terrestrial wildlife crossings provide safer crossings for wildlife and connect fragmented habitat patches.

Principles

- Identify design species and their crossing structure needs; design crossings that work for as many species as possible
- Consider and design for long-range traffic volume projections for roadway
- Consider visual quality and aesthetic impact of structures
- Improve nearby habitat for wildlife, especially areas leading to or connecting with crossings
- Maximize opportunity for restoration project links to crossing/connectivity sites
- Consider "right crossing, right place" when locating crossings
- Review the corridor management or crossing plan
- Bridge replacements are the best opportunity in a 50-70 year time frame to create movement opportunities and should be taken advantage of even if no other projects are in the area

Metrics

- Evidence of unmet need to cross
- Improved wildlife counts in adjacent areas after crossing implementation
- Improved wildlife dispersal rates
- Reduction in WVC

Resources

Bridge construction guidance.

AZ Game and Fish Dept., Habitat Branch. 2008. Guidelines for Bridge Construction or Maintenance to Accommodate Fish & Wildlife Movement and Passage.

Wildlife crossing structures and fencing effectiveness evaluation.

Hardy et al, Western Transportation Institute. 2007. Evaluation of Wildlife Crossing Structures and Fencing US Hwy 93 Evaro to Polson.

Effectiveness of various wildlife crossing types.

Transportation Research Board of The National Academies. 2008. Evaluation and the Use and Effectiveness of Wildlife Crossings.

Best practices for WVC reduction.

FHWA. 2008. Wildlife-Vehicle Collision Reduction Study, Best Practices Manual.

Guidance on reduction of WVC.

FHWA. 2008. Wildlife-Vehicle Collision Reduction Study, Report to Congress.

See FWS Refuge Roads Coordinator list of crossing issues by state (unpublished).

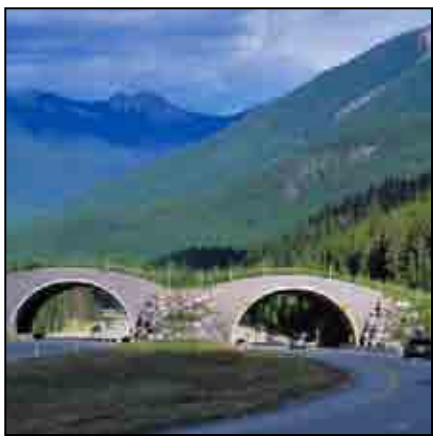
Wildlife Crossing and Aquatic Organism Passage Issues by State.

See crossing structure design in:

Proceedings of International Conference on Ecology and Transportation (ICOET). Access online at: http://www.icoet.net/.

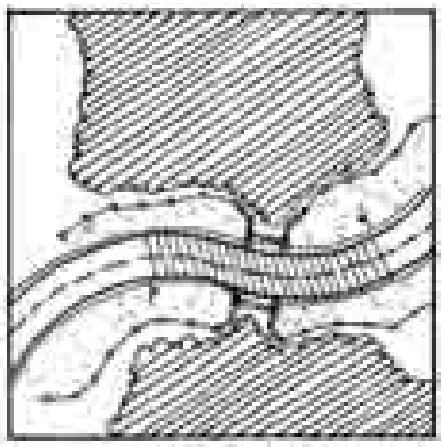
Bridge replacements are excellent opportunities to enhance terrestrial crossing opportunities (top); a wildlife overcrossing in Banff NP, Canada has successfully improved both safety and wildlife movement (bottom).

Brian Baimson



Florian Schulz

OP-4 Evaluate Need for Wildlife Fencing and Other Guiding Features



Fencing can help guide wildlife to safer crossing areas.

Intent

Wildlife-vehicle collisions (WVC) can be reduced through the use of barrier and diversion fencing or other features that help guide wildlife to crossing structures, including overpasses or underpasses. Effective wildlife barrier and diversion fencing forces animals off the road and into a crossing structure. In order for a crossing structure to be effective, it needs to be designed in conjunction with fencing. Project teams should consider aesthetics, where to end fencing and how fencing relates to topographical features in the landscape. Fencing design is highly species-specific and should be designed in consultation with an expert.

Barrier and diversion fencing requires maintenance. Successful projects account for maintenance concerns and budgets during the design phase. Fencing discussions might include a consideration of how to handle fence ends. Where to end a fence has major safety implications. It is a difficult decision, and is best done in consultation with an expert.

Principles

- Study WVC or other interactions along the corridor
- Recognize that fencing is a last resort option, and that the outcomes can be deadly for wildlife inadvertently trapped on a roadway
- Design fencing treatments based on species and environmental conditions
- Include escape structures in the design; jumpouts are more effective than the commonly used one-way gates
- To avoid "end run" WVC, end fencing beyond prime habitat areas *or* at locations with good visibility
- Boulder piles can act as a maintenance-free fence for ungulates
- Consider how best to accommodate multiple species
- Consider the aesthetic impacts of wildlife fencing
- Consider how to handle fencing at access roads

Metrics

- WVC counts
- Reduction in wildlife mortality due to WVC

Resources

BMPs for reduction of WVC.

FHWA. 2008. Best Practices Manual, Wildlife Vehicle Collision Reduction Study (Report to Congress). Found at http://www.fhwa.dot.gov/environment/hconnect/wvc/index.htm.

Wildlife crossing structures and fencing effectiveness evaluation.

Hardy et al, Western Transportation Institute. 2007. Evaluation of Wildlife Crossing Structures and Fencing on US Hwy 93 Evaro to Polson.

Effectiveness of various wildlife crossing types.

Transportation Research Board of The National Academies. 2008. Evaluation and the Use and Effectiveness of Wildlife Crossings (NCHRP Report 615).

Website with additional guidelines and case studies of construction and maintenance practices to benefit wildlife along roadways.

FHWA - Keeping It Simple: Easy Ways to Help Wildlife Along Roads. See: http://www.fhwa.dot.gov/environment/wildlifeprotection/index.cfm.

Continuous page wire fencing is commonly used to keep wildlife off roads and to direct them to crossing structures (top); jumpouts are essential features to allow trapped animals to leave the road whenever continuous fencing is used (bottom).

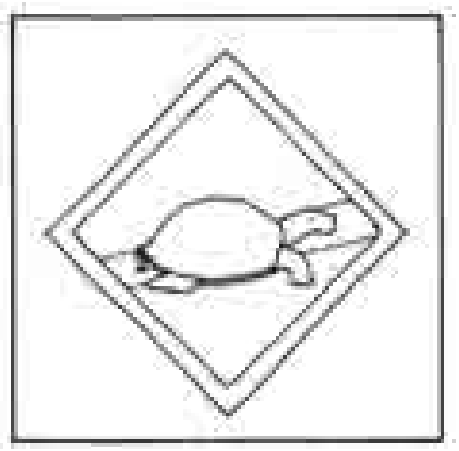
lisahends/Flickr.com

USFWS

OP-5 Consider Warning and Safety Systems for Drivers

Intent

An important component of facilitating terrestrial organism passage is promoting adequate awareness and caution on the part of drivers. Various systems exist to warn drivers of the presence of wildlife on a roadway. These systems include static signs to alert drivers to zones where wildlife typically cross roadways as well as flashing lights or other signals that respond to the presence of wildlife near the roadway. The most effective signage systems are active warning systems. Static warning signs, if strategically placed and well designed, can improve public awareness and may be a good fit for low volume roads.



Warning signs can help remind drivers to look out for wildlife on the road.

Principles

- Select the appropriate type of signage for the species, roadway LOS and site conditions
- Provide public information on the crossing design and intent
- Consider active warning systems for "end runs" of fencing, crossing hot spots and as temporary mitigation measures in the absence of crossing structures
- Consider the related benefits of communicating crossing and habitat areas, such as public education and communicating stewardship

Metrics

- Wildlife-vehicle collision (WVC) statistics (note that these are a better measure of safety than ecological conditions; even then, they are suspect unless expertly interpreted)

Resources

BMPs for reduction of WVC.

FHWA. 2008. Best Practices Manual, Wildlife Vehicle Collision Reduction Study (Report to Congress). Found at http://www.fhwa.dot.gov/environment/hconnect/wvc/index.htm.

Wildlife crossing structures and fencing effectiveness evaluation.

Hardy et al, Western Transportation Institute. 2007. Evaluation of Wildlife Crossing Structures and Fencing on US Hwy 93 Evaro to Polson.

Research on effectiveness of methods for collision reduction.

Huijser et al, and Salsman and Wilson. 2006. Animal Vehicle Crash Mitigation Using Advanced Technology, Phase I: Review, Design And Implementation, SPR-3(076).

In areas where wildlife is known to cross roadways, active warning systems can be effective to alert drivers to the presence of wildlife on or near a roadway.

Florian Schulz

Stormwater Management

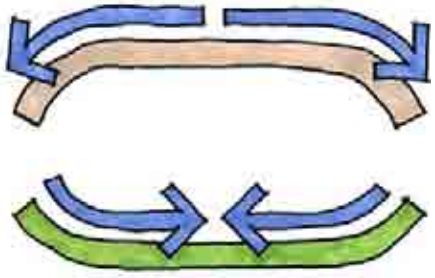
Stormwater Management
Overview

Cleaning Water, Improving Habitat
It is important to consider what happens to stormwater runoff along the entire roadway. Runoff from roadways on FWS managed lands may deliver chemical pollutants and sediment to surface and ground water. Roadways have a profound effect on the hydrology of a given site and watershed. Impervious surfaces increase runoff rates, volumes, temperature and duration. Roadway surfaces can concentrate flows, creating unnatural flow regimes that impact adjacent lands and lead to cumulative impacts downstream at the watershed scale, such as erosion and flooding.

This section discusses sustainable stormwater management techniques and points you to educational resources and guidelines on their design, construction and maintenance. Such techniques can help to clean stormwater runoff from roadways, filtering out particulates and other pollutants. They can also slow flows and detain water during peak storm events, restoring more natural flows to adjacent water bodies. A common term used to describe this approach to stormwater management is low impact development (LID). LID emphasizes conservation and the use of existing natural site features, integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns.

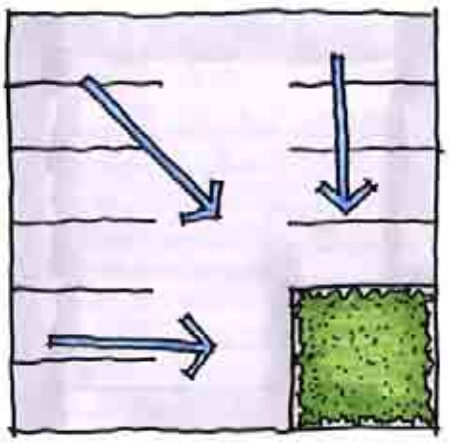
LID techniques include various features known collectively as natural drainage systems (NDS). These rely mainly on plantings, amended soils and other natural materials to treat, detain and retain stormwater runoff; these are often referred to as bioretention. Bioretention features include bioswales and rain gardens. Areas dedicated to NDS serve to buffer high value habitat from ecological disturbances caused by roadway infrastructure. Natural drainage features may also provide screening or visual buffering—functions that are often desirable when separating uses on a site or landscape.

NDS should be designed and implemented with care, so as to be compatible with habitat management goals. Concerns about their use include drawing wildlife closer to roadways through habitat creation (potentially causing increased negative animal-vehicle interactions), and the possibility of concentrating roadway pollutants into specific areas at levels that may be harmful to wildlife. These are important concerns to address, and care should be taken that each facility is designed to meet site-specific concerns.

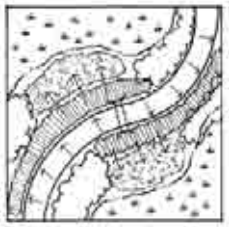


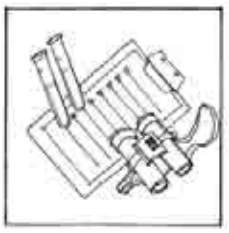
Typical facilities disperse runoff without treatment (top), while an LID approach detains and cleans water on site (bottom)

LID Philosophy
LID asks us to nurture stormwater rather than dispose of it. NDS features van help to achieve this.



Typical NDS Sizing
An NDS feature such as a bioretention area typically requires an area of only 10% of the impervious area it is designed to treat.





SM-1 Buffer Habitat from Polluted Runoff

Intent

Runoff from roadways can carry unwanted pollutants into adjacent streams and water bodies. It can also adversely affect (increase) the temperature of receiving water bodies. Methods for reducing pollution (chemical, particulate and temperature) should be considered and used to minimize or eliminate water quality issues roadway runoff. Treatment facilities in the right-of-way can also serve to intercept and improve the quality of runoff water from other nearby sources.

Principles

- Adhere to a low impact development (LID) strategy in planning and designing repairs and improvements
- Consider natural drainage system (NDS) treatment facilities, including filter strips and bioswales
- Stormwater treatment facilities and approach need to be site-specific
- Consider appropriate NDS features for the type of roadway—parking, auto tour route, entry/access road, highway, etc.
- Look at hydrology planning in the area and be aware of roadway impacts on it

Metrics

- Water quality testing
- Temperature monitoring

Resources

Design guidelines for LID features.

US Dept. of Defense. 2004. Unified Facilities Criteria (UFC) - Design: Low Impact Development.

LID guidelines for Pacific NW.

Hinman, Curtis. 2005. Low Impact Development: Technical Guidance Manual for Puget Sound. Puget Sound Action Team. Access at: http://www.psparchives.com/publications/our_work/stormwater/lid/lid_tech_manual05/LID_manual2005.pdf.

Buffer design guidelines for that include stormwater treatment.

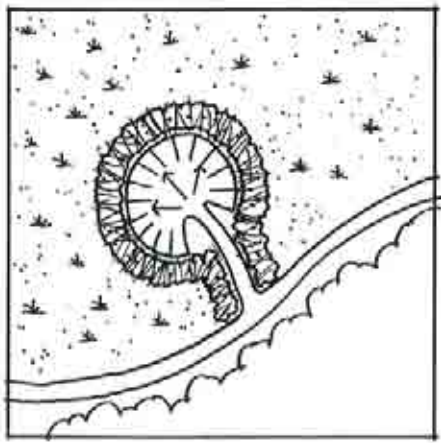
Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. Gen. Tech. Rep. SRS-109. Access at: http://www.unl.edu/nac/bufferguidelines/.

Roadway design guidance for lower impact to hydrology.

Dashiell and Lancaster. Undated. Road Design Guidelines for Low Impact to Hydrology. Five Counties Salmonid Conservation Program.

White paper on integrated LID and ecological analysis.

Mensing and Chapman. Undated. Conservation Development and Ecological Stormwater Management: An Ecological Systems Approach.



NDS features receive, clean and detain or retain runoff from roadways and other impervious surfaces; they can buffer habitat areas from negative ecological impacts.

Parking lot runoff at McNary NWR drains to a central bioswale that treats polluted runoff and buffers habitat from roadway impacts.

Brian Bainsson

Water Quality 101 **Issue: Stormwater runoff from roads and parking lots is laden with pollutants**

Alex Schwartz/USFWS

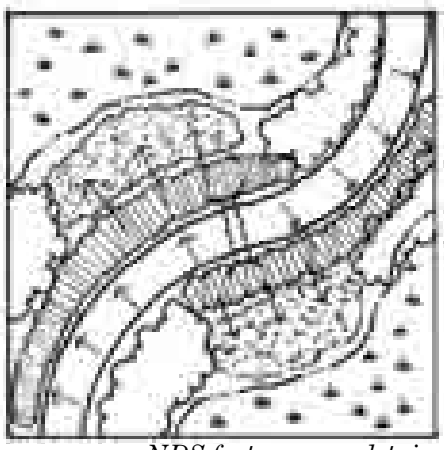
- Conventional facilities collect and drain polluted runoff using a variety of methods, such as sheet draining, "grassy swales," curbs and drainage inlets. These can quickly convey pollutants directly to sensitive habitats before the pollutants can be filtered out (*left*).
- Improved facilities are designed to intercept and filter polluted runoff before discharge to sensitive habitats (*right*).

SvR Design

SM-2 Protect Habitat from Erosive Flows and Flooding

Intent

The rate of flow of runoff from roadways is major issue of concern. Flow rates are typically much higher and shorter in duration than those which would come from the same areas in unpaved conditions. Such spikes in flow rates create erosion and flooding issues and prevent groundwater recharge. These effects can have major detrimental impacts on fish, wildlife and their habitats. Natural drainage system (NDS) facilities should be designed to not only clean water, but to detain peak flows and, where appropriate retain, runoff locally. Target flow control should be based on undeveloped conditions for local ecosystems, as well as current soil conditions and downstream concerns.



NDS features can detain runoff, slowing its flow to adjacent water bodies.

Principles

- Minimize quantity of stormwater runoff
- Minimize use of impervious materials
- Technologies to address water quantity issues include wet ponds, porous pavements, bioswales and rain gardens
- Improvements (stormwater facilities) must be sized appropriately to handle flow

Metrics

- Measurements of stormwater runoff rates and volumes
- Hydrographs for receiving water bodies

Resources

Design guidelines for low-use roads, focusing largely on hydrology.

Weaver, William and Danny Hagans. 1994. Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads.

Low impact development (LID) guidelines for Pacific Northwest.

Hinman, Curtis. 2005. Low Impact Development: Technical Guidance Manual for Puget Sound. Puget Sound Action Team. Olympia, WA.

Design guidelines for LID features.

US Dept. of Defense. 2004. Unified Facilities Criteria (UFC) - Design: Low Impact Development.

Info on vegetative filter strips (page 44) and other practices.

Smith, Stacy (Idaho Technology Transfer Center, Univ. of Idaho). 2005. BMP Handbook: Best Management Practices for Idaho Rural Road Maintenance.

Roadway design guidance for lower impact to hydrology.

Dashiell and Lancaster. Undated. Road Design Guidelines for Low Impact to Hydrology. Five Counties Salmonid Conservation Program.

BMPs for ESA compliance.

WSDOT. Best Management Practices Field Guide for ESA Sec 4(d) Habitat Protection.

A gravel parking lot with central vegetative swale at Ash Meadows NWR minimizes impervious materials and allows for large storm events to be infiltrated on site, away from more sensitive habitats.

Jeff Holm/USFWS

Water Quantity 101 **Issue: Impervious surfaces increase runoff rates, temperature, and volume**

SvR Design

- Runoff from impervious areas often concentrates flows, which impacts adjacent lands and also leads to cumulative downstream and watershed-scale impacts
- Where space is limited or linear alignment is tight, choose materials such as pervious paving (*left*) to reduce runoff rates
- Use NDS features to detain runoff before discharge (*right*)

SvR Design

SM-3 Monitor and Maintain Stormwater Facilities

Intent

Monitoring and maintaining stormwater facilities after project construction is key to learning from your work and improving the effectiveness of future projects. Particular attention should be given to monitoring the effects of the project on the landscape's environmental quality. Budgeting for and following standard monitoring and maintenance protocols are a critical component for stormwater management on FWS managed lands.

Principles

- Employ stormwater facility monitoring protocols (per ASCE or other standards)
- Maintain facilities in a manner that optimizes facility performance
- Collect relevant baseline data before project construction
- Check for and use appropriate control measures on any invasive species
- Check for levels of contaminants coming from roadway, and track their fate in areas adjacent to roadway
- Monitor level of compatibility with local wildlife and surrounding habitats
- Document maintenance needs and costs
- Document effectiveness of soil mixes and plants used
- Share or publish monitoring results to help improve design and results in other projects
- Use monitoring results in adaptive management

Metrics

- Measurements of stormwater runoff rates, volumes, temperature and contaminants
- Hydrographs for receiving water bodies
- Analysis documenting water quality improvements due to NDS features

Resources

Technical guidelines for monitoring of stormwater in various conditions.

US EPA. 2002. Urban Stormwater BMP Performance Monitoring. Access at: http://water.epa.gov/scitech/wastetech/guide/stormwater/monitor.cfm.

NDS maintenance guidelines that include guidance on monitoring.

City of Bellevue, WA. 2009. Natural Drainage Practices Maintenance Guidelines. Access at: http://www.bellevuewa.gov/pdf/Utilities/Natural_Drainage_Practices.pdf.

Study from UC Davis & USFS finding that bioswale significantly reduced runoff and removed pollutants; includes monitoring protocols used.

Xiao, Qingfu and E. G. McPherson. 2009. Testing a Bioswale to Treat and Reduce Parking Lot Runoff. Access at: http://www.fs.fed.us/psw/programs/cufr/products/psw_cufr761_P47ReportLRes_AC.pdf.

Standard operating procedures for stormwater monitoring.

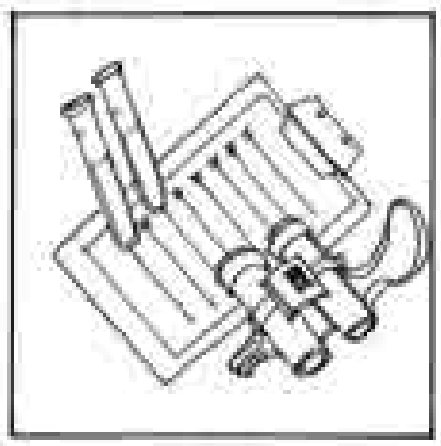
Washington Department of Ecology. 2010. Stormwater monitoring resources. Access at: http://www.ecy.wa.gov/programs/wq/stormwater/municipal/strmH2Omonitoring.html.

Guidance on stormwater monitoring for construction sites.

Washington Department of Ecology. 2006. How to do Stormwater Monitoring: A guide for construction sites. Access at: http://www.ecy.wa.gov/biblio/0610020.html.

Monitoring for larger debris.

ASCE. 2010. Guideline for Monitoring Stormwater Gross Solids. Order at: http://www.asce.org/Product.aspx?id=2147485997.



Monitoring projects will help advance the development of a focused approach to stormwater management on FWS managed lands that is responsive to the Service's mission.

Similar to managed wetlands, stormwater facilities should be periodically monitored for performance and to inform adaptive management and maintenance regimes.

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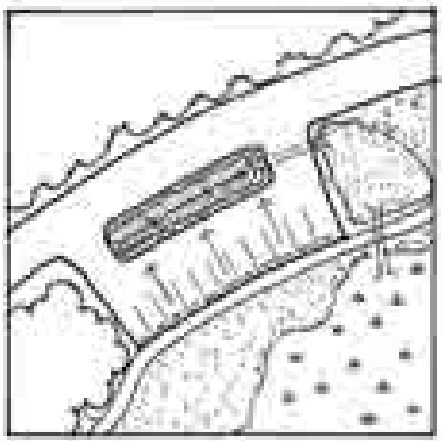
SM-4 Promote Stewardship of Aquatic Resources

Intent

Low impact development (LID) facilities for stormwater management serve the functional purposes of cleaning and slowing or retaining stormwater runoff and protecting our aquatic resources. Additionally they can help to raise public awareness and understanding of the relationship of roadways to aquatic resources, wildlife and habitat conservation. Stormwater facilities can be designed to reveal to and educate visitors about the impacts of development on aquatic resources. Facilities can communicate how they protect aquatic resources, and can influence behavior and management practices beyond FWS managed lands in support of the Service's mission.



Stormwater treatment facilities integrated into roadways provide places where FWS stewardship of aquatic resources can be demonstrated.

Principles

- Prioritize aesthetic and educational components of highly visible stormwater management facilities
- Use stormwater facilities to communicate stewardship commitment of FWS
- Design stormwater facilities with native plants in arrangements that respond to multiple objectives, including management, educational/ interpretive, aesthetic and maintenance goals
- Make stormwater part of the site's interpretive story and reveal the process of stormwater quantity and quality controls to the extent possible
- Consider educational and volunteer opportunities presented by stormwater management facilities
- Consider potential benefits or drawbacks of additional wetland habitat areas created by natural drainage facilities

Metrics

- "Friends" groups involvement & awareness
- Production/use of interpretive materials or content
- Use of stormwater facilities as positive examples or success stories (e.g. in public media, professional circles, within FWS)

Resources

Social benefits of road and highway systems.

AASHTO. 2008. Above and Beyond: The Environmental and Social Contributions of America's Highway Programs.

Promotional information for visitors to FWS sites.

USFWS. 2005. Byways to America's Wildest Places: Discover Your National Wildlife Refuges.

Scenic byways guidelines with details on benefits of good road design.

USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

Green Values calculator can help to quantify benefits from LID (aka green infrastructure) facilities.

Center for Neighborhood Technology. 2010. Green Values Stormwater Management Calculator. Access at: http://greenvalues.cnt.org/

Additional resources on green infrastructure (another term that includes natural stormwater management facilities).

US EPA. 2010. Green Infrastructure: Managing Wet Weather With Green Infrastructure (website). Access at: http://cfpub.epa.gov/npdes/home.cfm?program_id=298.

Report examining social, economic, and environmental benefits of green infrastructure.

Stratus Consulting. 2009. A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds.

Stormwater facilities can be an important part of visitor experience, providing interpretive opportunities (top) and allowing visitors hands-on experience planting or maintaining native vegetation (bottom).

Justin Martin

USFWS

Visitor Experience

Visitor Experience
Overview

Engaging the Public

Conservation of fish, wildlife, plants and their habitats is at the core of the Service's mission. Providing public access compatible with conservation goals is paramount to achieving this mandate. Roadways are the primary infrastructure elements that facilitate public access to FWS managed lands. Conversely, landscapes without roads or limited or restricted public access on roads can support protection of sensitive habitats when necessary. This section is intended to help you consider how best to provide access to FWS managed lands. Well-designed roadways on FWS lands can help demonstrate to visitors how the Service's mission is carried out at the landscape scale.

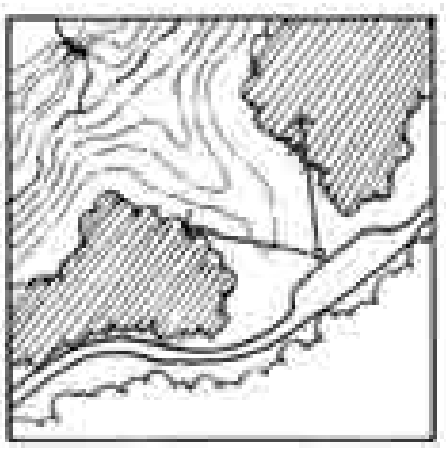
Scenic roadways offer visitors a glimpse into the habitat areas that the Service manages, helping to inspire an ethic of stewardship and conservation among the public. Roadways should be designed to afford such experiences and to convey a sense of place that is unique to each site and destination. They should take into account both the natural and cultural histories of the land they traverse, revealing but not destroying special places and artifacts along the way. This section of the guidelines will point you to resources to help with design solutions focused on the visitor's experience. Design of roadway elements such as safety and guiding features, interpretive signs and visitor facilities should be relevant and specific to the region, if not to the individual site or refuge.

National Wildlife Refuges, Fish Hatcheries and other FWS managed lands are national treasures. Facilities there should help visitors connect with the natural heritage that the Service works to conserve.

VE-1 Preserve and Highlight Scenic Value

Intent

The scenic value of wildlife refuges plays an important role in the visitor experience. Road alignments should be chosen or revised carefully so as to preserve the scenic value of the journey. Roadway alignments and locations on FWS managed lands should afford views and simultaneously prevent roadways from becoming dominant features of the visual landscape.



Plan roadways to afford views to areas of high scenic value.

Principles

- Consider designs that respond to the character of the landscape and management practices. For example, an entrance road may offer a change in design speed, scale and geometry in order to help visitors decompress from previous highway travel
- Provide appropriate orientation and directional signage in a style that fits with the local character and landscape
- Consider and plan the viewsheds and impacts of roadways on the visual and auditory landscape
- Consider and plan coherent and consistent design elements with the facility (color, texture, form)
- Consider the entry experience (does it welcome and orient visitors?) and sequence of visitor experiences when arriving at FWS managed lands or high use areas such as visitor centers
- Consider opportunities for interpreting culture and the landscape along the corridor
- Provide safe places, such as overlooks and viewpoints, to enjoy scenery

Metrics

- Visual resource analysis/ management - USFS or BLM methodologies (see Resources below)

Resources

Scenic byways guidelines with details on benefits of good road design.

USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

Study on context sensitive roadway design from New Mexico.

New Mexico Department of Transportation. 2006. Architectural and Visual Quality Design Guidelines for Context Sensitive Design and Context Sensitive Solutions.

Roadside treatment design guidelines.

FHWA. 2008. Safe and Aesthetic Design of Urban Roadside Treatments.

Regional guidelines for roadside development.

ODOT. 2006. Roadside Development Design Manual - Guidelines for Visual Resource Management, Landscaping, and Hardscaping (DRAFT).

Design guidance based on human behavior patterns.

Transportation Research Board of The National Academies. 2008. Human Factors Guidelines for Road Systems (NCHRP Report 600B).

USFS visual assessment technique.

USDA Forest Service. 1995 (rev. 2000). Landscape Aesthetics: A Handbook for Scenery Management. AH-701.

BLM visual assessment technique.

BLM. 2007. Visual Resource Management (website). Access at http://www.blm.gov/nstc/VRM/.

Roadways provide or give access to scenic vistas (top) and visitor facilities such as a viewing blind at Finley NWR (bottom).

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Brian Baimson

VE-2 Promote and Facilitate Multiple Modes of Transportation

Intent

Access to FWS managed lands, where compatible with Station purpose, should be available to visitors via multiple forms of transportation, including public transit, bicycle, and walking. Alternative forms of transportation can help reduce visitors' carbon footprints, which in turn may have long term positive affects for the natural resources we manage. Planning and building to accommodate sustainable transportation options can help to achieve the FWS mission.

Principles

- Design alternative transportation facilities that are compatible with wildlife and habitat conservation
- Provide parking for bicycles and other alternative types of transportation
- Consider adding charging stations for electric vehicles
- Coordinate with other agencies or organizations that could provide public transportation to FWS managed lands
- Promote and partner to develop bicycle routes to FWS managed lands
- Consider bicycle routes through FWS managed lands where compatible with wildlife, safety, and user experience
- Consider signage or pavement markings to alert drivers to other types of road users
- Use outreach to encourage use of alternative transportation modes to and within the FWS managed lands

Metrics

- Counts of users arriving by public transportation, using bicycles, etc.
- Use rates of stationary facilities, such as special parking or bike racks

Resources

Potential funding source for transit and other alternative transportation options.

Paul S. Sarbanes Transit in Parks Program (5320). Access at: http://www.fta.dot.gov/funding/grants/grants_financing_6106.html.

Case studies for alternative transportation projects in National Parks.

See: http://www.volpe.dot.gov/nps/projects.html.

Design guidelines (see pp. 70-76).

USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

Potential funding for developing alternative transportation systems for visitors through the Transit in Parks Program (5230)

See: http://www.fta.dot.gov/funding/grants/grants_financing_6106.html.

Bicycling on federal lands - case studies include two National Wildlife Refuges.

FHWA. 2008. Guide to Promoting Bicycling on Federal Lands. FHWA Pub. No. FHWA-CFL/TD-08-007.

Case studies that include alternative transportation programs in parks, such as shuttle bus systems.

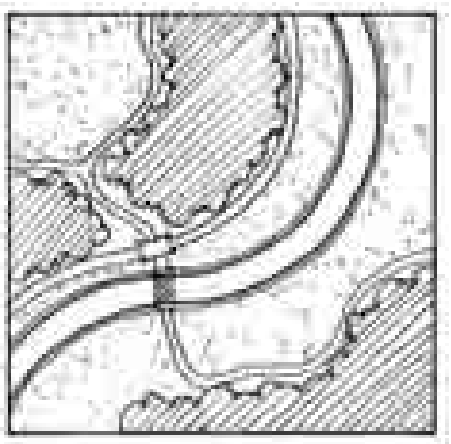
NPS Partnerships Case Studies (Transportation). See: http://www.nps.gov/partnerships/cs_type.htm#anchor19.

Lessons from Europe on traffic calming, enhancing mobility options.

Brewer, Jim, et al. 2001. Geometric Design Practices for European Roads. FHWA, Office of International Programs.

Case Study.

Tualatin River NWR. Two parking spaces designated for hybrid vehicles; bicycle racks provided at parking area; bus stop for a public transit line adjacent to the Refuge.



Providing separate facilities can encourage users who don't want to bike or walk along a roadway.

Roadway projects should facilitate multiple modes of transportation; a roadway at Ding Darling NWR (top) accommodates both autos and bikers for wildlife observation; parking lot at Great Swamp NWR visitor center (bottom) provides a safe, convenient place for bicycle parking.

USFWS

Brian Bainnson

VE-3 Comply With Accessibility Standards and Guidelines

Intent
FWS managed lands should be accessible to all. FWS is subject to accessibility standards as dictated by the Architectural Barriers Act (ABA). Project teams should use the relevant suite of resources and guidance to ensure all FWS facilities are designed and constructed to comply with or exceed the mandates of the ABA.

Principles
- Define and consider visitor expectations for accessibility
- Balance safety and accessibility concerns
- Apply all relevant design criteria in order to meet or exceed the requirements of ABA
- Consider the relationship of accessible improvements to related infrastructure. Is there a completely accessible visitor experience?

Metrics
- Compliance with requirements, guidelines and standards
- Visitor use counts
- Outcomes of DCR facility audits

Resources
See ABA accessibility standards.

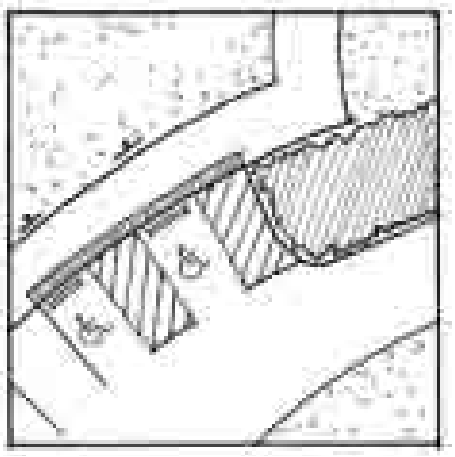
http://www.access-board.gov/gs.htm.

Draft Final Guidelines for accessibility in Outdoor Developed Areas on Federal lands:

http://www.access-board.gov/outdoor/.

Accessibility guidance for Federal outdoor areas (specific to USDA Forest Service lands/facilities).

USDA Forest Service. 2006. Accessibility Guidebook for Outdoor Recreation and Trails.



Brian Bainnson

Provide accessible parking spaces with appropriate access aisles and access to pathways (top); accessible parking at Great Swamp NWR (right).

What Federal Accessibility criteria should FWS projects follow?

The Architectural Barriers Act (ABA) of 1968
FWS is subject to the ABA. The ABA requires access to facilities designed, built, altered or leased with Federal funds. Passed by Congress in 1968, it marks one of the first efforts to ensure access to the built environment. The Access Board develops and maintains accessibility guidelines under this law. These guidelines serve as the basis for the standards used to enforce the law, the Architectural Barriers Act Accessibility Standard (ABASS).

Americans with Disabilities Act and the Architectural Barriers Act Accessibility Guidelines for Buildings and Facilities (ADAABAAG) as published in the Federal Register on July 23, 2004.
FWS should follow the scoping and technical requirements under the ABA sections. This direction covers accessibility to sites, facilities, buildings and elements by individuals with disabilities. The requirements are to be applied during design, construction, additions to and alterations of facilities.

Draft Final Accessibility Guidelines for Outdoor Developed Areas
Many FWS facilities can be characterized as Outdoor Developed Areas. The Access Board is proposing to issue accessibility guidelines for outdoor developed areas designed, constructed or altered by Federal agencies subject to the ABA of 1968. The guidelines cover trails, outdoor recreation access routes, beach access routes and picnic and camping facilities. Once these guidelines are finalized they will become the technical requirements for accessibility in outdoor developed areas. At this time, FWS may use these guidelines.

Accessibility Guidebook for Outdoor Recreation and Trails, USDA Forest Service, April 2006.
These guidelines only apply within National Forest System boundaries. However, they are a very useful tool for FWS projects recognizing that the Draft Final Accessibility Guidelines for Outdoor Developed Areas are still a work in progress.

And In General…
- Use principles of universal design—programs and facilities should be usable by all people, to the greatest extent possible, without separate or segregated access for people with disabilities.
- Accessibility does not supersede requirements for safety.
- Consider the level of development at a site to help balance safety and accessibility.

VE-4 Facilitate Compatible Wildlife Dependent Recreation and Education

Intent

The FWS mission is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people. The mission of the Service should be integrated and transparent in the design of roadways on FWS managed lands. Roadways are key in fulfilling the Service's priority of connecting people with nature, and can provide opportunities to do so in ways that are compatible with the conservation mission of the Service.

Principles

- Consider whether current or anticipated visitor impacts are compatible with wildlife and their habitats
- Consider safety for visitors, staff and wildlife
- Provide orientation and interpretive information to support visitor experiences
- Consider the enabling legislation of the refuge - what is the purpose of the unit?
- Consider relationships with other recreational or educational sites within the region
- Consider demand, site carrying capacity and quality of visitor experience
- Determine what kind of access to recreation sites is available, appropriate and necessary
- Consider impacts to recreational activities from roads
- Promote appropriate facilities for safely viewing wildlife from roads where necessary
- Plan for appropriate signage, including entrance, orientation, directional and interpretive
- Consider access for and needs of school groups

Metrics

- Visitor counts
- Diversity and quality of activities available for visitors
- Ease of use (proximity, clarity, etc.) of recreational and educational elements

Resources

California State Parks Children in Nature Campaign.

http://www.parks.ca.gov/?page_id=24914.

Information on local, regional and national programs to connect kids with nature.

Children and Nature Network. See: http://www.childrenandnature.org/movement/info.

National Wildlife Federation's kids outside program.

See: http://www.nwf.org/beoutthere/.

Washington State Parks "No Child Left Inside" campaign.

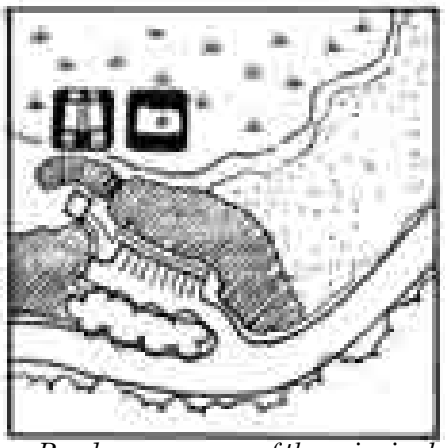
See: http://www.parks.wa.gov/NoChildLeftInside/.

USDA Forest Service Discover the Forest campaign.

http://www.discovertheforest.org/index.php.

Bicycling on federal lands - case studies include two National Wildlife Refuges.

FHWA. 2008. Guide to Promoting Bicycling on Federal Lands. FHWA Pub. No. FHWA-CFL/TD-08-007.



Roadways are one of the principal infrastructure elements that facilitate access to the Big 6 on FWS managed lands.

The Big Six

The 1997 Refuge System Improvement Act outlines "The Big Six" priority public uses for Refuge system improvements:

- Hunting
- Fishing
- Wildlife Photography
- Wildlife Observation
- Environmental Interpretation
- Environmental Education

Auto tour route at Ridgefield NWR provides visitors access to Big 6 activities, such as wildlife observation and photography.

USFWS

Appendices

Appendix A: Bibliography

LE - Landscape Ecology

Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture, Forest Service, Southern Research Station. 110 p. Access at http://www.unl.edu/nac/bufferguidelines/.

Climate Impacts Group. 2009. The Washington Climate Change Impacts Assessment. University of Washington. Seattle, WA.

Dashiell and Lancaster. Undated. Road Design Guidelines for Low Impact to Hydrology. Five Counties Salmonid Conservation Program. Weaverville, CA.

Dramstad, Wenche, James Olson and Richard Forman. 1996. Landscape Ecology Principles in Landscape Architecture and Land-Use Planning. Harvard GSD and Island Press. Washington, DC.

FHWA. 2008. Wildlife-Vehicle Collision Reduction Study, Best Practices Manual. Access at http://www.fhwa.dot.gov/environment/hconnect/wvc/index.htm.

Forman, Richard. "Roadsides and Vegetation." 2002. In Proceedings of the International Conference on Ecology and Transportation, Keystone, CO, September 24-28, 2001. Raleigh, NC: Center for Transportation and the Environment, North Carolina State University (March 2002): 85-91.

Forman, Richard, et al. 2003. Road Ecology: Science and Solutions. Island Press. Washington, D.C.

Green Highways Partnership. http://www.greenhighwayspartnership.org.

Jones, Grant R., David F. Sorey and Charles C. Scott. 2007. Applying Visual Resource Assessment for Highway Planning. In Landscape Architecture Graphic Standards (pp.130-139). Hoboken, New Jersey: John Wiley & Sons.

Jones, Grant R. and Charles C. Scott. 2007. Road Alignment. In Landscape Architecture Graphic Standards (pp.330-341). Hoboken, New Jersey: John Wiley & Sons.

Kentucky Transportation Center. Undated. Context-Sensitive Design Case Study No. 1: Paris Pike - Kentucky. College of Engineering, University of Kentucky. Lexington, KY.

Nevada Department of Transportation. 2002. Pattern and Palette of Place: A Landscape and Aesthetic Master Plan for the Nevada State Highway System.

New Mexico Department of Transportation. 2006. Architectural and Visual Quality Design Guidelines for Context Sensitive Design and Context Sensitive Solutions.

ODOT (Oregon Department of Transportation). 2006. Roadside Development Design Manual - Guidelines for Visual Resource Management, Landscaping, and Hardscaping (DRAFT).

Smith, Stacy (Idaho Technology Transfer Center, Univ. of Idaho). 2005. BMP Handbook: Best Management Practices for Idaho Rural Road Maintenance.

Sperling, Daniel and Deborah Gordon. 2008. Two Billion Cars: Transforming a Culture. In: TR News, No. 259 (Nov-Dec).

Transportation Research Board of The National Academies. 1997. Toward A Sustainable Future: Addressing the Long-Term Effects of Motor Vehicle Transportation on Climate and Ecology (SR 251).

Transportation Research Board of The National Academies. 2002. A Guide to Best Practices for Achieving Context Sensitive Solutions (NCHRP Report 480).

Transportation Research Board of The National Academies. 2008. Potential Impacts of Climate Change on US Transportation (TRB Report 290).

TransTech Mgmt., Oldham Historic Properties Inc. and Parsons Brinckerhoff Quade & Douglas for National Cooperative Highway Research Program. 2004. Performance Measures for Context Sensitive Solutions - A Guidebook for State DOT's.

Trombulak, Stephen and Christopher Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. Conservation Biology 14(1), February 2000, pp. 18-30.

USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

USDA Forest Service, Stream-Simulation Working Group. 2008. Stream Simulation: An Ecological Approach To Providing Passage for Aquatic Organisms at Road-Stream Crossings.

Weaver, William and Danny Hagans. 1994. Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads.

Western Governors' Wildlife Council. http://www.westgov.org/. Resources include the Wildlife Corridors Initiative Report (2008) and Wildlife Sensitivity Maps.

PC - Planning Context

AASHTO. 2008. Guidelines For Environmental Performance Measures. NCHRP 25-25, Task 23. Prepared by Cambridge Systematics, Inc. Cambridge, MA.

Florida Department of Transportation. 2003. Public Involvement Handbook. Available at: http://www.dot.state.fl.us/EMO/pubs/public_involvement/pubinvolve.htm.

Jones, Grant R., David F. Sorey and Charles C. Scott. 2007. Applying Visual Resource Assessment for Highway Planning. In Landscape Architecture Graphic Standards (pp.130-139). Hoboken, New Jersey: John Wiley & Sons.

Lennertz, Bill and Aarin Lutzenhiser. 2006. The Charrette Handbook. American Planning Association.

Myerson, Deborah L., AICP, 1999. Getting It Right in the Right-of-Way: Citizen Participation in Context-Sensitive Highway Design. Scenic America. http://www.scenic.org/.

NEPA information for EPA Region 10 (Pacific NW). http://yosemite.epa.gov/R10/ECOCOMM.NSF/webpage/national+environmental+policy+act.

ODOT (Oregon Department of Transportation). 2006. Roadside Development Design Manual - Guidelines for Visual Resource Management, Landscaping, and Hardscaping (DRAFT).

Peaks, Harold E. and Sandra Hayes. 1999. "Building Roads in Sync With Community Values." In Public Roads (Mar./Apr. 1999).

Porter, Douglas and David Salvesen, eds. 1995. Collaborative Planning for Wetlands and Wildlife: Issues and Examples. Island Press. Washington, D.C.

Transportation Research Board of The National Academies. 1997. Toward A Sustainable Future: Addressing the Long-Term Effects of Motor Vehicle Transportation on Climate and Ecology (SR 251).

Transportation Research Board of The National Academies. 2008. Potential Impacts of Climate Change on US Transportation (TRB Report 290).

TransTech Mgmt., Oldham Historic Properties Inc. and Parsons Brinckerhoff Quade & Douglas for National Cooperative Highway Research Program. 2004. Performance Measures for Context Sensitive Solutions - A Guidebook for State DOT's.

Stratus Consulting. 2009. A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds. Prepared for City of Philadelphia Water Department.

University of Washington and CH2MHill. 2009. Greenroads Rating System, v1.0. http://www.greenroads.us/.

USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

WSDOT. 2003. Building Projects that Build Communities: Recommended Best Practices.

DE - Design and Engineering

AASHTO. 2001. Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400), 1st Edition. Washington, D.C.

AASHTO. 2004. A Policy on Geometric Design of Highways and Streets, 5th Edition (aka 'Green Book). Washington, D.C.

BuildCarbonNeutral. 2010. http://buildcarbonneutral.org.

Calkins, Meg. 2009. Materials for Sustainable Sites. John Wiley & Sons. Hoboken, NJ.

Center for Environmental Excellence by AASHTO - Invasive Species/Vegetation Management, Reseach, Documents & Reports web page. Access at: http://environment.transportation.org/environmental_issues/invasive_species/docs_reports.aspx.

Crane, Bill. 2006. Road Maintenance with Threatened, Endangered, or Sensitive Plants: Finding Solutions. 0677 1807P. San Dimas, CA: U.S. Department of Agriculture, Forest Service, San Dimas Technology and Development Center. 60 p.

Ferguson, Leslie, Celestine L. Duncan and Kathleen Snodgrass. 2003. Backcountry Road Maintenance and Weed Management. 0371 2811. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 22 p.

FHWA. 2007. Roadside Revegetation: An Integrated Approach to Establishing Native Plants. FHWA-WFL/TD-07-005. Vancouver, WA.

FHWA. Undated. Flexibility in Highway Design. FHWA Pub. No. FHWA-PD-97-062. http://www.fhwa.dot.gov/environment/flex/index.htm.

Forman, Richard, et al. 2003. Road Ecology: Science and Solutions. Island Press. Washington, D.C.

Harper-Lore, Bonnie and Maggie Wilson, editors. 2000. Roadside Use of Native Plants. Island Press. Washington, D.C.

Jones, Grant R., David F. Sorey and Charles C. Scott. 2007. Applying Visual Resource Assessment for Highway Planning. In Landscape Architecture Graphic Standards (pp.130-139). Hoboken, New Jersey: John Wiley & Sons.

Kentucky Transportation Center. Undated. Context-Sensitive Design Case Study No. 1: Paris Pike - Kentucky. College of Engineering, University of Kentucky. Lexington, KY.

ODOT (Oregon Department of Transportation). 2006. Roadside Development Design Manual - Guidelines for Visual Resource Management, Landscaping, and Hardscaping (DRAFT).

Reyff, James. 2009. Reducing Underwater Sounds with Air Bubble Curtains. TR News, No. 262 (May-June).

Ruiz, Leo. 2005. Guidelines for Road Maintenance Levels. 0577 1205P. San Dimas, CA: U.S. Department of Agriculture, Forest Service, San Dimas Technology and Development Center. 71 p.

Skorseth and Selim. 2000. Gravel Roads Maintenance and Design Manual. South Dakota Local Transportation Assistance Program (USDOT - FHWA).

Smith, Stacy (Idaho Technology Transfer Center, Univ. of Idaho). 2005. BMP Handbook: Best Management Practices for Idaho Rural Road Maintenance.

Sustainable Sites Initiative (SSI). http://www.sustainablesites.org/.

Transportation Research Board of The National Academies. 2008. Human Factors Guidelines for Road Systems. NCHRP Report 600B.

University of Bath. Inventory of Carbon & Energy (ICE) Wiki. http://wiki.bath.ac.uk/display/ICE/Home+Page.

University of Washington and CH2MHill. 2009. Greenroads Rating System, v1.0. http://www.greenroads.us/.

USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

Washington Department of Ecology. 2006. How to do Stormwater Monitoring: A guide for construction sites. Access at: http://www.ecy.wa.gov/biblio/0610020.html.

Washington Department of Ecology. 2010. Stormwater monitoring resources. Access at: http://www.ecy.wa.gov/programs/wq/stormwater/municipal/strmH2Omonitoring.html.

Weaver, William and Danny Hagans. 1994. Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads.

Wisconsin Department of Transportation (WisDOT). 2003. Best Practices for Control of Invasive Plant Species.

WSDOT. 1997. Integrated Vegetation Management for Roadsides.

OP - Organism Passage

Arizona Game and Fish Department, Habitat Branch. 2008. Guidelines for Bridge Construction or Maintenance to Accommodate Fish & Wildlife Movement and Passage.

Beckmann, J. P., A. P. Clevenger, M. P. Huijser, and J. A. Hilty. 2010. Safe Passages. Island Press. Washington, D.C.

FHWA. 2008. Wildlife-Vehicle Collision Reduction Study, Best Practices Manual. http://www.fhwa.dot.gov/environment/hconnect/wvc/index.htm.

FHWA. 2008. Wildlife-Vehicle Collision Reduction Study, Report to Congress. Access at http://www.fhwa.dot.gov/publications/research/safety/08034/index.cfm.

FHWA. 2010. Keeping It Simple: Easy Ways to Help Wildlife Along Roads. http://www.fhwa.dot.gov/environment/wildlifeprotection/index.cfm.

Hardy et al, Western Transportation Institute (Montana State Univ.). 2007. Evaluation of Wildlife Crossing Structures and Fencing on US Highway 93 Evaro to Polson. Phase I: Preconstruction Data Collection and Finalization of Evaluation Plan.

Henke, R.J., P. Cawood-Hellmund and T. Sprunk. 2001. Habitat connectivity study of the I-25 and US 85 corridors, Colorado. Pages 499-508. Proceedings of the International Conference on Ecology and Transportation. Keystone, Colorado, September 24-28, 2001. Center for Transportation and the Environment, North Carolina State University, USA.

Huijser et al (Western Transportation Institute - Montana State University) and Salsman and Wilson (Sensor Technologies and Systems, Inc.). 2006. Animal Vehicle Crash Mitigation Using Advanced Technology, Phase I: Review, Design And Implementation, SPR-3(076). Oregon Dept. of Transportation Research Unit. Report No. FHWA-OR-TPF-07-01.

Jacobson, Sandra, Robert Gubernick and Michael Furniss. “Combining Aquatic and Terrestrial Passage Design into a Continuous Discipline”. In Proceedings of the 2007 International Conference on Ecology and Transportation, edited by C. Leroy Irwin, Debra Nelson, and K.P. McDermott. Raleigh, NC: Center for Transportation and the Environment, North Carolina State University, 2007. pp. 136-142. http://escholarship.org/uc/item/6w6573r8.

Mader, Sharon. 2006. Comparing the Ecological Effects of Linear Developments on Terrestrial Mammals. Wildlands CPR. Missoula, MT. http://www.wildlandscpr.org/biblio-notes/comparing-ecological-effects-linear-developments-terrestrial-mammals.

Minnesota Department of Transportation. 2009. Cost Analysis of Alternative Culvert Installation Practices in Minnesota.

Proceedings of the International Conference on Ecology and Transportation. Access biennial conference proceedings (2003, 2005, 2007, 2009) online at: http://www.icoet.net/.

Transportation Research Board of The National Academies. 2008. Evaluation and the Use and Effectiveness of Wildlife Crossings (NCHRP Report 615).

Trombulak, Stephen and Christopher Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. Conservation Biology 14(1), February 2000, pp. 18-30.

USDA Forest Service. 2002. Management Techniques for Riparian Restorations (Roads Field Guide, Volume II).

USDA Forest Service, Stream-Simulation Working Group. 2008. Stream Simulation: An Ecological Approach To Providing Passage for Aquatic Organisms at Road-Stream Crossings.

USFWS. Unpublished. Wildlife Crossing and Aquatic Organism Passage Issues by State. Contact FWS national Refuge Roads Coordinator.

Weaver, William and Danny Hagans. 1994. Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads.

SM - Stormwater Management

AASHTO. 2008. Above and Beyond: The Environmental and Social Contributions of America's Highway Programs.

Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture, Forest Service, Southern Research Station. 110 p. Access at http://www.unl.edu/nac/bufferguidelines/.

City of Bellevue, WA. 2009. Natural Drainage Practices Maintenance Guidelines. Access at: http://www.bellevuewa.gov/pdf/Utilities/Natural_Drainage_Practices.pdf.

Dashiell and Lancaster. Undated. Road Design Guidelines for Low Impact to Hydrology. Five Counties Salmonid Conservation Program. Weaverville, CA.

Hinman, Curtis. 2005. Low Impact Development: Technical Guidance Manual for Puget Sound. Puget Sound Action Team. Olympia, WA. http://www.psparchives.com/publications/our_work/stormwater/lid/lid_tech_manual05/LID_manual2005.pdf.

Mensing and Chapman. Undated. Conservation Development and Ecological Stormwater Management: An Ecological Systems Approach. Applied Ecological Services. Prior Lake, MN.

Smith, Stacy (Idaho Technology Transfer Center, Univ. of Idaho). 2005. BMP Handbook: Best Management Practices for Idaho Rural Road Maintenance.

Stratus Consulting. 2009. A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds. Prepared for City of Philadelphia Water Department.

US Dept. of Defense. 2004. Unified Facilities Criteria (UFC) - Design: Low Impact Development.

USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

US EPA. 2002. Urban Stormwater BMP Performance Monitoring. Access online at: http://water.epa.gov/scitech/wastetech/guide/stormwater/monitor.cfm.

US EPA. 2010. Green Infrastructure: Managing Wet Weather With Green Infrastructure (website). Access at: http://cfpub.epa.gov/npdes/home.cfm?program_id=298.

USFWS. 2005. Byways to America's Wildest Places: Discover Your National Wildlife Refuges.

Weaver, William and Danny Hagans. 1994. Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Maintaining and Closing Wildland Roads.

WSDOT. Best Management Practices Field Guide for ESA Sec 4(d) Habitat Protection. http://www.wsdot.wa.gov/NR/rdonlyres/A0C3F307-1548-4BED-8C7B-C4A79A788791/0/BMP_Field_Guide.pdf.

Xiao, Qingfu and E. G. McPherson. 2009. Testing a Bioswale to Treat and Reduce Parking Lot Runoff. Access at: http://www.fs.fed.us/psw/programs/cufr/products/psw_cufr761_P47ReportLRes_AC.pdf.

VE - Visitor Experience

BLM. 2007. Visual Resource Management (website). Access at http://www.blm.gov/nstc/VRM/.

Brewer, Jim, et al. 2001. Geometric Design Practices for European Roads. FHWA, Office of International Programs.

California State Parks. Children in Nature Campaign. http://www.parks.ca.gov/?page_id=24914.

Children & Nature Network. Regional Campaigns and Initiatives. http://www.childrenandnature.org/movement/info.

FHWA. 2008. Guide to Promoting Bicycling on Federal Lands. FHWA Pub. No. FHWA-CFL/TD-08-007.

FHWA. 2008. Safe and Aesthetic Design of Urban Roadside Treatments. NCHRP Report 612. www.TRB.org.

National Park Service. NPS Partnerships Case Studies (Transportation). http://www.nps.gov/partnerships/cs_type.htm#anchor19.

National Wildlife Federation. 2010. Be Out There Campaign. http://www.nwf.org/beoutthere/.

New Mexico Department of Transportation. 2006. Architectural and Visual Quality Design Guidelines for Context Sensitive Design and Context Sensitive Solutions.

ODOT (Oregon Department of Transportation). 2006. Roadside Development Design Manual - Guidelines for Visual Resource Management, Landscaping, and Hardscaping (DRAFT).

Transportation Research Board of The National Academies. 2008. Human Factors Guidelines for Road Systems (NCHRP Report 600B).

US Access Board. Guidelines and Standards (ABA, ADA, etc). http://www.access-board.gov/gs.htm.

USDA Forest Service. 1995 (rev. 2000). Landscape Aesthetics: A Handbook for Scenery Management. AH-701.

USDA Forest Service. 2002. Scenic Byways: A Design Guide for Roadside Improvements.

USDA Forest Service. 2006. Accessibility Guidebook for Outdoor Recreation and Trails. Publication number 0623-2801-MTDC.

USDA Forest Service. 2010. Discover the Forest campaign. http://www.discovertheforest.org/index.php.

USDOT Federal Transit Administration. 2010. Transit in Parks Program (5230). http://www.fta.dot.gov/funding/grants/grants_financing_6106.html.

Washington State Parks. 2008. No Child Left Inside campaign. http://www.parks.wa.gov/NoChildLeftInside/.

Additional Resources

Anderson, Linda. 2005. Highway Crossing Structures for Metropolitan Portland's Wildlife. Portland State University. Portland, OR.

Bates, Ken. 2003. Design of Road Culverts for Fish Passage. Washington Dept. of Fish and Wildlife.

Cosgrove and Orrick. 2004. The Future that Never Was: Lessons from Visions of Transportation.

FHWA. 2008. Consistency In Safety-Related Design Decisions on Federal Lands Highway Jobs. FHWA Pub. No.

FHWA and USFWS. 2005. Guidance on the Federal Lands Highway Refuge Roads Program.

Green Infrastructure Wiki. 2010. Access at: http://www.greeninfrastructurewiki.com/.

Iowa State University Dept. of Civil Engineering and Minnesota Dept. of Transportation. 2005. Economics of Upgrading an Aggregate Road.

Marriott, Paul Daniel. 1998. Saving Historic Roads: Design and Policy Guidelines. Preservation Press and John Wiley & Sons, Inc.

Maryland National Capital Park and Planning Commission and The Montgomery County Department of Parks and Planning. 1996. Rustic Roads Functional Master Plan.

National Park Service. 1984. Park Road Standards.

Otto, Sandra. 2000. "Environmentally Sensitive Design of Transportation Facilities." In Journal of Transportation Engineering, 126(5) Sept/Oct, pp. 363-366.

Regional Road Maintenance Technical Working Group (Washington) Regional Road Maintenance Endangered Species Act Program Guidelines.

Robson, Sara, and James Kingery. 2006. Idaho Native Plants for Roadside Restoration and Revegetation Programs. Idaho Transportation Department.

USFWS. 2008. Project List Meeting Report: Long-Range Transportation Plan for the US Fish and Wildlife Service Lands in Region 1. Report prepared by PBS&J.

Appendix B: Glossary

Abbreviations

ABA Architectural Barriers Act

ABAAS Architectural Barriers Act Accessibility Standards

ADA Americans with Disabilities Act

ASCE American Society of Civil Engineers

BGEPA Bald and Golden Eagle Protection Act

BLM Bureau of Land Management

CCP Comprehensive Conservation Plan

CFR Code of Federal Regulations

DCR Division of Diversity and Civil Rights (FWS Region 1)

EE Environmental Education

ES Ecological Services

ESA Endangered Species Act

FHWA Federal Highway Administration

FWCA Fish and Wildlife Coordination Act

FWS U.S. Fish & Wildlife Service (also Service, USFWS)

GIS Geographic Information System

LID low impact development

LOS level of service

LRTP Long Range Transportation Plan

MBTA Migratory Bird Treaty Act

NDS natural drainage system

NEPA National Environmental Policy Act

NWR National Wildlife Refuge (also Refuge).

NWRS National Wildlife Refuge System

ODOT Oregon Department of Transportation

R1 Region 1 of the FWS (HI, ID, OR, WA, Pacific Islands)

ROW Right-of-way

SAMMS Service Asset Maintenance Management System

USDA United States Department of Agriculture

USFS United States Forest Service

VMT Vehicle miles traveled

WDFW Washington State Department of Fish and Wildlife

WSDOT Washington State Department of Transportation

WSPRC Washington State Parks and Recreation Commission

WVC Wildlife-vehicle collisions

Definitions

Adaptive Management. Refers to a process in which policy decisions are implemented within a framework of scientifically driven experiments to test predictions and assumptions inherent in management plan. Analysis of results help managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

Alternative. Alternatives are different means of accomplishing Refuge purposes and goals and contributing to the System mission (draft Service Manual 602 FW 1.5). The no action alternative is the manner in which the refuge is currently managed, while the action alternatives are all other alternatives.

Bald and Golden Eagle Protection Act (Federal). This law makes it illegal for anyone to take (as defined therein) a bald or golden eagle, or their parts, nests, or eggs except as authorized under a permit. Since this law extends protection to eagle nests, it may come into play during the construction and maintenance of transportation infrastructure.

Biological Diversity (also Biodiversity). The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (USFWS Manual 052 FW 1. 12B). The System's focus is on indigenous species, biotic communities, and ecological processes.

Biological Integrity. Biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities (NWRS Biological integrity policy).

Compatible Use. A wildlife-dependent recreational use or any other use of a Refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the Mission of the System or the purposes of the refuge (Service Manual 603 FW 3.6). A compatibility determination supports the selection of compatible uses and identifies stipulations or limits necessary to ensure compatibility.

Comprehensive Conservation Plan. A document that describes the desired future conditions of the Refuge, and provides long-range guidance and management direction for the Refuge manager to accomplish the purposes of the refuge, contribute to the mission of the System, and to meet other relevant mandates (Service Manual 602 FW 1.5).

Contaminants (also Environmental Contaminants). Chemicals present at levels greater than those naturally occurring in the environment resulting from anthropogenic or natural processes that potentially result in changes to biota at any ecological level (USGS, assessing EC threats to lands managed by USFWS). Pollutants that degrade other resources upon contact or mixing (Adapted from Webster's II).

Cooperative Agreement. This is a simple habitat protection action, in which no property rights are acquired. An agreement is usually long term but can be modified by either party. They are most effective in establishing multiple use management of land. An example would be a wildlife agreement on a Corps reservoir.

Context Sensitive Solutions (CSS). A theoretical and practical approach to transportation decision-making and design that takes into consideration the communities and lands through which streets, roads, and highways pass ("the context"). CSS seeks to balance the need to move vehicles and other transportation modes efficiently and safely with other desirable outcomes, including historic preservation, environmental goals such as wildlife and habitat conservation and the creation of vital public spaces.

Critical Habitat. Areas that are essential to the conservation of ESA listed species.

Cultural Resources. The physical remains, objects, historic records and traditional lifeways that connect us to our nation's past (USFWS, Considering Cultural Resources).

Disturbance. Significant alteration of habitat structure or composition. May be natural (e.g. fire) or human-caused events (e.g. aircraft overflights).

Ecosystem. A dynamic and interrelating complex of plant and animal communities and their associated non-living environment.

Ecosystem Management. Management of natural resources using system-wide concepts to ensure that all plants and animals in ecosystems are maintained at viable levels in native habitats and that basic ecosystem processes are perpetuated indefinitely.

Environmental Assessment. A concise public document, prepared in compliance with the National Environmental Policy Act (NEPA), that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether an environmental impact statement must be prepared, or a finding of no significant impact can be issued (40 CFR 1508.9).

Endangered Species Act (Federal). The purpose of the ESA is to protect and recover endangered and threatened species and the ecosystems upon which they depend. Under the ESA, species may be listed as either endangered or threatened and critical habitat may be designated.

ESA Listed Species. A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range (endangered) or likely to become so within the foreseeable future (threatened).

Environmental Education Facility. A building or site with one or more classrooms or teaching areas and environmental education resources to accommodate groups of students.

Fish and Wildlife Coordination Act (Federal). This law provides the basic authority for the FWS to evaluate impacts to all fish and wildlife from proposed water resource development projects. This law may come into play for transportation projects that involve effects to a water body(ies).

Gap Analysis. Analysis done to identify and map elements of biodiversity that are not adequately represented in the nation's network of reserves. It provides an overview of the distribution and conservation status of several components of biodiversity, with an emphasis on vegetation and terrestrial vertebrates (Cassidy et al.1997).

Goal. Descriptive, open-ended and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (Draft Service Manual 620 FW 1.5).

Green infrastructure. A concept and approach in which natural assets are managed and/or designed to provide multiple ecosystem and human services, including services such as stormwater management, flood prevention, carbon sequestration, and habitat. Green infrastructure includes natural drainage systems (NDS) and may be applied as a tool in achieving low impact development (LID).

Habitat. Suite of existing environmental conditions required by an organism for survival and reproduction. The place where an organism typically lives.

Habitat Connectivity (Also Landscape Connectivity). The arrangement of habitats that allows organisms and ecological processes to move across the landscape; patches of similar habitats are either close together or linked by corridors of appropriate vegetation/habitat. The opposite of fragmentation (Turnbull NWR Habitat Management Plan).

Habitat Management Plan. A plan that guides Refuge activities related to the maintenance, restoration, and enhancement of habitats for the benefit of wildlife, fish, and plant populations.

Habitat Restoration. Management emphasis designed to move ecosystems to desired conditions and processes and/or to healthy ecosystems.

Historic Conditions. Composition, structure and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human related changes to the landscape (NWRS Biological integrity policy).

Hydrologic influence. Having an effect on water quality and quantity.

Hydrology. A science dealing with the properties, distribution and circulation of water on and below the earth's surface and in the atmosphere (yourdictionary.com).

Indicator. Something that serves as a sign or symptom (Webster's II).

Interpretation. A teaching technique that combines factual information with stimulating explanation (yourdictionary.com). Frequently used to help people understand natural and cultural resources.

Interpretive Trail. A trail with informative signs, numbered posts that refer to information in a brochure, or where guided talks are conducted for the purpose of providing factual information and stimulating explanations of what visitors see, hear, feel, or otherwise experience while on the trail.

Landform. A natural feature of a land surface (yourdictionary.com).

Landscape Linkages. Landscape features linking areas of similar habitat. Plants and smaller animals are able to use landscape linkages to move between larger landscape blocks over a period of generations.

Landscape Ecology. The science and study of the relationship between spatial pattern and ecological processes on a wide variety of landscape scales and organizational levels.

Low Impact Development (LID). A stormwater management strategy that emphasizes conservation and use of existing natural site features integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns. (LID Guidance Manual for Puget Sound).

Maintenance. The upkeep of constructed facilities, structures and capitalized equipment necessary to realize the originally anticipated useful life of a fixed asset.

Maintenance includes preventative maintenance; cyclic maintenance; repairs; replacement of parts, components, or items of equipment, periodic condition assessment; periodic inspections, adjustment, lubrication and cleaning (non-janitorial) of equipment; painting, resurfacing, rehabilitation; special safety inspections; and other actions to assure continuing service and to prevent breakdown.

Mesh Size. The average area or diameter of the polygons enclosed by a road network, as in a fishnet; it is proportional to road density but focuses on the enclosed parcels rather than the roads (Forman 2003).

Migratory Bird Treaty Act (Federal). This law makes it illegal for anyone to take any migratory bird, or the parts, nests, or eggs of migratory birds, except under the terms of a valid permit issued pursuant to federal regulations. This law can come into play during the maintenance and removal of transportation infrastructure as well as during the construction of new structures.

Mission Statement. Succinct statement of a unit's purpose and reason for being.

Monitoring. The process of collecting information to track changes of selected parameters over time.

National Environmental Policy Act of 1969 (NEPA). Requires all Federal agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (from 40 CFR 1500).

National Register of Historic Places. The Nation's master inventory of known historic properties administered by the National Park Service. Includes buildings, structures, sites, objects and districts that possess historic, architectural, engineering, archeological, or cultural significance at the national, state and local levels.

National Wildlife Refuge (also Refuge). A designated area of land, water, or an interest in land or water within the System.

National Wildlife Refuge System (NWRS; also System). Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction; all lands, waters and interests therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; games ranges; wildlife management areas; or waterfowl production areas.

Native. With respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem (NWRS Biological integrity policy).

Natural Drainage System (NDS). A set of stormwater management features using plants and specialized soils that slow and infiltrate stormwater and can help remove pollutants through filtration and bioremediation. These features—such as open, vegetated swales, stormwater cascades and small rain gardens or wet ponds—mimic or restore natural functions impeded by development. In contrast to pipes and vaults, these systems increase in functional value over time.

Non-Consumptive Recreation. Recreational activities that do not involve harvest, removal or consumption of fish, wildlife or other natural resources.

Noxious Weed. A plant species designated by Federal or State law as generally possessing one or more of the following characteristics: aggressive or difficult to manage; parasitic; a carrier or host of serious insect or disease; or non-native, new, or not common to the United States, according to the Federal Noxious Weed Act (PL 93-639), a noxious weed is one that causes disease or has adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the United States and to the public health.

Nutrient Loading. The presence of nutrients, such as nitrogen and phosphorus, in waterways insufficient amounts to cause effects such as algal blooms and oxygen depletion, with potentially lethal effects on fish and wildlife species.

Operations. Activities related to the normal performance of the functions for which a facility or item of equipment is intended to be used. Costs such as utilities (electricity, water, sewage) fuel, janitorial services, window cleaning, rodent and pest control, upkeep of grounds, vehicle rentals, waste management and personnel costs for operating staff are generally included within the scope of operations.

Outreach. The process of providing information to the public on a specific issue through the use of the media, printed materials and presentations.

Plant Community. An assemblage of plant species unique in its composition that occurs in particular locations, under particular influences, which reflect or integrate the environmental influences on the site, such as soils, temperature, elevation, solar radiation, slope, aspect and rainfall.

Preferred Alternative. This is the alternative determined (by the decision maker) to best achieve the Refuge purpose, vision and goals; that best contributes to the System mission and addresses the significant issues; and that is consistent with principles of sound fish and wildlife management.

Priority Public Uses. Hunting, fishing, wildlife observation and photography, environmental education and interpretation were identified by the National Wildlife Refuge system Improvement Act of 1997 as the six ("Big Six") priority public uses of the National Wildlife Refuge System.

Public. Individuals, organizations, and groups outside the planning team, including officials of Federal, State, and local government agencies, Indian tribes and foreign nations. It includes those who may or may not have indicated an interest in Service issues and those who may be affected by Service decisions.

Refuge Purpose(s). The purpose(s) specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, a refuge unit, or refuge subunit (Draft Service Manual 602 EW 1.5).

Restoration. The act of bringing back to a former or original condition (Webster's II).

Riparian. An area or habitat that is transitional from terrestrial to aquatic ecosystems, including streams, lakes, wet areas, and adjacent plant communities and their associated soils which have free water at or near the surface; an area whose components are directly or indirectly attributed to the influence of water; and of or relating to a river. Specifically applied to ecology, "riparian" describes the land immediately adjoining and directly influenced by streams. For example, riparian vegetation includes any and all plant life growing on the land adjoining a stream and directly influenced by the stream.

Road Density. The average total road length per unit area of landscape (i.e. kilometers per square km, or miles per square mile) (Forman 2003).

Road-Effect Zone. The zone of influence of a roadway into the surrounding areas. Distance depends upon the type of effect and site conditions (Forman 2003; see graphic, p. 308).

Roadway. The suite of typical improvements associated with a vehicle-focused transportation project. This extends from the centerline of an existing or proposed road outward, to include associated infrastructure components such as paving, utilities, grading and planting. Roadway also refers here to other facilities and infrastructure commonly associated with vehicular transportation, such as parking, visitor contact facilities and pullouts. From an ecological perspective, the roadway conceptually includes impacts such as habitat fragmentation, habitat disturbance, pollution, and aquatic and terrestrial species conflicts.

Strategy. A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (Service Manual 602 FW 1.5).

Viewpoint. A designated point that provides an opportunity to see wildlife or habitats of interest. The point may or may not be "supported" with an interpretive sign. Usually the viewpoint is supported by a pullout or a parking area.

Visitor Center. A building with staff that provides visitors with interpretation, education and general information about the natural and cultural resources of the Refuge and the local area.

Visitor Contact Point or Center. A kiosk or other location where visitors may go to learn about Refuge resources, facilities, trails, etc.

Vision Statement. A concise statement of the desired future condition of the planning unit, based primarily upon the System mission, specific Refuge purposes and other relevant mandates (Service Manual 602 FW 1.5).

Watershed. The region or area drained by a river system or other body of water (Webster's II).

Wetlands. Transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water at some time each year (Service Manual 660 FW 2).

- Permanent wetland - a wetland basin or portion of a basin that is covered with water throughout the year in all years except extreme drought. Typically, the basin bottom is vegetated with submerged aquatic plant species, including milfoil, coontail and pondweeds.

- Semi-permanent wetland - a wetland basin or portion of a basin where surface water persists throughout the growing season of most years. Typical vegetation is composed of cattails and bulrushes.

- Seasonal wetland - a wetland basin or portion of a basin where surface water is present in the early part of the growing season but is absent by the end of the season in most years. Typically vegetated with sedges, rushes, spikerushes or burreed.

Wildlife-Dependent Recreation. Hunting, fishing, wildlife observation and photography, environmental education and interpretation. These are also referred to as the priority public uses of the National Wildlife Refuge System or "Big Six".

U.S. Department of the Interior
U.S. Fish & Wildlife Service

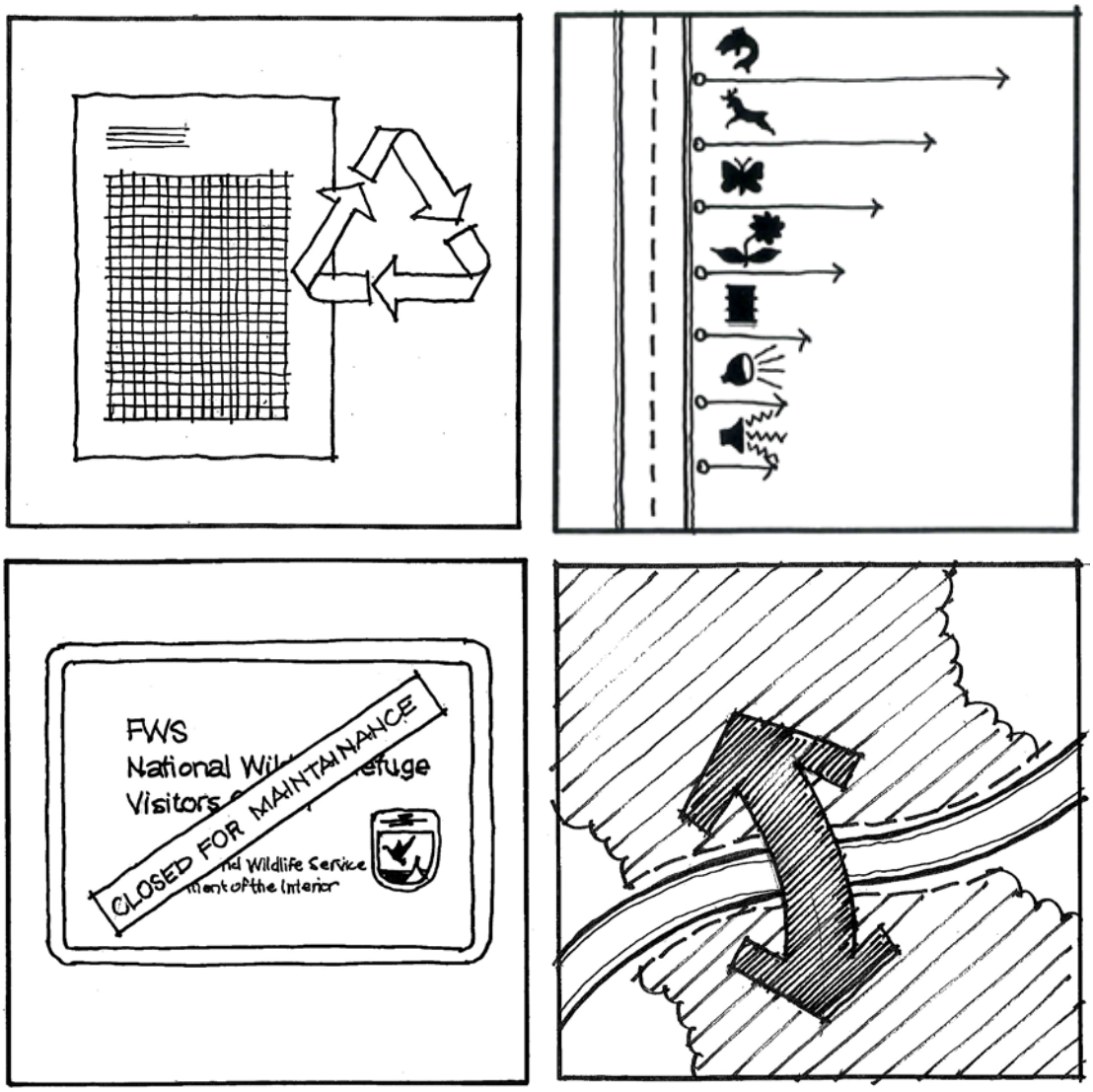
http://www.fws.gov

August 2012

U.S. Fish & Wildlife Service

Roadway Design Guidelines

Instructions



Introduction and Background on the FWS Roadway Design Guidelines

Purpose and Authority

The purpose of this document is to provide project teams involved with transportation projects on FWS managed lands with instructions on how to document the use of the FWS Roadway Design Guidelines (Guidelines) on a project. FWS policy requires that the Guidelines are used on all FWS transportation projects.

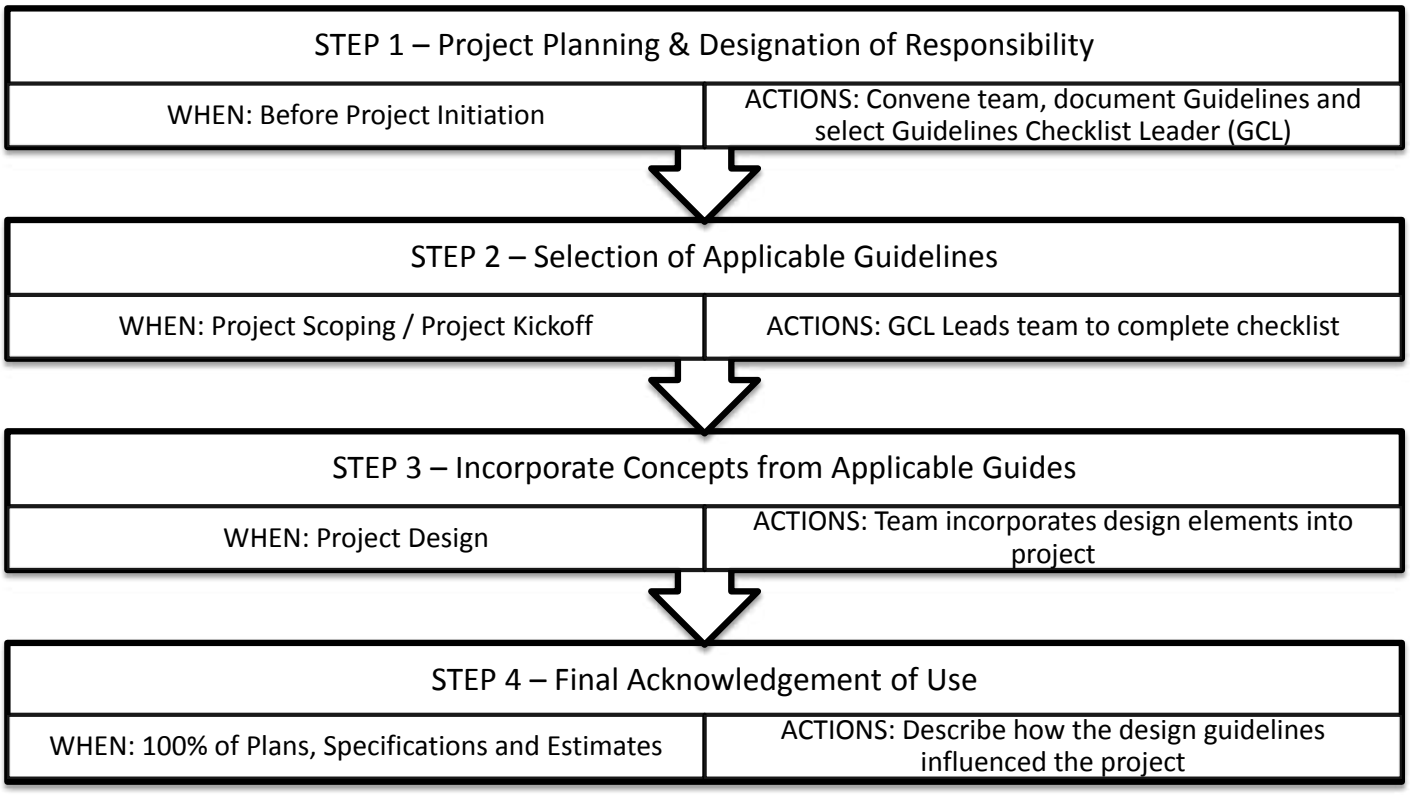
FWS policy requires that the Roadway Design Guidelines are used on all FWS transportation projects. Depending on the project delivery method selected by the FWS Regional Transportation Coordinator, individual FWS Project Management Plans or FHWA Project Agreements, Project Charters, and Project Management Plans will include a statement requiring the use of the FWS Roadway Design Guidelines referencing the specific procedures for use as outlined in these instructions.

Steps and Introduction to the Guidelines

The FWS Roadway Design Guides highlight state of the art ecological, planning, design and engineering considerations for roadway projects that heed both the significant benefits and impacts these projects present. Roadway projects on FWS managed lands should conform to planning and design criteria that have been established to support the FWS mission. The FWS Roadway Design Guides document includes 30 individual project planning and design guidelines, organized around 6 major themes.

The project checklist serves as an overview of these guidelines, and has been provided as a tool to assist in project planning, design and implementation. Using these guidelines is not an end in itself. Rather, the guidelines are a starting point from which to explore solutions to implement a roadway project of the highest standard. As such, projects funded through the FWS Transportation Program will go through a sign-off process at several stages of project development to ensure guideline accountability.

Please refer to the Guidelines document for more detailed information or contact your FWS Transportation Program Regional Coordinator.



Procedure for Using the Guidelines

Step 1 - Project Planning & Designation of Responsibility

Project Planning

The FWS Regional Transportation Coordinator will ensure that a statement requiring the use of the FWS Guides is included in applicable project planning documentation, such as FWS Project Management Plans or FHWA Project Charters, Project Agreements, and Project Management Plans. The following example statement has been provided for use in those documents:

"FWS policy requires that the Roadway Design Guidelines are used on all FWS transportation projects. A copy of the USFWS Roadway Design Guidelines along with instructions for their use is available from the USFWS Regional Transportation Coordinator."

Designation of Responsibility

The FWS Regional Transportation Coordinator will designate a Guidelines Checklist Leader (GCL) for the project. This action should occur after a project is identified for preliminary engineering or schematic design and prior to project scoping or any related project specific investigations or studies beginning. The GCL may be any of the following project team members below. GCL responsibilities may not be designated to contractors or sub-contractors working for FHWA or FWS.

List of Potential Candidates for Project GCL Assignment:

- FWS Transportation Coordinator
- FHWA Program Manager
- FHWA Project Manager
- FHWA Project Designer
- FWS Engineering Project Manager
- FWS Project Leader / Deputy Project Leader
- FWS Refuge Manager
- FWS Station Biologist
- FWS Station Visitor Services Manager
- FWS Project Landscape Architect or Professional Engineer

Procedure for Using the Guidelines

Step 2 - Selection of Applicable Guidelines

The GCL should review the FWS guidelines in order to understand how they will relate to the project ahead. The GCL will present the guidelines and their purpose to the project team during a project's scoping phase. During project scoping, the GCL will complete a project checklist with the team. Specific Instructions for the GCL for Completing the Checklist:

- Become familiar with each guideline in advance of project meetings.
- Review the checklist as a group (i.e. Regional Transportation Coordinator, FWS station staff, FHWA staff, etc.).
- Decide which guides are applicable to the project.
- For guidelines that are applicable, discuss why they are applicable. Brainstorm specific response to applicable guidelines that will occur during the planning and design phase to ensure that the subject guideline was adequately considered.
- Briefly document each applicable guideline to be referenced and a proposed response on the Selection of Applicable Guidelines section of the Project Acknowledgements document.

*If the project requires a scoping field visit by project team members, it is recommended that the GCL completes the above activities at this time. If a field visit is not required, the GCL should convene a meeting or conference call to specifically discuss the Guidelines with the project team.

Step 3 - Incorporate Concepts From Applicable Guidelines Into the Project Design

Once applicable guidelines and related project specific responses have been documented; it is the responsibility of the GCL to work with project team members to ensure that information from each applicable guideline is being adequately considered. The GCL will review submittals at each deliverable milestone to ensure specific design responses are reflective of the guidelines.

Step 4 - Final Acknowledgement of Use

At the conclusion of the design phase 100% PS&E should reflect the spirit of the Guidelines and include specific design responses to applicable guidelines. If this has occurred at final design review, the GCL should complete the statement of use section and route to the FWS Regional Transportation coordinator for a signature.

Roles and Responsibilities on the Project Team

Regional FWS Transportation Coordinator

Once a project has been identified and is ready for project scoping, the Regional FWS Transportation Coordinator will identify and assign a member of the project team to serve as the Guidelines Checklist Leader. The Transportation Coordinator has authority and oversight of all the procedures for use as discussed in these instructions.

Guidelines Checklist Leader (GCL)

The Guidelines Checklist Leader is the responsible team member for monitoring and completing the Checklist. The GCL is responsible for ensuring that all project team members are aware of expectations and specific design goals, strategies and outcomes that result from the consideration of applicable Guidelines identified and documented during project scoping. The GCL is also the responsible team member for routing the completed acknowledgements back to the Regional Transportation Coordinator.

FWS Project Leader or Designee

Ensures that the GCL and Project team have adequately considered applicable design guidelines based on their knowledge of the project and field station needs. FWS National Transportation Coordinator Ensures that Regional Transportation Coordinators have completed all sections of the Project Acknowledgements document prior to the obligation of FWS Transportation funds for project construction.

FHWA Program and Project Manager

On projects where delivery will occur via FHWA, the FHWA program manager and FHWA project manager will insure that the GCL and project team have adequately considered applicable design guidelines based on their knowledge of the project and field station needs.

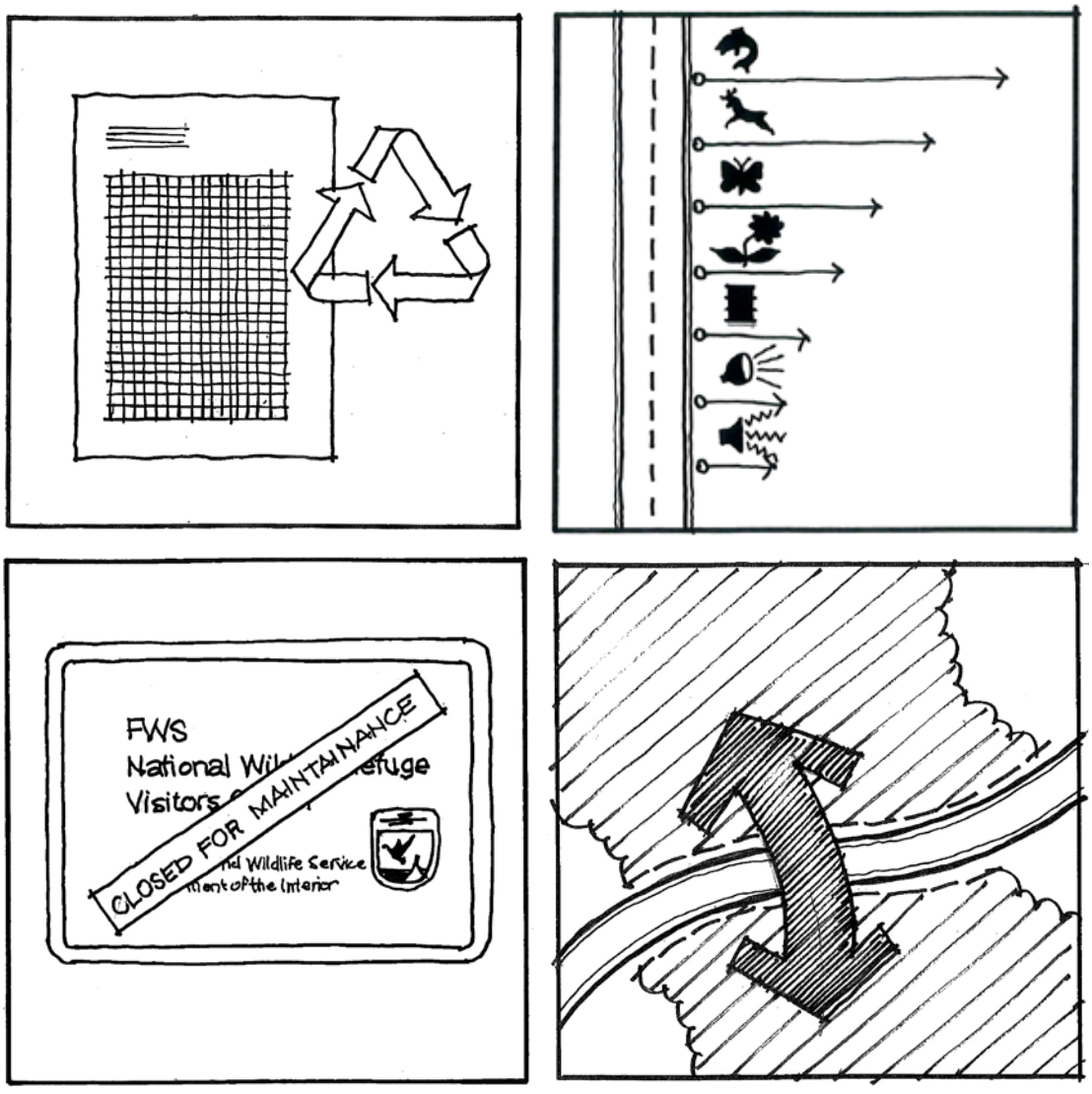
Project Delivery Leader

Staff / Project Manager responsible for managing the scope, schedule and budget of the project. Ensures that the project is fully completed and compliant with all applicable FWS standards.

U.S. Fish & Wildlife Service

Roadway Design Guidelines

Project Acknowledgements



Project Information

To be Completed Prior to Project Scoping

Region: Region 1 - Pacific

Project Location: Field Station Name and Unit

Project Title: Name of Project

Project Funding Information: Source(s)

Project Delivered By: Agency (i.e. FHWA, FWS ENG, FWS FIELD STATION, ETC.)

FWS Asset Number: FWS Route Number:

Step 1 - Designation of Responsibility

The Guidelines Checklist Leader (GCL) for this Project is:

GCL Contact Info:

Agency:

Address:

Phone:

Email:

GCL Signature and Date:

Project Delivery Leader Signature and Date:

Regional Transportation Coordinator Signature and Date:

Step 2 - Selection of Applicable Guidelines [LE]

Landscape Ecology:

The study of the relationship between spatial patterns and ecological processes on a wide spectrum of scales.

To be Completed Prior to Design Work Beginning

I acknowledge that a project checklist has been completed and distributed to all members of the project team and will include the following specific considerations per selected guideline:

☐ **LE - 1: Improve habitat connectivity**

Notes and Comments

☐ **LE - 2: Reduce impacts to wildlife and habitat**

☐ **LE - 3: Understand hydrologic processes of regional landscape**

☐ **LE - 4: Respond to intrinsic qualities of regional landscape**

☐ **LE - 5: Address climate change**

Step 2 - Selection of Applicable Guidelines [PC]

Planning Context:

Consideration of the project in the broader contexts of: engineering, policy, projected usage, practical alternatives and costs.

To be Completed Prior to Design Work Beginning

I acknowledge that a project checklist has been completed and distributed to all members of the project team and will include the following specific considerations per selected guideline:

☐ **PC - 1: Review relevant planning, policy and regulatory information**

Notes and Comments

☐ **PC - 2: Define level of service for the project**

☐ **PC - 3: Evaluate multiple siting and alignment alternatives**

☐ **PC - 4: Assess full costs and impacts of transportation system**

☐ **PC - 5: Communicate with team and stakeholders**

Step 2 - Selection of Applicable Guidelines [DE]

Design and Engineering:

Methods and materials that minimize the environmental impacts of the transportation facility and associated construction work.

To be Completed Prior to Design Work Beginning

I acknowledge that a project checklist has been completed and distributed to all members of the project team and will include the following specific considerations per selected guideline:

☐ **DE - 1: Preserve and restore native vegetation and other natural resources**

Notes and Comments

☐ **DE - 2: Consider and plan for invasive species management**

☐ **DE - 3: Minimize cut and fill with existing landscape**

☐ **DE - 4: Consider road geometries for lower speeds, safety and alertness**

☐ **DE - 5: Consider construction impacts and best practices**

☐ **DE - 6: Consider range and sources of materials for sustainable construction**

☐ **DE - 7: Consider maintenance**

Step 2 - Selection of Applicable Guidelines [OP]

Organism Passage:

Ensuring that fish and wildlife can move across (either over or under) transportation infrastructure to maintain continuity of habitat

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To be Completed Prior to Design Work Beginning

I acknowledge that a project checklist has been completed and distributed to all members of the project team and will include the following specific considerations per selected guideline:

☐ **OP - 1: Develop your corridor plan for crossing**

Notes and Comments

☐ **OP - 2: Provide and enhance aquatic organism crossings**

☐ **OP - 3: Provide and enhance terrestrial organism crossings**

☐ **OP - 4: Evaluate the need for wildlife fencing and other guiding features**

☐ **OP - 5: Consider warning and other safety systems for drivers**

Step 2 - Selection of Applicable Guidelines [SM]

Stormwater Management:

Manage and abate the volume, velocity and water quality of runoff from impervious surfaces during and after weather events.

To be Completed Prior to Design Work Beginning

I acknowledge that a project checklist has been completed and distributed to all members of the project team and will include the following specific considerations per selected guideline:

☐ **SM - 1: Buffer habitat from polluted runoff**

Notes and Comments

☐ **SM - 2: Protect habitat from erosive flows and flooding**

☐ **SM - 3: Monitor and maintain stormwater facilities**

☐ **SM - 4: Promote stewardship of aquatic resources**

Step 2 - Selection of Applicable Guidelines [VE]

Visitor Experience:

Roadways and other facilities should enhance the visitation experience and highlight the natural resources surrounding them.

To be Completed Prior to Design Work Beginning

I acknowledge that a project checklist has been completed and distributed to all members of the project team and will include the following specific considerations per selected guideline:

☐ **VE - 1: Preserve and highlight scenic value**

Notes and Comments

☐ **VE - 2: Promote and facilitate multiple modes of transportation**

☐ **VE - 3: Comply with accessibility standards and guidelines**

☐ **VE - 4: Facilitate compatible wildlife dependent recreation and education**

I acknowledge that all pages of the Selection of Applicable Guidelines are complete.

GCL Signature and Date:

Project Delivery Leader Signature and Date:

Regional Transportation Coordinator Signature and Date:

Step 3 - Incorporate Concepts from Applicable Guides Into Project Design

To be Completed During Project Design

It is the responsibility of the Guidelines Checklist Leader to work with project team members to ensure that information from each applicable guideline is being adequately considered. The GCL will review submittals at each deliverable milestone to ensure specific design responses are reflective of the guidelines.

Completion of this effort is documented during step 4.

Step 4 - Final Acknowledgement of Use

To be Completed Prior to Obligation of Construction Funds

Briefly describe how the use of the FWS Roadway Design Guidelines influenced this project:

I acknowledge that the project team considered and discussed applicable concepts presented in the FWS Roadway Design Guidelines during the course of designing this project which is now ready for construction. I acknowledge that the checklist is fully complete and therein will deliver a transportation improvement consistent with the mission of USFWS.

GCL Signature and Date:

Project Delivery Leader Signature and Date:

Regional Transportation Coordinator Signature and Date:

FWS Transportation Program Safety Analysis Toolkit

Prepared for:

U.S. Fish and Wildlife Service and the Federal Highway Administration

TABLE OF CONTENTS

FWS TRANSPORTATION PROGRAM SAFETY ANALYSIS TOOLKIT

ACRONYMS

FWS TRANSPORTATION PROGRAM SAFETY ANALYSIS TOOLKIT

DOT	Department of Transportation
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
FLH	Federal Lands Highway
FWS	Fish and Wildlife Service
FWS-IMARS	FWS Incident Management and Analysis Reporting System
MAP-21	Moving Ahead for Progress in the 21st Century Act
NHTSA	National Highway Traffic Safety Administration
RATE	Regional Alternative Transportation Evaluation
RIP	Roadway Inventory Program
RSA	Road Safety Audit
SMIS	Safety Management Information System
SMS	Safety Management System

1. INTRODUCTION

The Fish and Wildlife Service (FWS) and Federal Highway Administration (FHWA) work closely together to continually improve safety on the transportation system that serves the National Wildlife Refuges and Fish Hatcheries. The FWS and FHWA have developed a Safety Management System (SMS) that can be used to identify, prioritize, mitigate, and track the performance of transportation safety investments for the FWS transportation system. To complement the SMS and provide tools for analyzing safety issues within the FWS transportation system, the Safety Analysis Toolkit was developed. The Toolkit includes discussions on the roles and responsibilities of partner agencies, the safety analysis tools that can be used to study safety issues, and the steps for implementing countermeasures that have been identified.

Ash Meadows National Wildlife Refuge Source: USFWS

1.1 Purpose

The Safety Analysis Toolkit will support the FWS efforts to identify, analyze, and mitigate safety issues on the FWS transportation system. The Toolkit presents a safety analysis process that emphasizes the strong coordination that should occur between FWS Field Station Managers and Staff, FWS Regional Transportation Coordinators, and the FHWA Safety Discipline Team. Each of these partners plays an important role in identifying, analyzing, and developing countermeasures to address safety issues in National Wildlife Refuges and Fish Hatcheries.

The information in the Safety Analysis Toolkit is also intended to assist the FWS with developing a consistent procedure for determining the appropriate safety analysis type and to encourage a consistent level of safety analysis across the FWS. The Toolkit provides a description of a number of types of safety analysis tools that should be carefully considered when analyzing a safety issue. It provides guidance on what type of analysis to use and discusses the basic steps involved with each. Every field station and every safety issue will be different and at times none of the specific study types discussed will be a perfect fit for the analysis of a safety issue. The Toolkit encourages using a combination of studies as needed to address safety issues when appropriate.

The safety analysis process presented in this Toolkit is a key step in meeting the FWS goal of eliminating crashes on the FWS transportation system. The safety analysis process emphasizes identification of safety issues before crashes occur and promotes coordination between FWS and FHWA to work closely together to analyze safety issues and identify countermeasures if required.

1.2 Relationship to Safety Management System

The SMS establishes an annual process to collect and store safety data in order to identify transportation safety issues at FWS field stations. While some of the data collected in the SMS will include crash reports or other objective information from traffic and safety studies, much of the data collected in the SMS is subjective data compiled from surveys and other input from field stations. Regardless of the source of a safety issue identified in the SMS, the safety analysis process discussed in the Safety Analysis Toolkit can be used to move the safety issues identified in the SMS forward by providing a process to determine if a safety study is needed an if so, what type of safety study is appropriate.

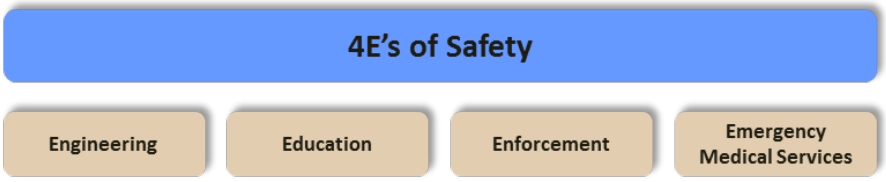
When a safety issue originates from a field station, the SMS database should be reviewed to determine if additional information is available in the database that is related to the safety issue. For example, the SMS database may have a record of a crash from the FWS Incident Management and Analysis Reporting System (FWS-IMARS) at the same location, or concerns about the location may have been noted on past Regional Alternative Transportation Evaluation (RATE) surveys. This type of information would be valuable when determining if a study is needed to address the safety issue.

The SMS database will also be available to the FWS Regional Transportation Coordinators and the FWS Field Station Manager. As additional safety data is added the SMS database each year, it should be periodically reviewed to determine if there are safety issues noted in the databases that should be considered for a safety study.

1.3 How to Use this Toolkit

As stated earlier, the Safety Analysis Toolkit is intended to assist the FWS with developing a consistent procedure for determining the appropriate safety analysis type and to encourage a consistent level of safety analysis across the FWS. The Safety Analysis Toolkit should primarily be used as a guideline in selecting the type of safety analysis tool to be used for safety issues that appear to need further analysis. Use of the process and guidance provided in the Safety Analysis Toolkit should allow for more consistency in how safety issues are identified for analysis as well as more consistency in which type of analysis is used.

It is important to note that the Safety Analysis Toolkit provides guidance but does not provide requirements on which safety issues to study or which type of study to select. The final decisions should be based on the expertise, experience, and local knowledge of FWS, FHWA, and other partner agency staff members. When safety issues are identified at the field station level, it is strongly encouraged that as a first step the FWS Field Station Managers and Staff contact the FWS Regional Transportation Coordinators, and that the FHWA Safety Discipline Team also be brought in to partner with FWS.

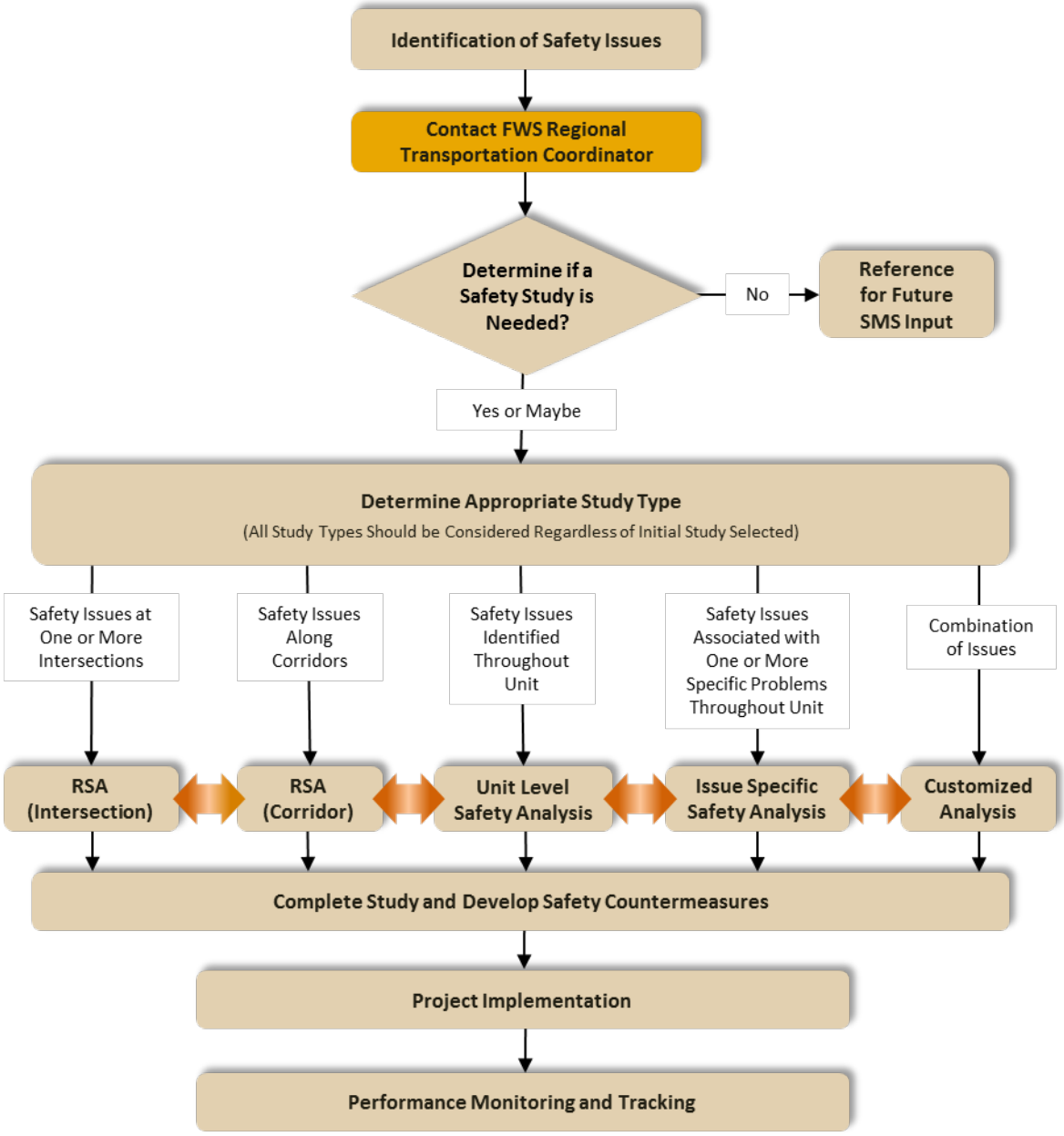


The Safety Analysis Toolkit should be considered in conjunction with the Four E's of Safety: engineering, education, enforcement, and emergency medical services. While many of the safety analysis studies may be inclined to consider engineering solutions for safety issues, it is important to also consider how education, enforcement, and emergency medical services may be used to address safety issues as well. These can often provide very cost effective solutions and may address a safety issue as well or better than an engineering solution. Very often the best solution may lie in some combination of two or more of the Four E's of Safety and all four should be considered as part of every safety analysis.

2. SAFETY ANALYSIS PROCESS

The FWS and FHWA Federal Lands Highway (FLH) have defined a general process that should be considered when safety issues are identified on FWS transportation facilities. The process relies on a strong partnership between FWS Field Station Manager, FWS Regional Transportation Coordinators, and the FHWA FLH Safety Discipline Team. An overview of the process is presented in the figure below, and the process as well as the roles and responsibilities of the partner agencies are discussed in more detail in Section 2 of this report.

Safety Analysis Process



Note: The safety analysis process presented above emphasizes the need to involve FWS Regional Transportation Coordinators as soon as a safety issue is identified. Decisions on the need for a safety study as well as the type of study performed should be made by FHWA FLH Safety Discipline Team Lead in close coordination with the FWS. Although the process above provides general guidance for selecting the appropriate study type, each safety issue is unique and will need to be carefully reviewed to determine the most appropriate course of action to address the issue.

2.1 Safety Analysis Process

The FWS and FHWA FLH have defined a general process that should be considered for safety issues that arise on the FWS transportation system. The process relies heavily on a high level of cooperation between the FWS Field Stations, FWS Regional Transportation Coordinators, and the FHWA FLH Safety Team. Each of these will both lead and support the various steps that should occur from the initial identification of safety issues through project implementation if applicable. The key steps in the process are discussed in more detail below.

Identification of Safety Issues – Safety issues may be identified at the field station, regional, or national level within the FWS. While some issues, such as a missing stop sign, will be most appropriately addressed by field station staff, other may require more in-depth analysis to determine the cause of the issue and develop countermeasures that adequately address the issue. As a first step, whenever safety issues arise that cannot be readily addressed by field station staff, it is recommended that the FWS Regional Transportation Coordinator be contacted.

Contact the FWS Regional Transportation Coordinator – The FWS Regional Transportation Coordinators will act as the primary contact point for addressing safety issues that cannot be readily addressed at the field station level. The FWS Regional Transportation Coordinators will be able to share experiences of other FWS field stations that may have had similar safety issues, they will be aware of existing policies and programs available to address safety issues, and they will act as the primary point of contact between FWS and the FWHW FLH Safety Discipline Team.

Determine if a Safety Study is Needed – The determination of the need for a safety study should be made with close coordination between the FWS Field Station Staff, FWS Regional Transportation Coordinators, and the FHWA FLH Safety Discipline Team Lead, with the FHWA FLH Safety Discipline Team Lead taking the lead role in making this determination. Depending on the issue, a field review may be needed to make this determination and to gather additional information in order to determine the appropriate study type.

Determine Appropriate Study Type – Based on information available, the FHWA FLH Safety Discipline Team Lead, in coordination with the FWS, will determine the type of safety analysis study that should be completed in order to address the safety issue. There should be flexibility in this process as each safety issue is unique. In many cases a customized analysis approach may be selected to adequately address an issue. For example, a unit level safety analysis may be selected for a Refuge to address multiple safety issues, but it may also be determined that a road safety audit (RSA) should be performed at several intersections within a Refuge to address specific concerns at intersections that have had a history of crashes.

Complete Study and Develop Recommended Countermeasures – The study and development of recommended countermeasures will be led by the FHWA FLH Safety Discipline Team Lead. Key steps include:

- Formation of the Safety Team
- Data Collection and Assembly
- Develop Recommended Countermeasures

The safety team could include members of the FWS Field Station Staff, FWS law enforcement, local law enforcement, state departments of transportation (DOTs), and local DOTs or public works in addition to the FHWA FLH Safety Discipline Team Lead and the FWS Regional Transportation Coordinators.

Data collection and assembly will generally be the responsibility of FWS Field Station Staff who will have the most history on the safety issues at a field station. The FWS National SMS Specialist should

also be consulted to identify any safety issues, crash reports, or other safety data that may be available in the FWS SMS.

Recommendations will be made by the safety team with the FHWA FLH Safety Discipline Team Leader taking the lead role in making recommendations to FWS.

Project Implementation – Implementation of recommendations from safety studies will ultimately depend on priority of the need, availability of funding, and jurisdictions involved. The implementation will be led by the FWS Field Station Manager but tracked by the FWS Regional Transportation Coordinators. Project implementation information should also be provided to the FWS National SMS Specialists so that the improvements can be monitored and tracked for performance measurement.

Performance Monitoring – As part of the FWS SMS, the FWS National SMS Specialist will monitor any locations with safety improvements to determine if a measurable difference in safety can be identified.

2.2 Partner Agency Roles and Responsibilities

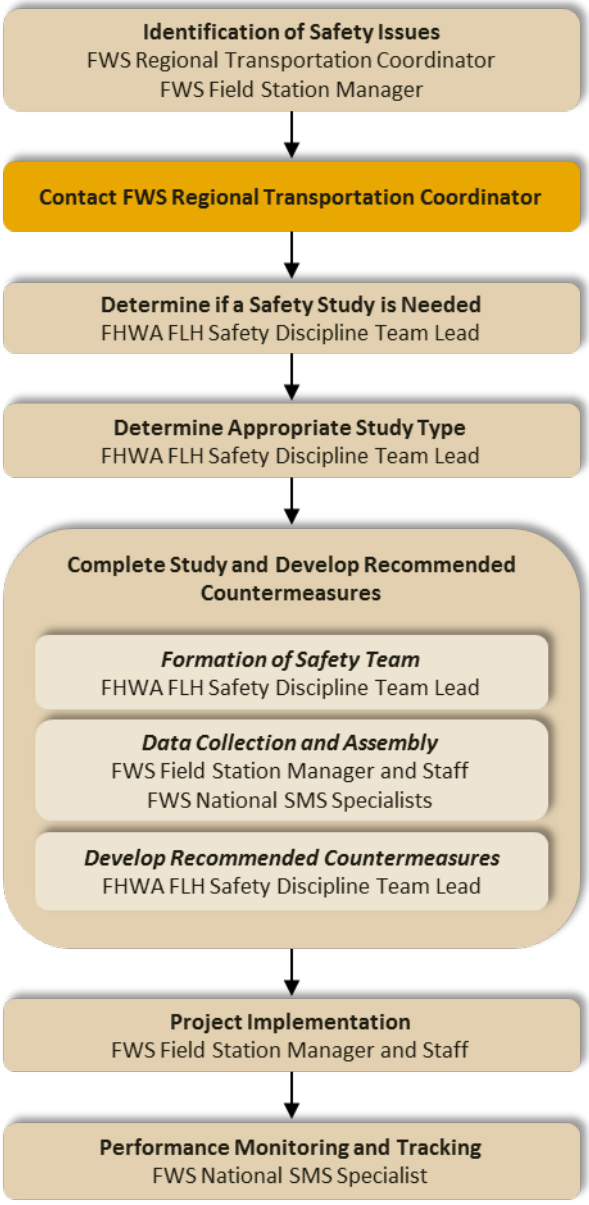
The FWS and its partner agencies each play a critical role in providing a safe transportation system within the FWS field stations. Close cooperation and partnerships between these agencies will allow FWS to continue to provide the safest transportation system possible. The key partners involved in the safety analysis process include:

- FWS Regional Transportation Coordinator
- FWS Field Station Manager
- FWS National SMS Specialist
- FWS Law Enforcement
- FHWA FLH Safety Discipline Team Lead
- State Departments of Transportation
- Local Law Enforcement
- Local DOTs or Public Works Departments

In the diagram to the right, the basic steps of the safety analysis process are identified along with the lead agency or agencies that are responsible for each step. The FHWA FLH Safety Discipline Team Lead has been identified with many of the lead roles, but it is expected that they will coordinate very closely with the FWS Regional Transportation Coordinators and the FWS Field Station Manager throughout the safety analysis process.

On the table on the following page, the specific roles of the most common partner agencies have been documented. While the FWS and FHWA are generally involved in safety work at FWS field stations, it will also be important to engage state and local partners. For example, RSAs are defined as formal safety performance evaluation of an existing or future road or intersection by an independent, multi-disciplinary team. RSAs include state DOTs and

Safety Analysis Process Lead Roles



local law enforcement officers in the process to provide an independent evaluation of safety issues from other agencies and disciplines. These partners can offer new perspectives and ideas on addressing safety issues.

Partner Agency Roles and Responsibilities

Partner Agencies	Roles and Responsibilities
FWS Regional Transportation Coordinator	**Co-Lead – Identification of Safety Issues** Determine Appropriate Study Type Develop Recommended Countermeasures Project Implementation
FWS Field Station Manager	**Co-Lead – Identification of Safety Issue** Lead – Determine Appropriate Study Type **Co-Lead – Data Collection and Assembly** Develop Recommended Countermeasures **Lead – Project Implementation**
FWS National SMS Specialist	**Co-Lead – Data Collection and Assembly** **Lead – Performance Monitoring and Tracking** (Included as part of overall role to maintain SMS)
FWS **Local Law Enforcement**	Data Collection and Assembly Develop Recommended Countermeasures
FHWA FLH Safety Discipline Team Lead	**Lead - Determine if Safety Study is Needed** **Lead – Determine Appropriate Study Type** **Lead – Formation of Safety Team** **Lead – Develop Recommended Countermeasures** Project Implementation
State DOTs **Local DOTs** **Public Works Departments**	Data Collection and Assembly Develop Recommended Countermeasures Permitting and Approval Project Implementation

3. IDENTIFICATION OF SAFETY ISSUES

The identification of safety issues can occur on a national, regional, or local level. On a national level road safety issues will be identified and compiled in the SMS. Regionally the FWS Regional Transportation Coordinators will review the SMS database as well as share experience gathered from other safety studies to identify potential safety issues at field stations. Locally, safety issues are more likely to be identified through less formal means, relying on experience within the field station as well as reports and information from staff, law enforcement, and visitors to the field station. Safety issues should include not only safety issues on the FWS transportation system, but also safety issues on roads that provide access to National Wildlife Refuges and Fish Hatcheries. In this section some of the sources of information that can be reviewed to identify safety issues are discussed and a broad overview of common safety issues is provided.

3.1 Identification of Safety Issues

A crash is not required in order to report a transportation safety issue. The goal should be to identify and address safety issues before any type of crash occurs on the transportation system.

One of the goals of FWS is to eliminate crashes on the FWS transportation system. In order to achieve this goal the FWS must be proactive in identifying potential safety issues and taking the appropriate steps to mitigate those issues as needed. Ideally safety issues are identified and mitigated before a crash ever occurs.

At the national level, the FWS is developing a SMS. The goal of the SMS is to ensure that safety is considered on the FWS transportation system and to improve safety on that system through the project selection and development process. The SMS will consider safety on the entire transportation system, not just roadways. It will include transit, bicycle facilities, water-based transportation facilities, aviation facilities, and trails in addition to roadways.

The SMS will utilize existing sources of crash and safety data to build a SMS database. These sources include the FWS-IMARS, surveys completed through the Long Range Transportation Plan process and other planning efforts, surveys completed at part of the FWS Roadway Inventory Program (RIP), and information from the National Highway Transportation Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS). In some cases statewide crash databases may also be reviewed to determine the crash history at particular locations.

Safety issues identified in the SMS can occur on both a project level and a program level. Project level safety issues will be resolved on a case by case basis following a study and development of finalized countermeasures. Program level safety issues may be addressed across the FWS when a repeated issue is noted. By taking notes and documenting complaints locally, and then passing those notes along to Regional Transportation Coordinators, program

SMS Data Collection Sources

- FWS-IMARS: FWS Incident Management and Analysis Reporting System
- SMIS: FWS Safety Management Information System
- FARS: NHTSA Fatality Analysis Reporting System
- Statewide Crash Databases
- FWS Long Range Transportation Plan (LRTP) Surveys
- FWS Regional Alternation Transportation Evaluation (RATE) Surveys
- FWS Roadway Inventory Program (RIP) Surveys
- Traffic Counts
- Other Sources

level safety concerns may be discovered earlier and resolved in a more timely matter.

The SMS will be reviewed on an annual basis to identify safety issues. The SMS will be available to the FWS Regional Transportation Coordinators to determine if there are safety issues that should be considered for additional study.

At the local level, identifying road safety issues will be an ongoing task that will require gathering of information from many sources. In the diagram below, the sources of data that may assist the FWS Field Station Staff with identifying safety concern are identified. These include local sources of data, such as field observations or coordination with local law enforcement, as well as sources of data available to local staff through the SMS, such as crash data from the FWS Law Enforcement FWS-IMARS. While there are many safety issues that can be addressed at the local level, such as a missing stop sign or damaged guard rail, whenever a safety issue exists without a clear solution the FWS Field Station Staff are encouraged to contact the FWS Regional Transportation Coordinators to determine if the issue should be considered for a safety study.

Data Inputs for Identifying Safety Issues

Finally, at all levels it is important to note that safety issues should not just be considered on FWS transportation facilities. Safety issues on transportation facilities that provide access to National Wildlife Refuges and Fish Hatcheries should also be identified and reviewed with the FWS Regional Transportation Coordinators to determine if safety studies should be conducted. The Moving Ahead for Progress in the 21st Century Act (MAP-21) transportation legislation included dedicated funding for the Federal Lands Access Program. This program provides funds for projects on Federal Lands access transportation facilities that are located on or adjacent to, or that provide access to Federal Lands but are not owned by the FLMA.

3.2 Common Safety Issues and Concerns

Safety issues can vary and each situation should be uniquely evaluated. However, within the FWS there are some commonly reported safety issues. Below is a summary of some of those issues. Although this is not an exhaustive list, it does provide some insight into the types of issues that may be expected to arise on the FWS transportation system.

Aviation

Safety issues for aviation at FWS field stations will largely consist of safety on runway and airfields. Issues may involve interaction with wildlife or appropriate levels of clearing for adjacent vegetation.

Bicycles

Bicycle safety includes well marked trails and paths as well as signed crossing points. Primary points of concern are locations where bicycles interact with motorized vehicles; this includes intersections, insufficient sight distance around curves for vehicles to see bicycles, and narrow roads with insufficient width for vehicles to pass.

Bridges

While integrity of bridge structures is often the most serious safety concern, other safety issues with bridges may include insufficient width for two-way traffic, lack or guardrail, low clearance, waterways overflowing onto the bridge deck, and unsafe conditions due to winter weather.

Parking Lots

Parking lots can present unique safety concerns. Lack of striping, poor signage, ingress and egress issues, poor internal circulation patterns, and vehicle-pedestrian conflicts can all be potential causes for accidents and/or crashes even at low vehicular travel speeds.

Kenai National Wildlife Refuge Source: Steve Hillebrand, FWS

Pedestrians

Similar to bicycles, safety issues can arise in any location where pedestrians frequently interact with motorized vehicles. Lack of adequate signing and pavement markings at crossings can be a safety issue, as well as roads without adjacent sidewalks or trails that require pedestrians to walk in the roadway.

Roadway Design

There are a significant number of roadway elements that may present safety issues. These include poor drainage, lack of guardrail or safety barriers, poor pavement quality, or inadequate pavement markings.

Roadway Intersections: Field Station Egress and Ingress

Ingress and egress to field stations can pose safety issues, particularly when vehicles that accelerate or decelerate slowly (such as large RVs and vehicle towing boats) are presented with potential conflicts with fast moving vehicles on state or county roads that provide access to the field station. Common safety issues include lack of acceleration or deceleration lanes, inadequate signage or pavement markings, nearby at-grade railroad crossings, or the need for a traffic signal.

Roadway Intersections: Internal Field Station Intersections

Internal field station intersections may have many of the same safety issues as intersections at the field station entrances. Other common safety issues may include inadequate horizontal or vertical sight distance, lack of clear right-of-way, narrow roadways, or poor pavement conditions.

Roadway Pull-out

Informal parking along roadways can create safety issues. These may occur along auto tour routes or locations where there are scenic view pull-outs that are not adequately signed. High speeds can cause safety issues at these locations as well as limited sight distance.

Wichita Mountains Wildlife Refuge Source: Kimley-Horn

Security Issues

Security related safety issues may involve unauthorized users or vehicle types on roadways, and the enforcement of roadway regulations.

Water Based Transportation

Water based transportation safety issues may include such issues as boat ramp safety or boat to boat crashes on waterways.

Weather

Weather related safety issues that may need to be addressed include roadway flooding, ponding of water on roadways, icy conditions, temporary closures due to snow, or fog.

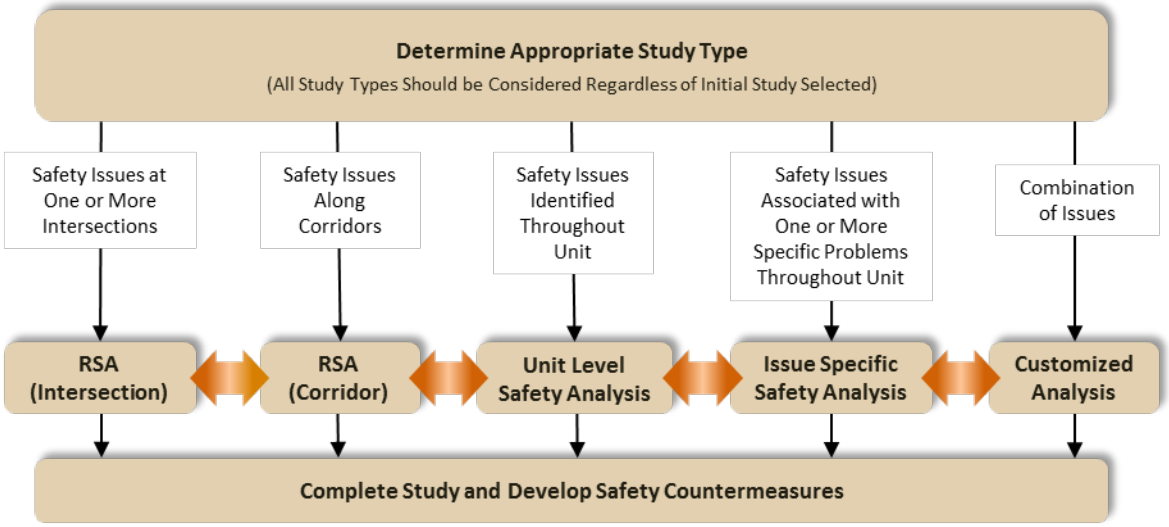
Wildlife-Vehicle Collisions

Reducing wildlife-vehicle collisions not only improves safety but also serves an important part of the FWS mission of conservation of wildlife. Roadway fencing, grade separated wildlife crossings, and improved signage are all considerations if wildlife-vehicle collisions present a safety issue at a field station.

4. SAFETY ANALYSIS TOOLS

In Section 2 of this document a safety analysis process was presented that provides recommended steps for moving from the identification of a safety issue to analysis of the issue to project implementation. In Section 4, the determination of the appropriate safety analysis study is discussed. Discussion is included on four unique types of safety analysis tools: Intersection RSAs, Corridor RSAs, Unit Level Safety Analysis, and Issue Specific Safety Analysis. The need for a customized analysis to address unique safety issues is also discussed.

Safety Analysis Process
(Safety Analysis Study Type Determination)



The determination of the appropriate study type will generally be led by the FHWA FLH Safety Discipline Lead in close coordination with the FWS Regional Transportation Coordinators and FWS Field Station Manager. The FHWA FLH Safety Discipline Lead will also take the lead on completing the safety analysis, however assistance may be sought from local and regional transportation experts as well as consultants to assist with performing the safety analysis.

In the remainder of Section 4, each of the safety analysis study types are described in more detail. The general timeframe to complete each study, the team used for each study, the commitment required from the FWS field stations, and reasons for selecting each type of study are discussed.

4.1 Road Safety Audit (RSA) – General

RSAs are a common and valuable tool used to analyze safety on roadway intersections and corridors. The FHWA defines an RSA as a "formal safety performance evaluation of an existing or future road or intersection by an independent, multi-disciplinary team." The FHWA has developed a *Road Safety Audit Toolkit for Federal Land Management Agencies and Tribal Governments*. The Safety Analysis Toolkit provides information regarding what an RSA is, when an RSA should be considered and how an RSA should be conducted. A brief summary of information found in that document is provided here.

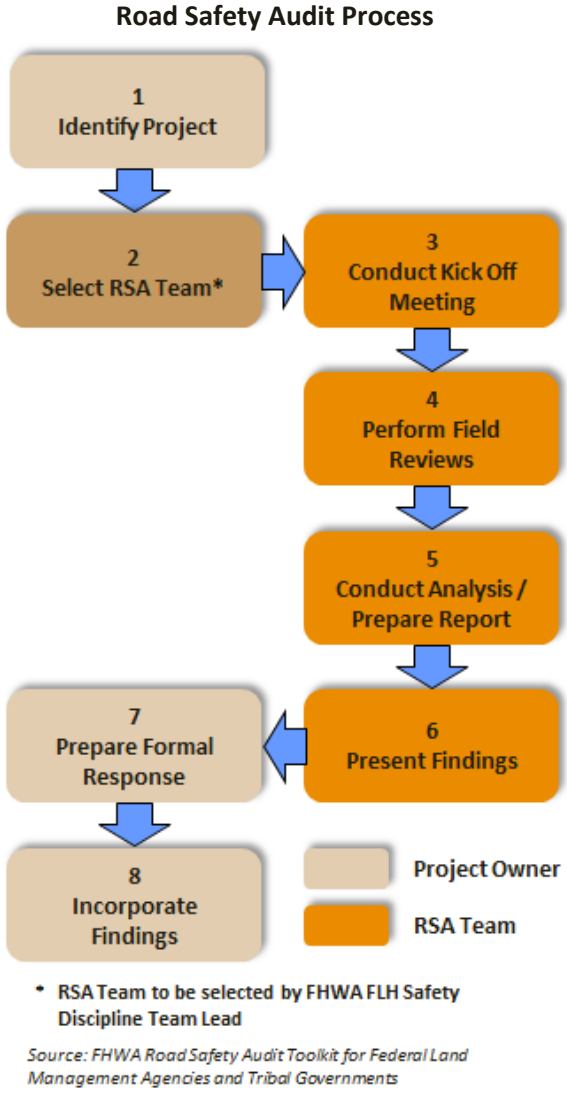
RSAs may be used on any type of facility and during all stages of the project development process; additionally, RSAs consider potential safety issues for all road users under all conditions. Attention should be given to travel conditions such as darkness, severe weather, peak travel times, special events, or other factors that may not normally exist at the site.

RSAs Are:	RSAs Are Not:
Focused on road safety	A means to evaluate the design of a facility
A formal examination	A check of compliance with standards
Proactive in nature	A redesign of a project
Conducted by a multidisciplinary team	A means of rating one design option over another
Conducted by a team that is independent of the operations, design, or management of the facility	A means of ranking or justifying one project over another
Conducted by a qualified team	A safety review
Broad enough to consider the safety of road users of the facility	A crash investigation (although the crash history of an existing facility is reviewed)
Qualitative in nature	

Source: FHWA Road Safety Audit Toolkit for Federal Land Management Agencies and Tribal Governments

Many factors may lead to the decision to request the preparation of an RSA. Common factors may include a high crash frequency, high profile crash types, or significant changes in traffic characteristics or patterns (current or expected). Other factors may include unique design proposals for the area or a major change in adjacent or surrounding land uses.

RSA project scopes should generally remain small, including no more than one to two miles of corridor or no more than four to five intersections, if possible. Limiting the scope allows RSAs to be completed expeditiously. Typical RSA field work can be completed in one or two days, with one week being a standard maximum. If an RSA includes a corridor longer than two miles or a large number of intersections to be assessed the timeframe for completion of the project, particularly the amount of time required for field work, may increase dramatically.



Completing an RSA is an 8 step process which is outlined in the *FHWA Road Safety Audit Guidelines*. Responsibility of each step is assigned to either the project owner or the RSA Team lead as illustrated in the figure at left. The project owner would most likely be the FWS, represented by the FWS Field Station Manager as well as the FWS Regional Transportation Coordination. If a safety issue was identified on a road that provided access to a field station but was not owned by the FWS, the project owner would be the owning and operating agency such as a State DOT or a County Public Works Department. The RSA Team will most likely be led by the FHWA FLH Safety Discipline Team.

A summary of the 8 steps are provided below.

Step 1 – Identify Project or Existing Road for RSA: As noted in Section 2.1, the need for a RSA will be determined through close coordination between the FWS Field Station Staff, FWS Regional Transportation Coordinators, and the FHWA FLH Safety Discipline Team Lead. The FHWA FLH Safety Discipline Team Lead will take the lead role in making this determination.

Step 2 – Select Independent and Multidisciplinary RSA Team: The FHWA FLH Safety Discipline Team Lead will select the RSA Team. RSA Team members should be independent of the road operations and the design of facility to eliminate potential bias. RSA members can include individuals with expertise in road safety, traffic operations, road design, road maintenance, transportation planning, law enforcement, public outreach, community organizations, and user groups such as cyclists, hikers, boaters, or all-terrain vehicle users. A recommended best practice is to use the smallest team possible that still brings the necessary knowledge and experience for the location and safety issues being reviewed. In general, teams should consist of a maximum of five people, although more people may be involved in the Kick-Off meeting discussed in Step 3 when information is initially being gathered for the RSA.

Step 3 – Conduct Kick-Off Meeting to Exchange Information: The Kick-Off meeting will provide an opportunity for the Project Owner and RSA Team to understand the purpose, schedule, and roles and responsibilities of all participants. The meeting also allows the RSA Team members to ask specific questions of the Project Owner regarding the safety issues.

Step 4 – Perform Field Reviews under Various Conditions: The field review should be performed during various conditions, such as day and night as well as peak and non-peak visitor times. Certain conditions such as special events and severe weather may not exist or may not allow the RSA Safety Team to safely perform the safety review but those types of conditions should be considered to the best of the RSA Team's ability.

Step 5 – Conduct RSA Analysis and Prepare Report Findings: The RSA report should include a summary of the safety issues and suggestions for countermeasures. Prior to preparing the report the RSA Team may meet with the Project Owner to discuss the preliminary findings.

Step 6 – Present RSA Findings to Project Owner: This step provides an opportunity for the RSA Team and Project Owner to discuss the RSA findings. The Project Owner may make recommendations for additional or alternative countermeasures.

Step 7 – Prepare Formal Response: The Project Owner should review the RSA findings and prepare a formal response that outlines what action they plan to take with respect to each safety issue identified in the RSA findings.

Step 8 – Incorporate Findings into the Project when Appropriate: The Project Owner will be responsible for taking the necessary steps to implement the agreed-upon safety improvements. An after action review may also be scheduled to allow the RSA Team to evaluate the effectiveness of the safety improvements and evaluate if other measures are needed.

The field review described in Step 4 above will typically only take a few days to complete, but the entire process may take several months to several years to complete depending on the size and scope of the recommended safety improvements. In general, an estimate of approximately one to three months to complete Steps 1 through 7 would be reasonable, with Step 8 varying widely depending on the recommended safety improvements.

Additional details about the steps can be found in the *Roadway Safety Audit Toolkit for Federal Land Management Agencies and Tribal Governments.*

4.2 Road Safety Audit – Intersection Study

An intersection RSA is one in which one or more intersections are audited, but the corridor between them is not audited. An intersection RSA will use the eight-step process described in Section 4.1 regardless of size, scale, or number of intersections audited.

Road Safety Audit – Intersection Studies

A formal safety performance evaluation of an intersection by an independent multidisciplinary team.	
Timeframe	One to three months
Team	Independent multidisciplinary RSA team including safety, traffic, maintenance, and law enforcement expertise
Field Station Commitment	Facilities and law enforcement staff to assist with field review of all intersections
Reason for Use	Crashes or safety issues identified at one or more intersections

The timeframe for the field review will most likely be limited to a single day for a single intersection and up to a week for multiple intersections. The total time of the RSA, from the initial formation of the safety team until the findings are presented to the project owner, is expected to take approximately one to three months.

The RSA team will be made up of independent multidisciplinary experts representing road safety, traffic operations, road design, road maintenance, transportation planning, law enforcement, public outreach, community organizations, and user groups. The number of representatives on the RSA team will vary depending on the size and complexity of the RSA. For a single intersection RSA with low volumes, it is likely that a smaller RSA team would be used compared to an RSA that included a series of high volume intersections.

FWS field stations where RSA's are performed may be asked to have facilities and law enforcement staff participates on the RSA team. In some cases, representatives of visitor services or special use groups such as cyclists may also be asked to participate. The local knowledge the field station staff can bring to the RSA team is extremely valuable in helping the RSA team understand the safety issues and developing feasible countermeasures.

Intersection RSAs should be considered at any location where crashes or safety concerns are limited to one or more intersection specific issues. Following the implementation of any of the recommended countermeasures, an after action review should be considered to evaluate the effectiveness of the recommendations.

Savannah and Pinckney Island National Wildlife Refuges Road Safety Audit

The Savannah and Pinckney Island NWR RSA examined safety issues at the entrances to both refuges as well as at two other locations at the Savannah NWR.

The RSA included a review of existing geometric conditions, traffic data, and crash data. Based on this review six safety issues were identified, including roadway geometry, signing and pavement markings, traffic congestion, roadside design, night time and poor visibility, and bicyclists.

Source: FWS

Roadway geometry was determined to be the most critical issue and recommendations for countermeasures included installation of new turn lanes, lengthening of existing turn and acceleration lanes, addition of a shoulder bypass lane, and the installation of signage to improve locations where horizontal and vertical curvature limits sight distance. Recommendations also included non-engineering solutions, including increased education and enforcement.

4.3 Road Safety Audit – Corridor Study

A corridor RSA focuses on a segment of a corridor, a full corridor, or multiple corridors. It may include one or more intersection as part of the study. A corridor RSA will also use the eight-step process described in Section 4.1 regardless of length or number of corridors being audited.

Road Safety Audit – Corridor Studies

A formal safety performance evaluation of a corridor by an independent multidisciplinary team.	
Timeframe	Two to four months
Team	Independent multidisciplinary RSA team including safety, traffic, maintenance, law enforcement expertise
Field Station Commitment	Facilities and law enforcement staff to assist with field review of all intersections
Reason for Use	Crashes or safety concerns identified along a corridor. Corridor studies may also be appropriate even if a safety issue is only identified at a single location, because that issue may exist elsewhere on a corridor even though it is not identified.

The timeframe for the field review will vary quite a bit depending on the length and number of corridors. The field review may take as little as one day for shorter corridors and up to a week or more for longer corridors. The total time of the RSA, from the initial formation of the safety team until the findings are presented to the project owner, is expected to take approximately two to four months.

Patuxent Research Refuge Road Safety Audit

The Patuxent Research Refuge RSA included two corridors that intersect at the Patuxent Research Refuge in Prince Georges County, Maryland. Both corridors are over two miles in length. These corridors had 126 reported crashes between 2002 and 2006, including four fatal crashes.

A crash analysis was completed and field visits were conducted during both daytime and nighttime. Several safety issues and corresponding suggestions were identified as part of the study. The safety issues were categorized into seven categories: signing and pavement marking, nighttime visibility, roadside design, drainage, access to and from side streets, effects of roadway curvature on motorists, and genera intersection safety concerns.

Source: FWS

These categories and their associated safety issues were prioritized based on how critical they were to the safety of the corridors. Signing and pavement markings were determined to be the most critical within the study area. The suggested improvements for signing and pavement markings included the addition of stop bars, the duplication of stop signs, the replacement or relocation of damaged or poorly located signs, and the trimming of vegetation around signage.

The RSA team will be made up of independent multidisciplinary experts representing road safety, traffic operations, road design, road maintenance, transportation planning, law enforcement, public outreach, community organizations, and user groups. The number of representatives on the RSA team will vary depending on the size and complexity of the RSA. For a single low volume two-lane corridor it is likely that a smaller RSA team would be used compared to an RSA that included a series of longer high volume corridors with turn lanes, pull-outs, or other unique features.

FWS field stations where RSA's are performed may be asked to have facilities

and law enforcement staff participates on the RSA team. In some cases, representatives of visitor services or special use groups such as cyclists may also be asked to participate. The local knowledge the field station staff can bring to the RSA team is extremely valuable in helping the RSA team understand the safety issues and developing feasible countermeasures.

It can be expected that a corridor RSA will likely lead to a larger number of recommendations than might result from an intersection RSA. In some cases the recommendations for countermeasures will need to be prioritized as shorter-term recommendations that may be able to be implemented in the short-term to address any immediate safety issues, and long-term recommendations that may require additional project planning, design, or programming of funding.

Corridor RSAs should be considered at any location where crashes or safety concerns have been identified along a corridor. A corridor study may also be appropriate even if a safety issues is only identified at a single location. If similar conditions exist at other locations along a corridor they should be reviewed as part of the RSA to determine if the safety issue is broader than a single location. For example, if several crashes have occurred at one curve on a road, that curve may be the only safety issue identified. But if similar curves exist on the corridor, even if there have not been any crashes, those curves should be included as part of the RSA so that countermeasures, such as improved curve warning signs, can be consistently implemented along the entire corridor.

Following the implementation of any of the recommended countermeasures, an after action review should be considered to evaluate the effectiveness of the recommendations.

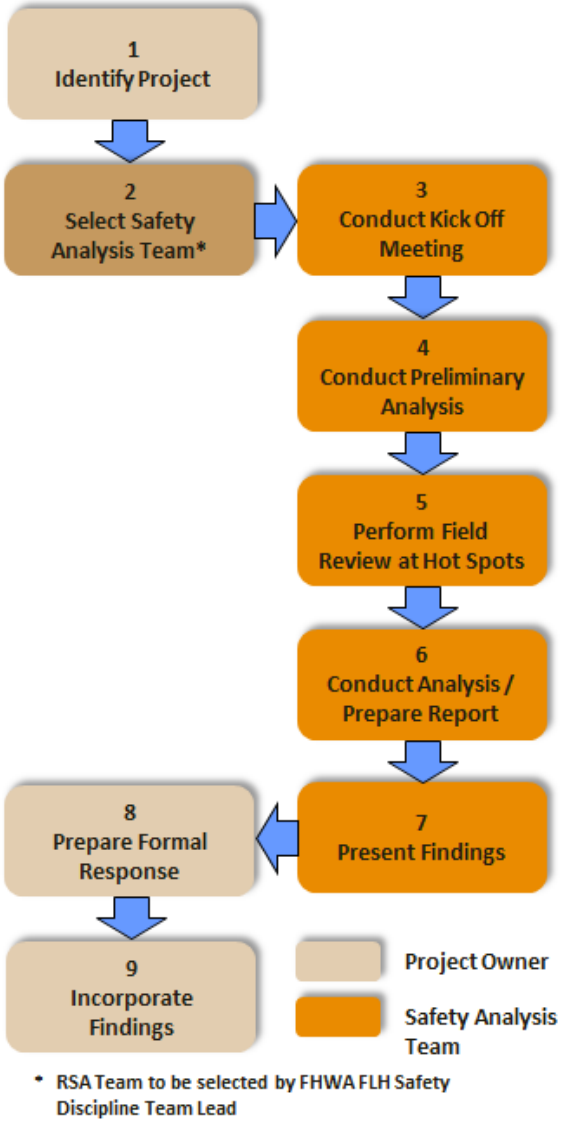
4.4 Unit Level Safety Analysis

A unit level safety analysis is intended to study safety issues throughout a field station. A unit level safety analysis should be considered when a field station has had a significant number or broad spectrum of safety issues identified throughout (rather than a limited number of safety issues identified at intersections or on corridors.) This type of safety analysis may also be recommended even if no major safety issues have been identified; regularly assessing safety on a unit wide level may help to prevent future incidents by identifying and mitigating potential safety issues.

Unit Level Safety Analysis

A comprehensive analysis of safety issues throughout a unit or field station.	
Timeframe	Three months to one year
Team	Multidisciplinary team including traffic, safety, and law enforcement expertise
Field Station Commitment	Facilities and law enforcement staff to assist with identification and field review of hot spots throughout a field station.
Reason for Use	Crashes or safety concerns identified throughout a field station.

Unit Level Safety Analysis Process



Unlike RSAs, there is not a formal process established for developing unit level safety analysis. However, many of the steps that are recommended for a unit level safety analysis are very similar to an RSA. Below are some of the steps that should be considered when developing a unit level safety analysis. Similar to the process for RSAs, the Project Owner represents the FWS field station.

Step 1 – Identify Project: As noted in Section 2.1, the need for any type of safety analysis should be determined in close coordination between the FWS Field Station Staff, FWS Regional Transportation Coordinators, and the FHWA FLH Safety Discipline Team Lead. The FHWA FLH Safety Discipline Team Lead will take the lead role in making this determination.

Step 2 – Select a Multidisciplinary Safety Analysis Team: Unit level safety analysis can cover a wide range of safety issues. It is important to select a team that represents not only traffic, safety, and law enforcement but also other safety issues that may have been identified on a Region. Examples include expertise in wildlife management if there are a large number of wildlife-vehicle collisions, expertise in boating safety if there are safety issues at boat ramps or on waterways that serve as a means of transportation, or expertise in aviation for refuges whose primary means of access are through planes.

Step 3 – Conduct Kick-Off Meeting: The Kick-Off meeting will provide an opportunity for the Project Owner and Safety Analysis Team to understand the purpose, schedule, and roles and responsibilities of all participants. The meeting also allows the Safety Analysis Team to better understand safety issues that may exist throughout the Refuge through discussions with field station staff and law enforcement.

Step 4 – Conduct Preliminary Analysis: Preliminary analysis should be conducted to identify hot spots where crashes have occurred or where there appears to be a high potential for crashes. Analysis could include a review of all available data in the SMS database, a review of crashes available through FWS law enforcement, a review of the statewide crash database, discussions of existing hot spots with field station staff and law enforcement, and a field review existing routes. The Kick-Off meeting will provide an opportunity for the Project Owner and RSA Team to understand the purpose, schedule, and roles and responsibilities of all participants. The meeting also allows the RSA Team members to ask specific questions of the Project Owner regarding the safety issues. Step 4 may occur in conjunction with Step 3.

Step 5 – Perform Field Review at Hot Spots: The Safety Analysis Team should perform a field review of the identified hot spots within a field station to determine causes of safety issues and potential countermeasures. The field review may include a combination of site specific reviews as well as corridor reviews.

Step 6 – Conduct Safety Analysis and Prepare Report: The Safety Analysis Team will prepare a safety analysis report which will include recommendations for safety improvements. A unit level safety analysis may include a large number of recommendations, some of which may require planning and programming of funds. The report should specify recommendations for short-term improvements to address immediate safety issues as well as recommendations for long-term improvements that may require additional project planning, design, or programming of funding. Prior to preparing the report the Safety Analysis Team may meet with the Project Owner to discuss the preliminary findings.

William L. Finley National Wildlife Refuge Road Safety Audit

Safety concerns, including poor sight distance, high traffic speed, high volumes of traffic stopping abruptly, and drainage issues led to a unit level RSA on William L. Finley National Wildlife Refuge. The RSA focused primarily on the two highest volume roads within the refuge as well as adjacent county roads that provide access to the refuge.

Seven locations were identified as hot spots and were assessed in more detail. These hot spots included two intersections, a roadway with wildlife viewing activities, a roadway that floods, two parking lots, and a pedestrian crossing. Each of these locations was reviewed in greater detail and specific recommendations were made.

Recommended improvements at each location were identified as priorities using two strategies: safety and cost benefits. This double prioritization of the recommendations highlighted the improvements that could have the largest impact on safety for the smallest cost.

Recommended improvements included strategies such as the relocation of the access point of a refuge road to improve sight-distance, installation of speed limit signs and increased enforcement by the county to reduce speeding, drainage improvements to reduce flooding, and the addition of a pull-out for wildlife viewing.

Source: Atkins

Step 7 – Present Safety Analysis Finings to Project Owner: The Safety Analysis Team will present the findings to the Project Owner and the recommendations should be discussed. The Project Owner may make recommendations for additional or alternative countermeasures.

Step 8 – Prepare Formal Response: The Project Owner should review the unit level safety analysis findings and prepare a formal response that outlines what action they plan to take with respect to each safety issue identified in the unit level safety analysis.

Step 9 – Incorporate Findings into the Project when Appropriate: The Project Owner will be responsible for taking the necessary steps to implement the agreed-upon safety measures. An after action review may also be scheduled to allow the Safety Analysis Team an opportunity to evaluate the effectiveness of the suggestion countermeasures and evaluate if other measures are needed.

The timeframe for the field review will vary quite a bit depending on the size of the field station and the number of safety issues and hot spots that are identified. The preliminary analysis discussed in Step 4 can also require a large investment of time depending on the availability of crash data and the amount of time dedicated to identifying hot spots within the unit. The total time of the unit level safety analysis, from the initial formation of the safety team until the findings are presented to the project owner, is expected to take approximately three months to one year.

The Safety Analysis Team assembled for the unit level safety analysis should be a multidisciplinary team that represents not only traffic, safety, and law enforcement, but also other expertise that can address unique safety issues that may have been identified at a field station. Examples include expertise in wildlife management if there are a large number of wildlife-vehicle collisions, expertise in boating safety if there are safety issues at boat ramps or on waterways that serve as a means of transportation, or expertise in aviation for refuges whose primary means of access are through aviation. The number of representatives on the Safety Analysis team will vary depending on the size of the field station and complexity of the safety issues.

Hagerman National Fish Hatchery Road Safety Audit

This unit level RSA was conducted on roads that provide access to the Hagerman National Fish Hatchery as well as three permitted facilities whose access is provided through the fish hatchery property. An increase in traffic had been observed in recent years on the FWS roads which prompted the RSA. The RSA focused on general issues associated with road safety to, from, and within the hatchery. FWS roads were analyzed as well as access and parking for fishing at an adjacent lake.

Source: FWS

Three main safety issues were identified as a result of this RSA: road improvements, signing improvements, and administration improvements. Road improvements included widening, conversion of some streets to one-way operation, and culvert improvements. Improved signing was recommended to reduce confusion for the vehicles accessing the permitted facilities located on the hatchery property, such as the University of Idaho Hagerman Fish Culture Experiment Station. A speed study and a traffic study were also recommended in order to identify and document traffic patterns, speed, and roadway usage. Finally, administration improvements were recommended to improve partnering and mediation between the permitted facilities on the hatchery property.

Safety improvement recommendations from the unit level safety analysis will vary from quick and simple improvements, such as adding a sign, to more involved recommendations that require advanced programming of funds and a design process, such as paving a section of roadway. The safety analysis report should specify recommendations for short-term improvements to address immediate safety issues as well as recommendations for long-term improvements that may require additional project planning, design, or programming of funding. An opinion of probable cost for each improvement should be developed. Improvements should be identified for each hot spot, but also categorized to develop a total recommended cost for improvement in key categories such as signing, striping, paving, and guardrail improvements. Those categories can also be classified into short, medium and long term improvements.

A unit level safety analysis can be very helpful even if specific issues have not been identified at a field station. A thorough safety analysis of a field station may identify high potential locations where crashes are most likely to occur in the future. The field station and FWS Regional Office can work together to begin developing a program to access funds and address locations considered to have the highest probability of a crash.

After the implementation of any of the recommended countermeasures, an after action review should be considered to evaluate the effectiveness of the recommendations.

4.5 Issue Specific Safety Analysis

An issue specific safety analysis is the study of a safety issue that has been identified at the field station, regional, or national level. Examples of issues which might require a safety analysis include speeding, bicycle or pedestrian safety, wildlife-vehicle collisions, and severe weather issues. An issue specific safety analysis can be challenging to define as the study could vary widely depending on the issue and if it is being studied at the field station, regional, or national level.

Issue Specific Safety Analysis

A comprehensive analysis of a single safety issue in on field station, across an entire region, or service-wide.	
Timeframe	Three months to one year
Team	Multidisciplinary team including expertise in the issues being studied
Field Station Commitment	Minimal commitment, particularly if study is regional or national. Law enforcement staff or facilities staff may be asked for assistance.
Reason for Use	One or more safety issue appearing at multiple locations across a field station, Region, or on the National Level.

Regardless of the safety issue, performance of an issue specific safety analysis should include the four E's of safety: engineering, education, enforcement, and emergency medical services. Many of the issues that may be investigated may best be solved through a combination of two or more of the four E's.

The timeframe to complete an issue specific safety investigation will vary based on the issue being studied as well as the size and scale of the study. Issues limited to a single refuge will likely take much less time to analyze than an issue that has been identified on a regional or national level. Often the countermeasures to address an issue specific safety analysis may be complex and require the participation of partners to develop non-engineering solutions.

A multidisciplinary team should be assembled to perform the issue specific safety analysis. The team will vary quite a bit depending on the issue or issues being studied. The safety analysis team should not be limited to a particular

Wildlife Mitigation and Human Safety for the Sterling Highway MP 58-79 Project

The Sterling Highway is a rural two-lane highway that bisects the Kenai National Wildlife Refuge in Alaska. The segment from MP 58-79 had historically experienced a high rate of wildlife-vehicle collisions. In anticipation of a planned reconstruction project on this segment, a study was performed in order to identify ways to reduce wildlife mortality, restore wildlife connectivity, and improve human safety through the reconstruction.

Several years prior to reconstruction over 60 moose and caribou were outfitted with GPS collars and their migration patterns were tracked. A hotline was also set up for the motoring public to report wildlife sightings along the Sterling Highway. A six mile segment was identified that contained almost half of the wildlife-vehicle collisions and a majority of the GPS crossings and hotline sightings.

Recommendations along this six mile section included fencing along with a wildlife overpass near MP 73, a wildlife underpass near MP 71, and a wildlife "crosswalk" near the ends of the fenced section. Additional crossings for large mammals were also recommended at other strategic locations along the corridor.

Source: FHWA

number of people and if needed, additional expertise should be brought in as needed to be sure all potential solutions are considered.

Issue specific studies will generally require more time from field station staff if the study is limited to a single refuge or fish hatchery. If an issue is being studied at the regional or national level there would be less impact expected on field station staff, however some field station staff may be asked to serve as part of the issue specific safety analysis team.

Expected results for this type of study will reflect the specific issue being studied. Recommendations may include broad changes implemented at the regional or national level, or smaller changes focused on local needs if the study is limited to one field station. An issue specific safety analysis is also likely to have recommendations which may go beyond traditional engineering solutions. These recommendations will rely on other partners to implement, such as a stricter enforcement of speed limits on a refuge or a public outreach and education campaign. Regardless of the recommendation, if possible FWS and FHWA should attempt to monitor the impact of changes that are made on safety at each affected field station.

4.6 Customized Analysis

Each field station is unique and not all safety issues will be able to be adequately studied using one of the safety analysis tools presented in Sections 4.1 through 4.5. The combination of safety issues that may exist at a field station or within a region may necessitate the use of a customized analysis to appropriately address the safety issues that have been identified.

Determining an appropriate customized analysis will be dependent on the expertise and experience within the FWS and FHWA. An early partnership between the FWS Field Station Manager, FWS Regional Transportation Coordinator, and FHWA FLH Safety Discipline Team Lead will allow the FWS and FHWA to closely review the safety issue and determine the best course of action to study the issue or issues that have been identified.

Customized analysis may include a mix of traditional traffic engineering tools, such as a traffic signal warrant analysis or sight distance analysis, as well as unique approaches that may be warranted. The same general approach should be followed for customized analysis as for the other safety analysis tools discussed in Section 4.1 through 4.5. This approach includes:

- Develop a partnership between the FWS Field Station Manager, FWS Regional Transportation Coordinator, and FHWA FLH Safety Discipline Team Lead to assess the safety issue and determine if a safety study is needed.
- Assemble a team of experts to assist with the study.
- Work closely with the field station to analyze the safety issues and develop recommended countermeasures.
- Present findings and provide an opportunity for the safety analysis team and the project owner to discuss the findings.
- Monitor the impacts of the implemented recommendations on safety.

5. IMPLEMENTATION

Identification and implementation of safety improvements should involve a team approach with expertise from the FWS and FHWA FLH. The FWS Regional Transportation Coordinators and FHWA FLH Safety Discipline Team Leads will serve as key partners to identify the appropriate type of safety analysis tool to use to address safety issues, conduct the safety analysis, and implement recommendations to mitigate safety issues.

Initiation

As shown in the Safety Analysis Process diagram presented in Section 2, the first step for any field station to initiate a safety analysis effort after identifying a safety issue should be to contact the FWS Regional Transportation Coordinator responsible for the Region where the field station is located.

The FWS Regional Transportation Coordinator will bring in expertise from the FHWA FLH and work with the field station manager to identify other expertise, such as law enforcement or State DOT officials, if needed for an RSA or other type of safety analysis.

Timeframe

Each safety issue is different which makes it challenging to identify a timeframe for completing a safety analysis, but in general the types of safety analysis tools identified in the Safety Analysis Toolkit should be complemented anywhere from as short as one month for a single intersection RSA, to as long as one year for unit level and issue specific safety analysis. The timeframe for the actual implementation of the safety countermeasures that are recommended through the various safety analysis efforts will also vary widely. Recommendations may include short-term improvements that can be quickly implemented to address immediate safety needs at minimal cost, such as relocating signs or adding striping to roadways, as well as longer-term recommendations such as the addition of turn lanes that may require programming of funds before they can be implemented.

Success Story: US Highway 93 Wildlife Mitigation in Montana

The US Highway 93 Wildlife Mitigation project in Montana is one of the most extensive wildlife-sensitive highway safety design efforts in the United States. Wildlife mitigation issues have been documented and studied along Montana Highway US 93 since the early 1980's. Since that time, numerous studies have been completed by a variety of agencies, and a comprehensive set of countermeasures has been implemented. These countermeasures are aimed at improving safety for the traveling public as well as wildlife by reducing wildlife-vehicle collisions and allowing wildlife to move safely across the highway and the surrounding landscape.

Specific countermeasures include the reconstruction of over 76 miles of road and the installation of 81 fish and wildlife crossing structures, including one overpass. Over 16 miles of linear wildlife exclusion fencing has also been installed and there are numerous installations of wing fencing throughout the corridor. Jump-outs have been installed to allow wildlife to safely exit the roadway if they do become trapped between the fences and wildlife "crosswalks" have been implemented to notify motorists when wildlife has crossed onto the roadway.

This project was completed using numerous safety studies, which were used to identify to the appropriate locations for each specific type of crossing and for the installation of fencing. The project is currently being studied for its effectiveness and results will not be available until 2015, however, the project is regarded as a success for its grand scale, collaborative efforts, and its use of creative solutions.

Source: FHWA

Outputs

The results of an RSA or other safety analysis will most commonly be a series of recommendations for implementation at the field station to address the identified safety issues. These recommendations may range from simple projects that can be implemented using maintenance staff, to larger capital projects that may require more extensive design and construction efforts, to additional studies that might be needed before a safety concern can be fully addressed. FWS field stations will be asked to review the recommendations that result from a safety analysis study and prepare a formal response regarding how they plan to address the recommendations.

Implementation

The safety analysis tools identified in this toolkit will provide the FWS with a series of recommendations to address safety issues. The involvement of the FWS Regional Transportation Coordinators and the FHWA FLH early in the process will assist the field stations with prioritizing and programming the recommended safety projects that result from the safety analysis effort. While funds for larger capital improvements may not be immediately available, incorporating these projects into the project programming process as early as possible is important so that they may be implemented as soon as possible. Following implementation, the FWS should monitor the performance of the improvements to determine if the countermeasures have had the desired impact on safety.