APPENDIX V-B

Agency Comments from the USACOE Public Interest Review

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
STATE REGULATORY PROGRAM OFFICE - MISSOURI
221 BOLIVAR STREET, SUITE 103
JEFFERSON CITY, MISSOURI 65101

REPLY TO
ATTENTION OF:

April 27, 2005

Missouri State Regulatory Office
(200402229)

Ms. Gayle Unruh
Wetland Coordinator
Missouri Department of Transportation
P.O. Box 270
Jefferson City, Missouri 65102

Dear Ms. Unruh:

This letter pertains to your application for a Department of the Army permit to widen and reconstruct approximately 18 miles of the existing Interstate 70 facility in Boone County for six travel lanes outside of Columbia (three travel lanes in each direction), eight travel lanes through Columbia (four lanes in each direction), frontage roads, and reconstructed interchanges. We circulated a public notice describing your activity and received substantive comments. Those substantive comments are enclosed for your information.

The Corps of Engineers will make the final decision on your application, and we will not issue a permit if issuance would be contrary to the public interest. We will consider the enclosed comments and your response, if any, along with other relevant factors in our determination of the public interest. Finally, you may choose to take no action on the enclosed comments. In that case, we will decide whether to issue the requested permit based on the information in your application, on the public notice comments, on the Final Environmental Impact Statement (EIS), and on any other information we have developed about your activity from our own evaluation.

Please provide our office with copies of the comments received from the public notice and public hearing for Section of Independent Utility (SIU) # 4, which was held in Columbia on February 28, 2005.

It is our understanding that the stream and wetland delineation results will be included in the Final EIS for SIU # 4. As of this date we have not received a preliminary jurisdictional report on waters of the U.S. for SIU # 4 for our review. Please note that we will not be able to issue a permit until we have approved the jurisdictional report on waters of the U.S. for SIU # 4 and until the Final EIS has been approved.

We recommend that drawings be included in the Final EIS that identify the proposed work activities and alignment which also include/identify impacts to the waters of the U.S. Please note that if the project is modified after approval of the Final EIS, and the modification involves impacts to waters of the U.S. not outlined in the EIS, detailed documentation will need to be provided justifying the modification and addressing alternatives regarding avoidance and minimization of impacts to waters of the U.S.

Also, please note that we will not be able to issue a permit until we have received an acceptable detailed compensatory mitigation plan for the unavoidable impacts to waters of the U.S. (including streams, wetlands, and jurisdictional ponds).

If we issue the permit, it may contain conditions that are necessary to address specific environmental issues or other public interest concerns. Some of those issues may be included in the enclosed comments, and others may be minor issues which are not in the enclosed comments.

In summary, we are forwarding the enclosed comments for your information and you do not have to respond. If you wish to respond in any way for consideration in our final decision, we encourage you to do so. However, we intend to finish processing your application as soon as possible. If you do not reply within 15 days, we will assume you are declining this opportunity to respond. If you have any questions concerning this matter, please feel free to write or call me at 573-634-2248 x 104 (FAX 573-634-7960).

Sincerely,

Kenny Pointer
Regulatory Project Manager
Missouri State Regulatory Office

Enclosures

Copies Furnished:

Environmental Protection Agency,
Water Resources Protection Branch wo/enclosures
U.S. Fish and Wildlife Service,
Columbia, Missouri wo/enclosures
Missouri Department of Natural
Resources wo/enclosures
Missouri Department of Conservation
wo/enclosures

HNTB Corporation
Attn: Ken Bechtel
715 Kirk Drive
Kansas City, MO 64105-1310
w/enclosures

Pointer, James K NWK

From: Taylor.Thomas@epamail.epa.gov
Sent: Monday, March 28, 2005 1:08 PM
To: Pointer, James K NWK
Cc: Rick_Hansen@fws.gov; gail.wilson@dnr.mo.gov; Brian.Canaday@mdc.mo.gov; donald.newman@fhwa.dot.gov; Cothern.Joe@epamail.epa.gov
Subject: Public Notice Comments:2004-02229 and -02232 (MoDOT)

MoDOTI-70SIU4&7404.doc

Attached is a copy of EPA comments to the public notices (2004-02229 and -02232) for I-70 projects proposed by MoDOT. If you are interested in receiving a signed copy or a different format from Word, please let me know.

Tom Taylor
Missouri Section 404/Wetlands Program Coordinator
U.S. Environmental Protection Agency
Water, Wetlands and Pesticides Division
Watershed Planning and Implementation Branch
913/551-7226
fax: 913/551-8722
e-mail: taylor.thomas@epa.gov
USEPA: www.epa.gov/owow

(See attached file: MoDOTI-70SIU4&7404.doc)

Kenny Pointer
U.S. Army Corps of Engineers
Missouri State Regulatory Office
221 Bolivar Street, Suite 103
Jefferson City, Missouri 65101

Dear Mr. Pointer:

We reviewed your Public Notice numbers 2004-02229 and 2004-02232, dated February 9, 2005, on applications from the Missouri Department of Transportation for individual Department of Army permits in accordance with ' 404 of the Clean Water Act (33 USC 1344). The applicant is requesting authorization to perform, 1) widening and reconstruction of approximately 18 miles of the existing I-70, Section of Independent Utility (SIU) four near Columbia; and 2) widening and reconstruction of approximately 40 miles of the existing I-70, Section of Independent Utility (SIU) 7 near St. Louis. The proposed projects would be located, 1) just east of, but not including, the Route BB interchange east through the city of Columbia, to just east of the Route Z interchange in Boone County; and 2) just west of Route 19 to Lake St. Louis Boulevard in Montgomery, Warrant and St. Charles counties, Missouri, respectively. Public Notice No. 2004-02229 indicates that the applicant=s project purpose is to accommodate existing and future traffic volumes on I-70, improve existing I-70 design, accommodate all users of I-70, and to improve user safety.

The public notices indicate that an undetermined amount of fill material would be discharged into waters of the U.S. For the Columbia project, a total of 21,600 linear feet of stream, 2.2 acres of jurisdictional ponds and 8.3 acres of wetlands would be filled. For the St. Louis area project, a total of 46,710 linear feet of stream, 1.51 acres of jurisdictional ponds and 2.43 acres of wetlands would be filled.

The Environmental Protection Agency (EPA) is not opposed to the highway widening and reconstruction projects. However, due to the amount of wetland impacts and the significant loss of streams associated with these projects, we believe that serious efforts should be made to mitigate these water resource losses.

Geographically-based Mitigation

The National Environmental Policy Act (NEPA) documents, Interstate 70 Corridor Second Tier Environmental Impact Statement and Section 4(F) Evaluation, October 2004 and Interstate 70 Corridor Section of Independent Utility 7 Draft Improve I-70 Second Tier Environmental Impact Statement, December 2004, noted that earlier discussions on mitigation

CONCURRENCE:H:\WPIB-Old\taylor2\:MoDOTI-70SIU4&7404.doc;3/28/05					
NAME	Taylor	Stockdale			
DIV/BRANCH	WWPD/WPIB	WWPD/WPIB			
SIGN					
DATE					

were held by federal and state natural resource agencies. The agencies identified the potential for three mitigation options: on-site (i.e., at one or several sites), off-site (i.e., wetlands bank), and off-system (i.e., sites identified by another agency for acquisition or on already existing agency property).

EPA generally supports the three geographic options for mitigation. Further, to help ensure the integrity of the watersheds affected by the projects, we support a watershed approach to determining the preferred mitigation area(s). For the Columbia area project, we recommend that such mitigation be focused on the same H.U.C. 8 watershed where the impacts are proposed to occur. For the St. Louis area project which involves more than one H.U.C. 8 watershed, mitigation should be apportioned to the respective H.U.C. 8. This approach will only partially support the idea of mitigation sited within the Loutre River valley (see page III-133 in "I 70 Corridor Second Tier EIS and Section 4(F) Evaluation"). Thus, other mitigation sites would be necessary.

Where it is determined not to be practicable to mitigate within the same H.U.C. 8 watershed, we recommend that mitigation be required in an area located within the same Ecological Drainage Unit (EDU) as denoted by the Missouri Resource Assessment Partnership (MoRAP). [Note: The use of these EDUs was adopted by the interagency Missouri Mitigation Coordination Team consisting of the U.S. Army Corps of Engineers, USDA-Natural Resources Conservation Service, U.S. EPA, and Missouri Departments of Transportation, Natural Resources, and Conservation.] We believe that such non-banked mitigation outside of the watershed of impacts should require a higher ratio (e.g., 2 mitigation units:1 impact unit).

Where banking is deemed appropriate, we recommend that the bank be required to be located within the same EDU as the project impacts and to contain sufficient credits of the same wetland or stream type. We do not support mitigation that is unrelated or outside of the appropriate EDU, unless appropriate mitigation ratio increases are required.

Ecologically-based Mitigation

Numerous individual impacts to a variety of wetland types, perennial and intermittent streams, and ponds were listed in the above mentioned NEPA documents. Although we support the option of consolidating mitigation, particularly for the purpose of ensuring better mitigation success, we believe that, where practicable, the various impacted waterbody types and water regimes should be targeted to better ensure in-kind mitigation. The Cowardin wetland classification system should help for designating types and water regimes. In the case of ponds, the mitigation focus should be more on replacing lost primary functions including floodwater storage, livestock watering, and recreation.

Because the methodology for mitigating impacts to streams is not well advanced in Missouri, we believe that a broad ecosystem approach be used. Within and out of channel

options for improving stream systems should be considered, as they can be very helpful in restoring stream functions such as water quality improvement, recreation, and provisions for fish and wildlife habitat. Examples include: full meander restoration on straightened reaches, daylighting of channels in urban areas, bank grading and stabilization, strategic in-channel placement of grade control structures, boulders and trees, and the establishment or restoration of riparian buffers. We believe significant opportunities exist for the Missouri Department of Transportation to mitigate the many miles of lost streams associated with the proposed projects.

Based on the information in the public notices, we recommend that the permits not be issued without clear wetland and stream mitigation plans in place. Such plans should generally follow available guidelines developed by the Corps. Our agency would be available to assist the Missouri Department of Transportation in any way possible to develop successful mitigation for the proposed projects.

We appreciate the opportunity to provide comments to your public notices. These comments have been prepared in accordance with our authority under the Clean Water Act as amended by the Water Quality Act of 1987. Please keep us informed of the status of this application. If you have any questions about the comments above, please contact Tom Taylor at (913) 551-7226.

Sincerely,

Margaret E. Stockdale
Chief
Watershed Planning and Implementation Branch

cc: Rick Hansen, U.S. Fish and Wildlife Service, Columbia, MO via e-mail
Gail Wilson, Missouri Department of Natural Resources, Jefferson City via e-mail
Brian Canady, Missouri Department of Conservation, Jefferson City via e-mail
Don Neumann, Federal Highway Administration, Jefferson City, MO via e-mail
Joe Cothern, EPA, NEPA Team via e-mail

Pointer, James K NWK

From: Doyle Brown [Doyle.Brown@mdc.mo.gov]
Sent: Thursday, March 10, 2005 4:18 PM
To: Pointer, James K NWK
Cc: don.boos@dnr.mo.gov; rick_hansen@fws.gov; Scott Voney
Subject: Public Notice Permit No. 200402229 (I-70 Segment Boone County)

APPLICANT: Missouri Department of Transportation
Post Office 270
Jefferson City, MO 65102

PROJECT LOCATION: Interstate 70, Section of Independent Utility (SIU) 4. SIU 4 is an approximate 18-mile-section of I-70 located in Boone County from just east of, but not including, the Route BB interchange (exit/mile marker 115), east through the City of Columbia, to just east of the Route Z interchange (exit/mile marker 133).

ACTIVITY: Widening and reconstruction of approximately 18 miles of the existing I-70 facility for six travel lanes outside of Columbia (three lanes in each direction), eight travel lanes through Columbia (four lanes in each direction), frontage roads, and reconstructed interchanges. An undetermined amount of fill material (consisting of soil, rock and concrete) would be discharged into waters of the U.S., including streams, wetlands and jurisdictional ponds for the construction of the roadway embankments and culverts for the additional travel lanes, frontage roads and reconstructed interchanges of the I-70 facility.

All of the stream crossings except two are to utilize reinforced concrete box (RCB) culverts or culvert extensions, and reinforced concrete pipes (RCP) or pipe extensions with the placement of riprap or concrete at culvert outlets. Two new bridges would be constructed, one crossing over Perche Creek and the other crossing over Hinkson Creek. A total of 21,600 linear feet of stream, 2.2 acres of jurisdictional ponds and 8.3 acres of wetlands would be filled. The purpose of the proposed work activities for SIU 4 are to accommodate existing and future traffic volumes on I-70, improve existing I-70 design, accommodate all users of I-70, and to improve user safety. SIU 4 is one of seven SIU's for a study that is being performed on improvements to I-70 for an approximate 200-mile portion between Kansas City and St. Louis.

WETLANDS: An estimate of approximately 8.3 acres of wetlands would be filled (based on NWI mapping/Draft Environmental Impact Statement). Detailed delineations of wetlands and other waters of the U.S. are to be performed for the preferred alignment and the results are to be presented in the Final Environmental Impact Statement.

COMMENTS/RECOMMENDATIONS: The Missouri Department of Conservation has reviewed the information provided in the public notice and has the following comments and recommendations.

Impacts to Aquatic Resources (Wetlands and Streams)

Care should be taken while excavating the sites that soil and other fill materials are not placed in the stream channel that is proposed to remain natural.

Try to minimize disturbance to existing vegetation along the stream banks as the root systems help the stream banks remain stable. The practice of straightening and channelization of streams should be avoided where possible. Plan and design for adequate flood water conveyance (and wildlife passage) at all bridge and culvert crossings,

where practical.

A riparian corridor (woody vegetation) should remain where possible or be reestablished along both sides of the stream. Revegetation of disturbed areas, particularly in riparian areas, should be immediate to protect the aquatic resources and maintain water quality.

Any rock or riprap placed on the stream banks for stabilization or in the stream channel at the pipe outfall should not be grouted (concrete spread on top of the rock).

Minimize the use of heavy motorized equipment within the stream channel to avoid water contamination due to oils and fuel.

The stream bed level should be returned to its natural elevation to avoid head cutting upstream from the construction sites.

Care in handling construction debris when above or adjacent to streams and wetlands will prevent the needless destruction of aquatic habitats. Develop BMPS to prevent falling debris during bridge renovations. Proper disposal of construction debris is encouraged.

Proper BMP's should be installed and maintained throughout the project to reduce sediments entering the streams.

Mitigation should always include avoidance and minimization prior to any compensatory mitigation for impacts to aquatic resources. The use of mitigation banks and payments to the Stream Stewardship Trust Fund may be appropriate for any unavoidable impacts to wetlands and streams.

Impacts to Wildlife

The I-70 corridor poses an issue for safe and adequate migration of wildlife, both aquatic and terrestrial. Plan and design for adequate flood water conveyance (and wildlife passage) at all bridge and culvert crossings, where practical.

Doyle F. Brown
Policy Coordinator
Missouri Department of Conservation
P.O. Box 180
2901 West Truman Blvd.
Jefferson City, MO 65109
(573) 522-4115 Ext 3355
Doyle.brown@mdc.mo.gov

Pointer, James K NWK

From: Don Boos [don.boos@dnr.mo.gov]
Sent: Monday, March 07, 2005 3:46 PM
To: Pointer, James K NWK
Cc: doyle.brown@mdc.mo.gov; rick_hansen@fws.gov; Taylor.Thomas@epamail.epa.gov; Gail Wilson
Subject: RE: Public Notice Permit No. 200402229/CEK002271, MoDOT

The Missouri Department of Natural Resources' Water Protection Program has reviewed Public Notice Permit No. PN04-02229/CEK002271 for development of Interstate 70, Section of Independent Utility (SIU) 4 in which the applicant proposes to widen and reconstruct approximately 18 miles of the existing I-70 facility for six travel lanes outside of Columbia (three lanes in each direction), eight travel lanes through Columbia (four lanes in each direction), frontage roads and reconstructed interchanges. An undetermined amount of fill material (consisting of soil, rock and concrete) would be discharged into waters of the United States, including streams, wetlands and jurisdictional ponds for the construction of the roadway embankments and culverts for the additional travel lanes, frontage roads and reconstructed interchanges of the I-70 facility. All of the stream crossings except two are to utilize reinforced concrete box (RCB) culvert or culvert extensions, and reinforced concrete pipes (RCP) or pipe extensions with the placement of riprap or concrete at culvert outlets. Two new bridges would be constructed, one crossing over Perche Creek and other crossing over Hinkson Creek. A total of 21,600 linear feet of stream, 2.2 acres of jurisdictional ponds and 8.3 acres of wetlands would be filled. The purpose of the proposed work activities for SIU 4 are to accommodate existing and future traffic volumes on I-70, improve existing I-70 design, accommodate all users of I-70, and to improve user safety. SIU 4 is one of seven SIU's for a study that is being performed on improvements to I-70 for an approximate 200-mile portion between Kansas City and St. Louis.

The project is located in an approximately 18-mile section of I-70 in Boone County from just east of, but not including, the Route BB interchange (exit-mile marker 115), east through the City of Columbia, to just east of the Route Z interchange (exit/mile marker 133).

We offer the following comments:

1. A stream, its channel configuration and its adjacent floodplain, including wetlands, ponds and riparian vegetation, are interrelated portions of a dynamic ecosystem that constitute a valuable natural resource. Disruption of this system through filling, relocating, shortening, or changing the shape and vegetation of the stream channel may result in negative impacts on the stream's water quality and associated habitat value. The value of headwater streams, both ephemeral and intermittent, are being increasingly recognized as critical habitat for the breeding, brooding, feeding and other life functions of various aquatic and terrestrial species of wildlife. Channel modifications may cause cumulative impacts to watersheds, including bank instability, loss of aquatic habitat (pool and riffle complexes), bed degradation, and loss of riparian areas, prevention of fish passage and migration and channel incision is likely to occur downstream. Impacts should be avoided and minimized to the extent possible.

2. Wetlands were once a significant component of Missouri's natural heritage, accounting for almost 11 percent of its surface area. Historical wetland losses in Missouri have been significant. This department and other federal and state agencies are directed to implement a policy of no net loss of wetlands in permitting and certification work and, therefore, the wetlands impact should be avoided or minimized if possible.

3. After avoidance and minimization for the project, then impacts must be compensated for. Mitigation for the loss of aquatic stream resources in conformance with the attached *State of Missouri Aquatic Resources Mitigation Guidelines*. The mitigation must be concurrent with the impacts and the mitigation area must be protected by a permanent conservation restriction. The conservation restriction covering this tract must reserve the area for aquatic habitat/wetland protection and wildlife purposes exclusively, and must be filed and recorded as a deed restriction on the property in perpetuity. An acceptable mitigation plan must be presented prior to the rendering of any decision regarding water quality certification.

4. Clearing of vegetation/trees should be the minimum necessary to accomplish the activity.

5. Work should be conducted during low flow whenever possible

6. Any land disturbance activities disturbing one or more acres of total area for the entire project requires a storm water permit from the Water Protection Program for land disturbance activities. Note that this is one acre of area disturbed for the total project, not five acres of waters of the United States. It will be critical that the Best Management Practices for erosion control be adhered to so that the environmental degradation is not exacerbated by erosion into the remaining waterways.

7. The streambed gradient should not be increased during project construction. If a gradient change is unavoidable, the channel modification may require the installation of grade control structures above and/or below the affected area, as well as on tributaries within the affected area, to minimize the movement of streambed materials caused by the modification.

8. Care should be taken to keep machinery out of the waterway as much as possible. Fuel, oil and other petroleum products, equipment and any solid waste should not be stored below the ordinary high water mark at any time or in the adjacent floodway beyond normal working hours. All precautions should be taken to avoid the release of wastes or fuel to streams and other adjacent waterbodies as a result of this operation.

9. The riparian area, banks, etc., should be restored to a stable condition to protect water quality as soon as possible. Seeding/planting of native vegetation, mulching and needed fertilization should be within three days of final contouring, or as soon as possible as seasonal timing permits. On-site inspections of these areas should be conducted by the permittee as necessary to ensure successful revegetation and stabilization, and to ensure that erosion and deposition of soil in waters of the state is not occurring from this project.

10. The following materials are not suitable for bank stabilization and should not be used due to their potential to cause violations of the general criteria of the Water Quality Standards, 10 CSR 20-7.031 (A) – (H):

a. Earthen fill, gravel, broken concrete where the majority of material is less than 12 inches in diameter, and fragmented asphalt, since these materials are usually not substantial enough to withstand erosive flows;

b. Concrete with exposed rebar;

c. Tires, vehicles or vehicle bodies, construction or demolition debris are solid waste and are excluded from placement in the waters of the state; and

d. Liquid concrete, including grouted riprap, if not placed as part of an engineered structure.

Recycled concrete may be used provided that it is clean material broken into appropriately sized pieces (greater than 12 inches) of riprap with no protruding rebar.

11. All necessary Missouri Department of Natural Resources' Water Protection Program permits must be obtained prior to conducting work under a 401 certification.

Thank you for the opportunity to comment on this project. If you have any questions, please call Gail Wilson of the NPDES Permits and Engineering Section at (573) 526-1535.

GW:pc
Attachment

STATE OF MISSOURI AQUATIC RESOURCES MITIGATION GUIDELINES

OBJECTIVE: The goal of the federal Clean Water Act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters including wetlands. These guidelines will help determine the minimum acceptable levels of mitigation in regards to permits issued under Sections 404 and 401 of the federal Clean Water Act for the State of Missouri.

These guidelines were developed by the Missouri Department of Natural Resources (MDNR) with cooperation from the Missouri Department of Conservation (MDC), the U.S. Fish and Wildlife Service (USFWS), the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (COE), the Natural Resources Conservation Service (NRCS) and the Missouri Department of Transportation (MoDOT).

AUTHORITY: These guidelines are intended to comply with the following authorities:

1. Clean Water Act (33 USC 1251 et seq.)
2. National Environmental Policy Act (42 USC 4321 et seq.)
3. Executive Order 11990
4. Missouri Clean Water Law, Chapter 644, RSMO and implementing regulations 10 CSR 20-7.031, Water Quality Standards

The guidelines are consistent with the regulations and policies, including the Water Quality Standards, of the Department of Natural Resources and the Missouri Clean Water Commission as well as other policies or rules of the Department of Natural Resources and the cooperating agencies.

A. Mitigation is defined to include: avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time and compensating for impacts. This definition can be simplified into three general types: avoidance, minimization and compensatory mitigation. These guidelines will address these three general types of mitigation.

   1. Avoidance: No impacts to aquatic resources should occur if there is a practicable alternative to the proposed impacts which would have less adverse impacts to the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. If the impacts to the resource are so significant, the project should not be permitted even if no alternatives are available.

   2. Minimization: Appropriate and practicable steps to minimize adverse impacts will be required through project modifications and permit conditions.

   3. Compensatory Mitigation: Appropriate and practicable compensatory mitigation will be required for unavoidable adverse impacts to aquatic resources which remain after avoidance and minimization have been done to the extent practicable. The COE, or other agency with authority to delineate wetlands using the appropriate delineation manual, will determine the jurisdictional boundaries of wetlands or other waters at the project site.

B. Compensatory mitigation sites shall be recorded as deed restrictions in perpetuity, or some other method as approved by the COE and the MDNR, that will reserve the mitigation area in perpetuity or aquatic resource protection and wildlife purposes.

C. Projects in aquatic areas with federal or state endangered, rare or threatened species must consult with the USFWS and/or MDC for information to avoid/minimize any adverse impacts to these species.

GENERAL CRITERIA

A. Definitions: The following definitions describe the various terms relating to wetland mitigation to be used by MDNR for purposes of these guidelines:

1. *Aquatic Resources:* All aquatic areas which fall under the jurisdiction of Section 404 of the Clean Water Act.

2. *Created Wetland*: The conversion of a persistent non-wetland area into a wetland. Creation techniques vary but usually entail excavation or the construction of berms, levees and water control structures which establish wetland hydrology. Once the hydrology has been introduced, wetland plants may grow naturally, or it may be necessary to transplant desired vegetation from other established wetlands. Even when wetland vegetation is established, it will take an indeterminate amount of time for hydric soils to develop. Thus, created wetlands, also called artificial wetlands, may not meet the criteria for a true wetland for years after its creation.

3. *Degraded Wetland*: A wetland altered through impairment of some physical or chemical property which results in a reduction of habitat value or other reduction of functions.

4. *Enhanced Wetland*: An existing wetland where some activity of people increases one or more values; often with an accompanying decline in other wetland values.

5. *Preservation:* The protection of ecologically important wetlands or other aquatic resources in perpetuity through the implementation of appropriate legal and physical mechanisms. Preservation may include protection of upland areas adjacent to wetlands as necessary to ensure protection and/or enhancement of the aquatic ecosystem.

6. *Restoration*: Wetland restoration is the act of returning an area that was previously a wetland, or is presently a degraded wetland, back to a condition of equal or greater acreage and/or function within the same wetland classification type. In many cases, reestablishing the hydrology is sufficient to reactivate the seedbed that lies dormant in the wetland soil. For example, restoration of a drained wetland may be as simple as removing the drainage tiles or plugging up the drainage ditch that removed the water from the area.

7. *Shrub:* A woody plant which at maturity is usually less than six meters (20 feet) tall.

8. *Tree:* A woody plant which at maturity is usually six meters (20 feet) or more in height.

9. *Watershed*: Watershed or basin areas, for these guidelines, will use the cataloging unit boundaries (eight digit number) as developed by the U.S. Geological Survey (USGS) and shown on the enclosed maps.

10. *Wetland*: Areas which are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

B. Mitigation Site

1. Compensatory mitigation shall occur on-site unless:

   a. On-site mitigation is impractical
   b. On-site mitigation will not adequately replace lost functions
   c. It is determined that off-site mitigation is environmentally preferable considering the type of aquatic resource impacted and the historic loss of aquatic resource types and functions in the watershed.

2. Off-site mitigation shall be conducted: adjacent to or connected with other protected sites in the same watershed unless the applicant demonstrates the impracticality of doing so.

3. Compensatory mitigation shall be done in the same watershed where adverse impacts occurred, unless the impracticability of doing so is demonstrated.

4. Exceptions:

   a. Mitigation for linear projects (i.e., along highway right-of-way or pipelines) with impacts in several watersheds may be done at a single mitigation site.

   b. If mitigation in one site is not possible, mitigation for a single project may be conducted at more than one site and with more than one mitigation technique.

C. Mitigation Type:

1. Mitigation shall be in-kind unless the applicant demonstrates the impracticality of in-kind habitat mitigation or;

2. It is determined that out-of-kind habitat mitigation is environmentally preferable considering the type of aquatic resource impacted, and the historic loss of aquatic resources and the functions and values in the watershed.

D. Mitigation Method: Unavoidable losses to aquatic resources may be compensated for in several ways.

1. Restoration of historic wetlands (i.e., prior converted cropland). This is the preferred method for wetlands compensation.

2. Creation of wetlands in areas where wetlands did not historically exist.

3. Enhancement of existing wetlands. This method should not result in secondary impacts to wetlands or the aquatic system.

4. Preservation of existing wetlands. This method should only be used in unusual circumstances, determined on a case by case basis and will generally receive only partial credit. Therefore, more acreage would be required as compared to other methods of compensation.

5. Other.

   a. Mitigation for aquatic resources besides wetlands should be dealt with case by case since providing wetland acreage may not be appropriate for other aquatic resource impacts. Methods may include: restoring a degraded reach, designing a new reach as close to a natural one as possible or riparian plantings.

   b. Other methods of compensatory mitigation exist. These include banking and in lieu fee. These types of agreements shall be determined on a case by case basis. Applicants wanting to use one of these methods must still go through the avoidance and minimization process. On-site mitigation is preferred unless there is some extenuating circumstance in which off-site mitigation would better serve the resource that is damaged. Any mitigation banks that are used shall be developed by following the current federal guidance for mitigation banks. The first guidance was issued November 28, 1995. This guidance may be fine tuned at a later date to be specific to the State of Missouri.

E. Mitigation Ratios

1. Acreage ratios are useful to ensure consistency among projects and as a surrogate for more complex functional assessment methodologies when seeking to ensure the replacement of lost aquatic habitat including wetland functions. The ratios reflect the uncertainty of mitigation success, the time delay between the loss of functions and the reestablishment of those functions and the value of the aquatic resource from a water quality perspective.

2. The following ratios have been developed by the participating agencies for use in the State of Missouri for wetland creation/restoration. The ratios are intended for use by projects for which the sequencing requirements have been completed and it has been determined at that point that compensatory mitigation is appropriate. The ratios are not intended for enforcement purposes, however, the high end of the range may be an appropriate place to begin negotiations for enforcement cases.

Farmed Wetlands	1.0-1.5
Emergent	1.0-3.0
Shrub-Scrub Wetlands	1.5-3.0
Wooded Wetlands	2.0-4.0
Open Water	1.0
Streams	Case by Case (refer to General Criteria D.5.a. & b.)

These ratios may be increased when:

a. Mitigation is not conducted before or concurrently with a development project.
b. Out-of-watershed mitigation is proposed.
c. Projects impact functioning mitigation sites.
d. Other relevant circumstances make increases in the ratio appropriate.

3. Rare and unique aquatic habitats may not be appropriate for any mitigation and therefore no impacts should occur in these areas. This would include fens, mature bottomland woodland or other areas as described by the current NRCS Missouri categorical exclusion and red flag areas.

F. Wetland Classification (from Cowardin, Classification of Wetlands and Deepwater Habitats

of the United States, FWS/OBS-79/31, December 79

1. "If vegetation (except pioneer species) covers 30% or more of the substrate, we distinguish classes on the basis of the life form of the plants that constitute the uppermost layer of vegetation and that possess an areal coverage 30% or greater. For example, an area with 50% areal coverage of trees over a shrub layer with a 60% areal coverage would be classified as Forested Wetland; an area with 20% areal coverage of trees over the same (60%) shrub layer would be classified as Shrub-Scrub Wetland. When trees or shrubs alone cover less than 30% of an area but in combination cover 30% or more, the wetland is assigned to the class Shrub-Scrub. When trees and shrubs cover less than 30% but the total cover of vegetation (except pioneer species) is 30% or greater, the wetland is assigned to the appropriate class for the predominant life form below the shrub layer."

G. Mitigation Plan

1. All mitigation plans must be submitted and approved before work begins on the project. The applicant must also demonstrate financial and technical capability to do the work and show that a suitable site is available.

2. When possible, mitigation should be completed before project proceeds or completed prior to or at the same time the project is completed. Failure to achieve this may result in increased mitigation ratios.

3. Mitigation plans should include the following information.

   a. Clear statement of objectives;
   b. Description of the wetland functions that will be lost and those that will be replaced;
   c. Statement of the location and description of the baseline elevation and hydrology of the mitigation site;
   d. Detailed construction plan with post-construction contour map, detailed location map and as built drawings;
   e. Plans for establishment of vegetation including what, where and when if planting is proposed. Also, detailed drawings of planting plan and any proposed structures;
   f. Description of a mitigation monitoring program;
   g. Performance standards for site grading, hydrology and plant community establishment, composition and survival;
   h. Contingency plan;
   i. Guarantee that the work will be performed as planned; and
   j. Provisions for long-term management and maintenance.

Pointer, James K NWK

From: Magliola, Lawrence [MagliolaL@health.missouri.edu]
Sent: Thursday, March 24, 2005 6:06 PM
To: Pointer, James K NWK; don.boos@dnr.mo.gov
Subject: I-70 expansion comments

Show-Me Clean Streams is an organization located in Columbia, Missouri dedicated to preserving and enhancing the quality of mid-Missouri streams. We have reviewed the 404 Permit No. 200402229 public notice concerning the expansion of the Interstate 70 corridor. Our comments are contained in the document entitled I-70 eis edit.doc and submitted here as an attachment. In addition, "A Conceptual Framework for Assessing Impacts of Roads on Aquatic Biota" by Paul L. Angermeier, A. P. Wheeler, and A. E. Rosenberger is attached (road impact on aquatics.pdf). Please consider the comments in both of these documents in your water quality certification decision. Thank you for the opportunity to comment on this project. If you have any questions, you may contact Scott Hamilton at 882-9909 ext 3257.

Sincerely,

Larry Magliola
President, Show-Me Clean Streams

Show-Me Clean Streams
4403 South Pinebrook Lane,
Columbia, MO 65203

Show-Me Clean Streams has reviewed the 404 Permit No. 200402229 public notice (Interstate 70 Corridor, Section of Independent Utility #4) ,and offers the following comments:

Avoidance of Impacts

It is the philosophy of the Clean Water Act to first avoid impacts to waters of the U.S., then minimize necessary impacts, and as a last resort, mitigate for their effects. It was stated in Draft 1st Tier EIS on pgII-19 (and elsewhere) that "six lanes are needed to adequately serve future traffic" even in rural areas. This seems excessive in terms of environmental impacts as well as costs to taxpayers. As borne out by Tables I-1, I-2, I-5, in that document, the use of I-70 is not consistent throughout the corridor, and thus the need for lane expansion is not consistent throughout the corridor. Options should be explored that would add capacity only to the areas where lane expansion is needed most, thus avoiding impacts to water and other resources by minimizing stream crossings and other disruptions. While there are traffic congestion problems within Columbia, these are mainly caused by awkward intersection transitions, especially the 63-I70 interchange. Once one is westbound from the Stadium exit, there is no need for an additional lane. Similarly, there is no need of an additional lane when one is eastbound of the Hwy 63 interchange. These are both practicable alternatives that would minimize impacts to jurisdictional waterbodies.

In general, the proposed impacts by the Missouri Department of Transportation (MODOT) average 864 feet per stream crossing, which is an extraordinarily excessive amount, considering that most of the impacts are adding a lane to an existing road. Surely these impacts can be radically reduced.

MODOT has allowed its roads to deteriorate to such a degree that the current condition of our highways is deplorable. If the existing amount of pavement cannot be properly maintained, why does MODOT feel they can take on the burden of maintaining yet more road? The concrete needed for the proposed I-70 highway expansion could be better used to patch the existing potholes found throughout the state's ailing highway system.

Water Quality Issues

In "A Conceptual Framework for Assessing Impacts of Roads on Aquatic Biota" by Paul L. Angermeier, A. P. Wheeler, and A. E. Rosenberger (full article attached to this e-mail), it is reported that many of the long-term water quality impacts of road projects are not adequately considered in EIS documents. Experience in mid-Missouri has shown us that long-term impacts from roads is not addressed in 404 permits or 401 water quality certifications. In their words:

"In addition to physical effects of road presence, there is a suite of acute and chronic chemical effects associated with maintenance activities and vehicular traffic. Deicing salt is commonly applied to roads and eventually enters waterways, where it can dramatically alter ion concentrations or add heavy metals. During runoff events, traffic residues produce a contaminant "soup"of metals, oil, and grease, some of which accumulates in stream sediments or disperses into groundwater. Sublethal effects (e.g., on behavior, growth, or reproduction) of such contaminants seem likely but are largely unknown."

Initial sampling on the Hinkson by DNR staff revealed toxicity related to salt from a MODOT facility, which solidifies the points made by Angermeier et.al . The "improvements" proposed to I-70 are certainly not going to improve water quality in nearby streams, and will almost certainly further degrade them. Since the impairment of the Hinkson is still unknown, and a TMDL still unwritten, the DNR should not issue a 401 certification for a project of this magnitude that will certainly further degrade the quality of the Hinkson and other local streams.

Hydrologic Changes

In general, the increase in the impermeable area caused by the addition of roadway and interchanges will affect the hydrology of the area. This effect will be to diminish the groundwater recharge in the area, in turn diminishing the base flow. The most severe effects will be realized in times of drought, when groundwater discharge is the only input into stream systems. Accordingly, there will be an increase in the peak flow, due to:

1) increases in impermeable surface;
2) reduction of channel length by culvert pipes;
3) reduction of interception of precipitation through continuous mowing/maintenance of grass along right-of-ways;
4) increases in velocity due to reduced roughness within culvert pipes/riprap areas; and
5) shunting of runoff directly into streams through engineered ditches.

Alterations to flow from culverts can have simple or cumulative effects to upstream and downstream areas. If a stream system realizes increased peak flows for the reasons stated above, nearby in-stream structures may begin to fail. For instance,

- downstream road crossings/culverts that were designed to handle historic peak flows may now not have enough hydraulic capacity, and begin to cause localized flooding to roads and/or residences;
- increased velocities may incise channels downstream of the highway crossing, sending headcuts upstream which may cause bank instability from the resultant steeper side slopes. This may jeopardize any structures or roads near upstream banks;
- increased velocity and power from peak flows will increase erosive forces on the outside banks of meanders. This may cause these banks to erode quicker, changing the course of the stream system.

The manipulation of stream crossings without taking these concerns into account would result in increased costs to nearby landowners as well as local public works agencies. This may also cause streams to violate the general water criteria, specifically 10 CSR 20-7.031 (3) C, "Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity...," and G, "Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community."

These hydrologic changes should be assessed in the detailed environmental impact statement, and stormwater management facilities should be included to eliminate any hydrologic changes from pre-construction conditions.

Impact Minimization

Bridges are preferable over culverts because they minimize impacts to aquatic resources. Bridges reduce the amount of stream channelization, are less likely to become clogged with debris, and allow for natural substrate and vegetation to remain in place. In general, culverts should be designed so that they do not change the low-flow characteristics of the streams. Culvert designs that allow the original substrate to remain intact are preferable (e.g., using arches instead of boxes). Efforts should be made to use bio-engineered structures when constructing stream crossings, such as incorporating native plant material into bank stabilization areas. This way, the connectedness of the continuous riparian corridor is maintained, and water quality is improved through shading, interception of run-off, etc. Grade controls may be necessary to control any headcuts/channel incision that may occur from this project.

Roadside ditches that lead to jurisdictional streams should be constructed so that they discharge run-off slowly. A series of check-dams can effectively slow run-off from roadways, as the City of Columbia has proven with a project on Forum Blvd. Concrete trapezoidal ditches should not be used because they invariably fail, leading to soil erosion conveyed directly into streams. MODOT should take a look at the Hwy 63 overpass of Hominy Creek for a prime example of this.

The use of retaining walls, geotextile-reinforced soil, and other soil stabilizing techniques that would minimize impacts to wetlands and/or streams by reducing the length of the side-slopes is recommended.

As mentioned in the "Corridor Enhancement Plan" (Pg. 18) of the draft Tier 1 EIS, efforts should be made to landscape right-of-ways with native plant material that will require little long-term maintenance/mowing. By reducing or ceasing to mow these areas, the amount of water intercepted and retained by vegetation will increase, reducing erosion and peak flows. Vegetation also provides filters and can absorb some roadside contaminants. Using native vegetation will benefit aquatic organisms that have terrestrial life stages and have evolved floristic environmental cues.

Mitigation

Any wetlands impacted by this project will need to be mitigated in conformance with the "State of Missouri Aquatic Resources Mitigation Guidelines" within the watershed impacted. Similarly, any sections of stream lost to channelization need to be mitigated in at least a 1:1 ratio within the watershed. There should be no net loss of water resources within affected watersheds, particularly those on the 303(d) list. The mitigation should begin prior to the filling of wetlands and streams, so that mitigation isn't the last item on the project budget.

Thank you for the opportunity to comment on this project. If you have any questions, you may contact Scott Hamilton at 882-9909 ext 3257.

Sincerely,

Larry Magliola
President, Show-Me Clean Streams

A Conceptual Framework for Assessing Impacts of Roads on Aquatic Biota

ABSTRACT

Roads are pervasive in modern landscapes and adversely affect many aquatic ecosystems. Conventional environmental assessments of roads focus on construction impacts but ignore subsequent impacts. A comprehensive framework for considering all impacts of roads would enable scientists and managers to develop assessment tools that more accurately inform stakeholders and policymakers about the biological consequences of road building. We developed a two-dimensional framework to organize impacts of roads on aquatic biota. One dimension recognizes three phases of road development, each with distinctive ranges of spatial and temporal scales. The second dimension recognizes five classes of environmental impacts associated with road development. The framework is useful in evaluating the completeness of assessments and in identifying gaps in scientific knowledge. We applied the framework to a draft environmental impact statement (DEIS) for a proposed interstate highway to illustrate which road impacts are typically ignored in such assessments and how our framework can be used to enhance assessments. The DEIS largely omitted long-term, large-scale impacts from consideration. Such omissions preclude fair assessments of the desirability of roads and bias landscape-management decisions in favor of road building. Additional scientific input and changes in agency ideology are needed to reduce bias in assessments of the biological impacts of roads.

Paul L. Angermeier
Andrew P. Wheeler
Amanda E. Rosenberger

Angermeier is assistant unit leader—Fisheries, U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit 2, Virginia Polytechnic Institute and State University, Blacksburg. He can be reached at biota@vt.edu. Wheeler is an assistant fisheries biologist at the North Carolina Wildlife Resources Commission, Waynesville. Rosenberger is a post-doctoral researcher at the Rocky Mountain Research Station, Department of Civil Engineering, University of Idaho, Boise.

Introduction

Roads are pervasive features of modern landscapes and have major impacts on air, land, and water quality. The United States has >6.2 million km of public roads used by >200 million vehicles (National Research Council [NRC]1997). Road corridors (road plus maintained parallel strips) cover 1% of the United States (NRC 1997) but their direct environmental impacts extend to 20% of the land surface (Forman 2000). Ecological effects extend 100 to 1,000 m (average of 300 m) on each side of four-lane roads (Forman and Deblinger 2000). These effects, which stem from both construction and use, vary considerably in type and degree among regions and among particular roads (Forman and Alexander 1998; Trombulak and Frissell 2000).

Roads strongly affect the composition and operation of surrounding ecosystems. Natural habitats such as forests, wetlands, and streams are commonly disfigured, fragmented, or contaminated because of roads (Forman and Deblinger 2000; Trombulak and Frissell 2000; Paul and Meyer 2001). Effects on biotic populations and communities can be dramatic and extensive. Major direct effects on wild animals include modified behavior, impaired movement, and mortality from collisions with vehicles (Trombulak and Frissell 2000). Forman and Deblinger (2000) estimated that effects on large mammals, birds, and amphibians typically extended to 300 m on both sides of a four-lane highway in Massachusetts. In addition, key ecological processes, including the transport of water and sediment and the dispersal of organisms, are modified by roads (Forman and Deblinger 2000; Trombulak and Frissell 2000).

Despite the increasing prominence of roads across most landscapes, their impacts on aquatic biota are not well documented. Intuitively, effects on water quality (e.g., via toxic spills and runoff), habitat quality (via sediment loading and channel modification), and habitat connectivity (via barriers to movement) may often be severe. Roads may constrain fish distribution and abundance or impair ecosystem health. Many road crossings over streams constrain movements by small fishes (Warren and Pardew 1998). Such movements are essential for individuals to complete their life cycles and for metapopulations to remain viable (Schlosser and Angermeier 1995). To the extent that roads contribute to fine-sediment loading in waterways, they are serious threats to aquatic biota (Waters 1995; Wood and Armitage 1997). Roads are known to endanger 94 species across many taxa in the United States (Czech et al. 2000) and probably contribute to local extirpation and regional endangerment of many fishes. Managers of fishes and fisheries should be keenly interested in the environmental impacts of roads, especially proposed roads.

Assessing environmental impacts of human activities on public resources is an iterative collaboration among the public, resource managers, and scientists. Roles of the public include articulating the impacts of concern (e.g., through legislation) and hold-

ing managers accountable for assessing those impacts. It is incumbent on managers (often agencies) to implement specific policies and protocols that address societal concerns. This process includes seeking out and applying the best available scientific knowledge and methods to aid in assessing impacts. Implicit in their contract with society, scientists are obligated to develop concepts and methods relevant to societal concerns and to make them available for managers to apply. All three parties must participate actively for environmental impact assessments to serve as intended in the decision-making process.

Current assessments of environmental impacts of roads are inadequate to ensure informed decision-making (Atkinson and Cairns 1992; TRB 2002). Transportation policy in the United States is attentive to stream-channel geometry and soil erosion during road construction but largely ignores many other common consequences of roads for habitat quality, ecological processes, and biota (NRC 1997). In particular, the extensive and serious impacts of post-construction maintenance and of subsequent urban development along roads typically are excluded from agency decisions about building new roads. Thus, direct, localized, or acute impacts are emphasized whereas indirect, dispersed, or chronic impacts are neglected. This bias reflects the typical application of the National Environmental Policy Act (NEPA), wherein attention is narrowly focused on species rather than ecosystems, on site-specific scale rather than regional scale, and on short-term rather than long-term environmental impacts (Southerland 1995), despite the fact that the NEPA requires all reasonably foreseeable impacts to be assessed (Council on Environmental Quality [CEQ] 1993). The mismatch between scales of assessment and impact is especially problematic for roads because there is compelling scientific evidence that long-term, large-scale impacts are the greatest threats to biota. The problem of incomplete assessments of road impacts has been apparent throughout the 14 years that one of us (PLA) has consulted with the Virginia Department of Transportation (VDOT) and the U.S. Fish and Wildlife Service regarding effects of roads on imperiled fishes in Virginia.

This problem of incomplete assessments became more obvious and captured our attention when we recently reviewed VDOT's draft environmental impact statement (DEIS; VDOT 2000) for the proposed construction of a new interstate highway (I-73) through Virginia. We judged the DEIS to be inadequate in its assessment of impacts on the federally endangered Roanoke logperch (*Percina rex*) as well as more general impacts on ecosystem integrity (Wheeler et al. 2003). We suspect that such inadequacy is typical of assessments of road impacts. Our main concern is that omission of major impacts from official environmental assessments like this one precludes a fair evaluation of the actual costs of a new road, biases landscape-management decisions toward more road-building, and thus results in multiple failures to meet goals of the Endangered Species Act and the Clean Water Act.

Aquatic scientists as well as resource management agencies are culpable for inadequate assessments of road impacts. The lack of appropriate assessment tools contributes to the inadequacy of environmental assessments of roads (TRB 2002). The CEQ (1997) has informally outlined eight general principles and many steps useful in analyses of cumulative effects of projects such as roads, but legally binding requirements and an ecological framework for organizing such analyses are lacking. The DEIS for I-73 was based on a very narrow conception of what constitutes environmental impact and of the spatiotemporal frames in which impact is assessed. Perhaps that conception would have been broader if ecologists had provided a straightforward framework to facilitate a more comprehensive assessment of road impacts on aquatic environments. For example, a more complete view might recognize that impacts: (a) occur over multiple spatial and temporal scales, which reflect the overall process of road development, and (b) can be stratified into physical, chemical, and biological categories, which differ in their relative importance at various points in the road development process. A framework incorporating these features would provide a basis for gathering a richer array of relevant information and would enable managers to readily assess the completeness of their impact assessments. Because no such framework has been developed, many impacts, especially long-term and large-scale impacts, can be easily overlooked by managers and the public.

Our goal in this article is to present a comprehensive conceptual framework for considering impacts of roads on aquatic biota. First, we introduce a simple two-dimensional matrix of impact categories to organize and evaluate the myriad aquatic impacts associated with roads. The matrix columns reflect three major phases of road development, each of which generates impacts at a distinctive range of spatiotemporal scales. The matrix rows reflect five major classes of physical, chemical, and biological impacts associated with each development phase. Based on our review of the scientific literature, we rank each of the 15 cells in the matrix (three phases x five classes) with respect to the severity of associated impacts. Next, we draw from our experience with the I-73 DEIS to illustrate general shortcomings of conventional assessments of road impacts in the context of our framework. Finally, we discuss how our framework might be used to redress some of these shortcomings. This discussion is illustrative rather than prescriptive; developing a detailed protocol or methodology to evaluate impacts of roads is beyond the scope of this article. We do not thoroughly review road impacts (see Forman and Alexander 1998, Trombulak and Frissell 2000, and Spellerberg 2002 for previous reviews), but do offer examples from the United States to illustrate types of impacts repre-

sented in the framework. Although we emphasize paved roads, we suspect that the issues we address and the conclusions we draw also apply to most unpaved roads. We expect the framework to be most useful in identifying gaps in environmental impact assessments as well as gaps in scientific understanding of impacts. Although we focus on impacts to fishes, the framework is designed to apply to all aquatic biota.

Matrix Columns: Phases of Road Development

A crucial step in assessing biotic impacts of roads is recognizing that road development is a long-term process and that roads affect environmental conditions over a broad range of spatial and temporal scales. Our review of the literature suggests three main phases of road development, each with a distinctive but cumulative suite of environmental impacts road construction, road presence, and urbanization. Each phase features a distinctive spatial and temporal frame over which aquatic biota are affected (Figure 1), although individual roads vary widely in the details of particular impacts and spatiotemporal frames. Below, we provide a brief overview of each phase and describe general patterns of environmental impacts.

Phase 1: Road Construction

Road construction is characterized by relatively small temporal and spatial frames (days to years, hundreds to hundreds of thousands of square meters, respectively; Figure 1). Environmental impacts of construction largely stem from direct, localized, and acute alterations of physical conditions, including addition of fine-sediments, channelization of streams, and disruption of groundwater flow. Soil erosion associated with construction diminishes rapidly as exposed areas are revegetated and stabilized (Ketcheson and Megahan 1996).

Construction activities can affect aquatic biota directly and indirectly. Operating machinery in shallow-water habitats can destroy nests of animals or crush sedentary individuals (e.g., mollusks). The most serious and common biotic impacts of road construction stem from the indirect effects of elevated levels of fine sediment. Excessive fine sediment interferes with breathing, feeding, reproducing, and food production for many aquatic animals (Waters 1995; Wood and Armitage 1997). Consequently, sediments generated during construction can substantially depress certain populations of invertebrates (e.g., Cline et al. 1982) and fishes (e.g., Whitney and Bailey 1959), thereby producing communities dominated by silt-tolerant species. Reducing the impact of fine sediment generated by road construction is the principal focus of mitigation measures employed by transportation agencies during construction projects (Southerland 1995). For example, the VDOT regularly imposes restrictions on the seasons during which construction can occur and authorizes translocation of sedentary animals from construction sites. However, even though effects of construction-generated sediment may extend several km beyond the construction site and persist for years after construction, large-scale and long-term effects rarely are assessed or studied (but see Wellman et al. 2000).

Phase 2: Road Presence

We view roads passing within 1 km of a water body as being ecologically "present." Of particular concern are roads that cross or have a direct hydrological connection to a water body. Road presence affects aquatic systems over similar spatial frames but larger temporal frames (decades to centuries), compared to road construction (Figure 1). The longer timeframes reflect the fact that few roads are ever restored to natural habitat. Physical impacts of road presence include intermittently recurring effects of maintenance construction (short-term effects), as well as the long-term potential for alterations in stream hydrology and geomorphology. Hydrological effects of roads at the scale of whole watersheds are scarcely studied. However, studies in the Pacific Northwest show that roads increase the magnitude and frequency of floods and debris flows, and ultimately may increase the extent of stream networks (Jones et al. 2000). Thus, many roads may be major sources of sediment throughout their existence.

In addition to physical effects of road presence, there is a suite of acute and chronic chemical effects associated with maintenance activities and vehicular traffic. Deicing salt is commonly applied to roads and eventually enters waterways, where it can dramatically alter ion concentrations (Koryak et al. 2001) or add heavy metals (Oberts 1986). During runoff events, traffic residues produce a contaminant "soup" of metals, oil, and grease, some of which accumulates in stream sediments (e.g., Van Hassel et al. 1980) or disperses into groundwater (e.g., Van Bohemen and Janssen van de Laak 2003). Sublethal effects (e.g., on behavior, growth, or reproduction) of such contaminants seem likely but are largely unknown. Toxic spills are inevitable, potentially catastrophic impacts of large roads. Most hazardous materials, of nearly all types, are transported by truck in the United States

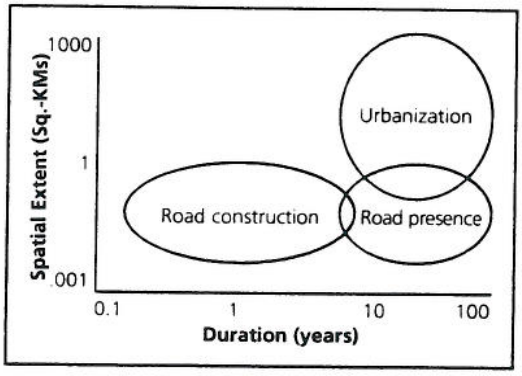

Figure 1. Temporal and spatial extent of biotic impacts due to the three main phases of road development. Road construction occurs over relatively small time and space scales, while urbanization occurs over much larger scales. Note logarithmic scaling of axes.

(Atkinson and Cairns 1992). Over 10,000 accidental releases of hazardous material occur annually on highways in the United States (USEPA 1996); many of these materials eventually reach waterways and devastate local biota.

The biological consequences of road presence are poorly documented. Several studies have shown elevated concentrations of contaminants in aquatic animals near roads (Van Hassel et al. 1980; Stemberger and Chen 1998) but effects on populations and communities are largely unexamined. Roads enhance human access to water bodies, thereby increasing the spread of non-native fishes (e.g., via authorized and unauthorized stocking), mollusks, and pathogens (Trombulak and Frissell 2000). Many roads fragment aquatic habitats at culverts, which can be significant barriers to fish movement (Warren and Pardew 1998; Wellman et al. 2000). Although poorly documented, such barriers could impair recolonization after local extinctions or reduce gene flow. The lack of extensive roadless areas in the United States makes scientific study of road impacts on biota very difficult. Nevertheless, we hypothesize that road density is correlated with increasing predominance of species tolerant to silt, metals, petroleum products, and salt. In areas with frequent toxic spills, predominant species must also be good colonizers. Unfortunately, none of these biological effects of road presence was discussed in the DEIS for I-73.

Phase 3: Urbanization

Urbanization, the final phase of road development, affects aquatic systems across large spatial and temporal frames (up to thousands of square kilometers and centuries respectively; Figure 1). Urbanization, the general transformation from rural or agricultural to residential, commercial, or industrial land use, has accelerated in recent decades and is a major contributor to contamination of surface and ground water and to modification of hydrology in the United States (USEPA 2000). Over 130,000 km of U.S. streams and rivers are impaired by urbanization, making it a leading cause of water-body impairment (USEPA 2000). Moreover, urbanization endangers at least 275 species in the United States, where it is the second-leading cause (next to nonnative species) of species imperilment (Czech et al. 2000).

The relation between road building and urbanization is noteworthy in the context of road impacts on aquatic biota because it is typically ignored in official impact assessments. This omission is puzzling in NEPA-driven assessments (required for all federally funded projects), given that highway projects are one the main types of federal action that cause urban sprawl (Southerland 2004). Effects of urbanization, which may lag behind road construction for decades, are generally excluded from impact assessments despite their severe, well-documented consequences for biota. More explicit recognition of the relation between road building and urbanization and of the effects of urbanization on aquatic biota is crucial to comprehensive assessment of road impacts. Roads, especially highways, are necessary but not sufficient for economic growth (TRB 1995). Although specific effects of new highways on land development patterns are poorly understood (TRB 2002), roads unquestionably facilitate urbanization, including more road building, through their strong influence on the distribution of development (TRB 1995). Although roads are not the sole determinants of economic growth, many highways are built for the express purpose of promoting it. For example, the U.S. Congress authorized building the Appalachian Development Highway System, a 5,535-km network of major highways, to promote economic development in Appalachia. This network, which is 75% complete, has contributed substantially to the region's economic growth (Wilbur Smith Associates 1998). In rural areas, where new highways tend to be built, economic growth is tantamount to urbanization. In some mountainous areas of the eastern United States, roads and urban sprawl generally follow stream valleys (Wear and Bolstad 1998), resulting in especially severe impacts on aquatic biota.

Urbanization affects aquatic ecosystems in many ways (see Paul and Meyer 2001 for a review of effects on streams). Physical and chemical effects of urbanization include all those of road construction and road presence, but are more severe because of greater road densities, more construction, and more vehicular traffic in urban areas. For example, urbanizing watersheds can contribute 10,000 times as much fine sediment to streams as forested watersheds (Wolman and Schick 1967). Urban streams also carry higher concentrations of phosphorous and nitrogen than forested or agricultural streams (Osborne and Wiley 1988).

An additional suite of physical effects on streams emerges in urbanized watersheds in response to hydrologic changes. The proliferation of impervious surfaces fundamentally alters the timing of precipitation runoff, resulting in higher peak flows during storms and lower base flows (e.g., Wang et al. 2001). Roads are often the biggest contributor to impervious area (May et al. 1997). The increased flood frequency causes stream channels to incise (Booth 1990), which may add additional fine sediment to bottom substrates. Consequently, urban streams tend to have deep, wide, silty channels with relatively little water. Although stream channels may naturally adjust to the altered hydrology, such adjustments may take several decades following urbanization (Henshaw and Booth 2000).

Habitat quality in urban streams is often further reduced by active removal of instream woody debris and riparian vegetation. Woody debris is crucial in providing cover for fishes and substrate for invertebrates, and as an agent of pool formation. Vegetation along streams is a key source of organic matter,

including wood, which supports food webs and biotic production. Riparian vegetation buffers streams from inputs of contaminants and fluctuations in temperature and flow (May et al. 1997). Riparian vegetation and large woody debris also help stabilize stream banks and channels.

The physical and chemical changes associated with urbanization strongly influence aquatic biota. Fish abundance often decreases as urbanization increases (Weaver and Garman 1994; Wang et al. 2000). Populations that persist in urban ecosystems must be tolerant to all the insults associated with road construction and presence, as well as to extreme variation in water flow, temperature, and food availability. Consequently, macroinvertebrate and fish communities in urbanized watersheds commonly exhibit low species and functional diversity (Weaver and Garman 1994; Kemp and Spotila 1997). Anadromous fishes are especially sensitive to urbanization (Limburg and Schmidt 1990). Although specific mechanisms are not well understood, biotic impacts are detectable quite early in the urbanization process. Tolerant macroinvertebrate and fish species quickly replace sensitive species as impervious surfaces cover 5–15% of a watershed's area. Biotic communities often change little after impervious land cover exceeds 20% of a watershed (Booth and Jackson 1997; Wang et al. 2000; but see Morley and Karr 2002 for a biotic response when impervious land cover exceeds 50%). Thus, unlike most agricultural land cover, small amounts of urban land cover, especially near streams, can severely impair biota (Wang et al. 2001). Additional study is needed to sort out the relative importance of physical versus chemical effects as the primary drivers of biological changes during urbanization.

Viewing road development in three progressive phases provides a simple framework for organizing the broad range of spatial and temporal scales over which biota are affected by roads. The three phases can serve as one dimension in categorizing the types of impacts that resource managers might need to assess. Each phase is associated with a distinctive suite of physical, chemical, and biotic effects; some effects in each phase are often severe. Ecologically organized categories for these effects would complement the phases of road development and serve as a second dimension in a framework for assessing road impacts. We suggest five such categories in the next section.

Matrix Rows: Classes of Factors Affecting Biota

For environmental impact assessments to be useful in public decisions, the assessors must clearly address the environmental concerns of society. These concerns are articulated in cornerstone pieces of federal legislation such as the Clean Water Act, which explicitly mandates the protection of aquatic biological integrity. This mandate provides an appropriate, well-established foundation for assessing impacts of roads on aquatic biota, where impacts are departures from the range of natural conditions for a given region. Important strengths of the integrity concept are that it applies to multiple levels of biotic organization (e.g., individual, population, community) and a wide range of spatiotemporal scales (Angermeier and Karr 1994). Incorporating biological integrity into assessments of road impacts will yield assessments that are more comprehensive and public decisions that are more informed.

The major determinants of biological integrity in aquatic ecosystems are commonly represented as five classes of factors: habitat structure, water chemistry, flow regime, energy source, and biotic interactions (Angermeier and Karr 1994; Karr and Chu 1998). Habitat structure encompasses physical features such as water depth, current velocity, and substrate composition, which form the habitat matrix in which aquatic organisms live. Water chemistry comprises parameters such as pH, dissolved oxygen, and contaminant concentrations. Flow regime refers to temporal patterns in the availability of water, especially seasonal and annual variability. Energy source encompasses aspects of size, abundance, and nutritional quality of food particles. Biotic interactions include competition, predation, and parasitism. These five classes provide an ecological framework for organizing the long lists of specific physical, chemical, and biological effects of roads. Moreover, based on our review of the scientific literature, we hypothesize that roads differentially and predictably influence classes of factors throughout the process of road development. To illustrate, we briefly summarize below typical trends in how these classes of factors are affected in a water body near to and downstream of a four-lane highway during the three phases of road development.

The primary impacts of road construction are linked to earth-moving, which directly alters stream channel morphology and indirectly accelerates fine-sediment loading by exposing soils to erosion. These alterations are manifest as shifts in descriptors of habitat structure such as channel depth, pool-to-riffle ratio, percent fines in substrates, and cover availability (Figure 2). Effects on the other four classes of factors are typically minor and localized.

Effects on habitat structure decrease somewhat during the road presence phase but effects on water chemistry and flow regime increase substantially (Figure 2). Changes in water chemistry commonly associated with contaminants from roads include elevated concentrations of salt, metals, and petroleum products. Toxic spills from trucks could cause catastrophic changes in various water-chemistry parameters. The extensive impervious surface of a highway would increase the frequency and magnitude of floods. If these increases were large, habitat structure (e.g., channel depth, percent fines) could be

affected. Although effects on energy source and biotic interactions are not expected to be large, they may become apparent during the road presence phase. Removal of riparian trees and shrubs, which often begins during road construction, may reduce the availability of coarse particulate organic matter and the ratio of allochthonous-to-autochthonous production. Introduced non-native species could cause shifts in the distribution, abundance, or size of native species.

Road impacts generally increase in severity and scope throughout the road development process. Urbanization strongly affects all aspects of aquatic ecosystems (Figure 2) and undermines biotic integrity more severely than the other phases of road development. Moreover, because the ecological effects of urbanization extend well beyond the immediate vicinity of roads, this is the phase most likely to threaten entire aquatic populations and community-types. Habitat evaluations in urbanized waterbodies are likely to reveal reduced spatial complexity, increased embeddedness of substrates, and unstable streambanks. A wide assortment of contaminants, including oil, metals, and pesticides, may impair quality of water and sediment. The hydrology of urban watersheds is likely to feature frequent and severe floods and low-flows, with reduced recharge of groundwater. Urban waters are typically eutrophic with simple food webs. The resulting biotic communities usually support higher proportions of non-native species and of native ecological generalists, all of which must be tolerant of poor water quality and frequent disturbance.

Applying the Conceptual Framework

Collectively, the three phases of road development and five classes of ecological factors form a tractable framework for organizing impacts of roads on aquatic biota. The framework can be depicted as a 15-cell matrix, where each cell's relative importance reflects the magnitude of expected effects shown in Figure 2. For simplicity, we assigned one of two ranks (high versus low impact) to each cell (Figure 3). These ranks provide a basis for prioritizing attention to monitoring, mitigation, or restoration efforts, as might be needed to meet the goals of the Clean

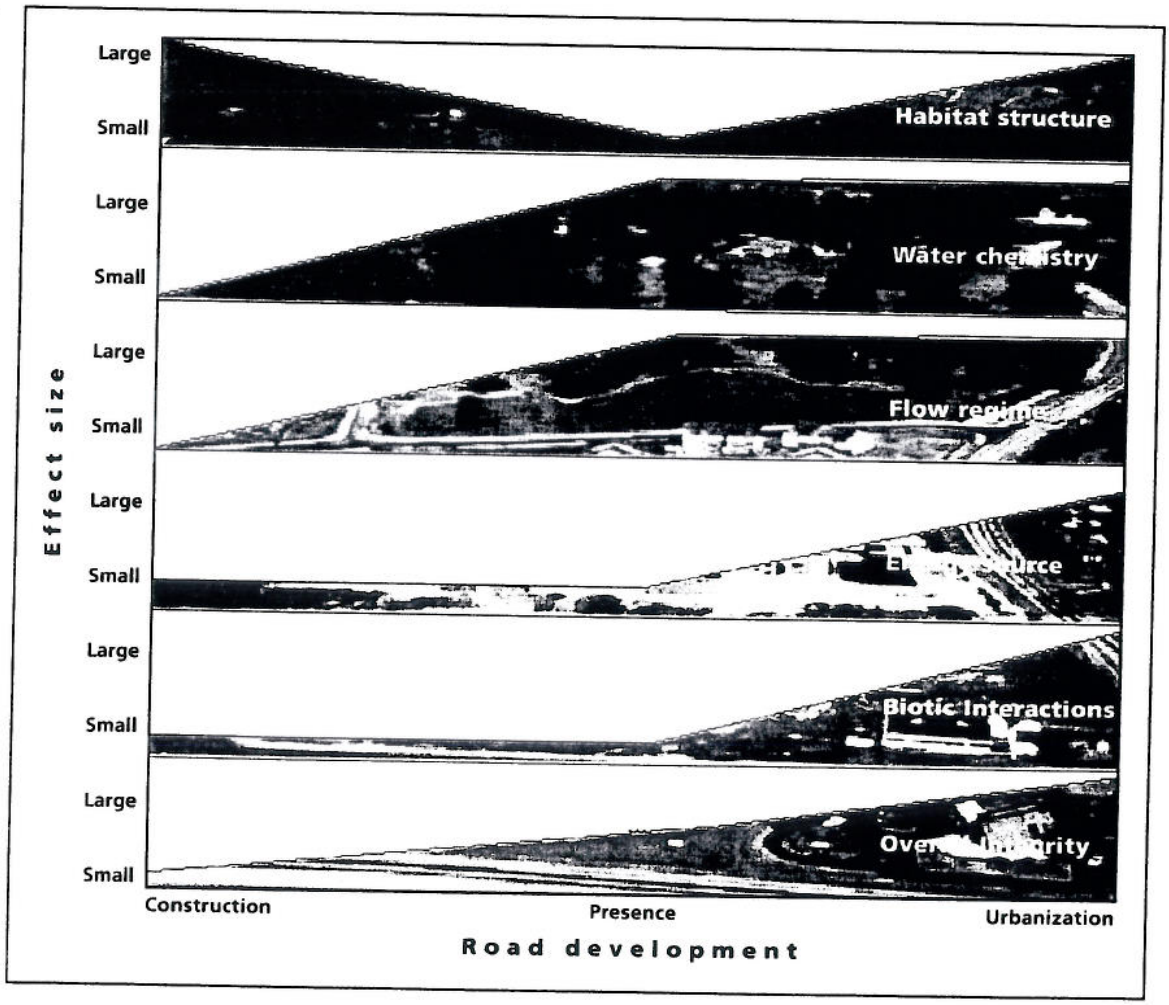

Figure 2. Hypothesized size of effects of road development on five classes of factors that determine biotic integrity of aquatic ecosystems. The size of overall effects on biotic integrity also is shown.

Water Act or the Endangered Species Act. For example, protecting a stream's biological integrity or imperiled species would dictate paying more attention to the impacts of road presence or urbanization than to the impacts of road construction, and more attention to impacts on habitat structure, water chemistry, and flow regime than to impacts on energy source and biotic interactions (Figure 3).

Cell ranks are effectively working hypotheses based on best available scientific information. Our cell ranks (Figure 3) reflect our collective best guesses, and warrant additional rigorous evaluation. Ideally, sound scientific information would support the ranks in every cell. In reality, the information available for cells will vary widely in how confidently it can be applied to a given road, and may come from studies of the road in question, studies of other roads, and expert opinion. The science that informs some cells (perhaps most) will necessarily be uncertain and come from inferences based on weights of evidence (Holling and Allen 2002) rather than from readily interpreted experimental studies. In any case, compiling the information relevant to each cell for each assessment is crucial to the general utility of this framework and to the cost-effective protection of aquatic biota. Despite the uncertainty of some of the information supporting cell ranks, we believe that impact assessments based on such a framework would provide a much broader knowledge base for informing decision-makers and stakeholders about the biological consequences of building roads than do conventional assessments.

We view our matrix as one of many tools that can be used to conceptualize and analyze environmental effects of roads (CEQ 1997). We expect it to be especially useful in scoping ecological consequences and in gauging the thoroughness of a given impact assessment. The I-73 DEIS that we reviewed appeared seriously incomplete because the impacts associated with only 2 of the 15 cells (and only 1 of the 8 high-impact cells) were addressed (Figure 3). A more appropriate assessment would have reviewed the scientific literature on the effects of roads on (a) Roanoke logperch (and closely related species), (b) biotic integrity of streams generally, and (c) other key resources (e.g., wetlands), then discussed those effects in the context of all 15 cells in our matrix. The DEIS discussed impacts on habitat structure and water chemistry during road construction but neglected all other impacts. This pattern is especially troubling because the I-73 DEIS appeared to follow standard Federal Highway Administration (FHA) guidelines for such documents. We suspect that most assessments of environmental impacts of roads are similarly superficial. In fact, there are several reasons to expect the I-73 DEIS to be more comprehensive than most. For example, the huge social, economic, and environmental costs of a new interstate and the potential impacts on federally endangered species should provide strong incentives for a thorough assessment. Given that the U.S. Environmental Protection Agency recently lauded the VDOT as "a model of environmental leadership" (VDOT 2003), VDOT's investment in environmental assessments seems well within the range of what is expected of a road management agency. The sharp contrast between the scope of an impact assessment based on our framework (i.e., with all 15 cells addressed) and the scope of an actual assessment for a proposed interstate suggests that current standards for environmental management by road agencies are too low to ensure protection of aquatic biota.

The inadequacies we observed in the I-73 DEIS reflect failures by both managers and scientists. The authors of the DEIS based their assessment of impact primarily on unpublished reports rather than on peer-reviewed literature, and on a narrow conception of what constitutes environmental impact. However, the scientific literature does not provide a useful framework for conducting comprehensive assessments of road impacts on aquatic environments. Consequently, many impacts can be overlooked easily by managers and stakeholders. Current approaches to environmental management recognize the need for explicit analysis at multiple spatial and temporal scales and for making the scale at which management occurs commensurate with the scale of human impact: (Fausch et al. 2002). The severity and extent of road impacts warrant assessments more complete than those traditionally conducted, including more attention to large-scale and long-term effects. Adopting our framework could help road managers develop more comprehensive assessments of road impacts on aquatic biota. For example, assessments might be structured so that each cell in our matrix is addressed in its own section of text.

Our framework may also be useful in identifying important gaps in the scientific knowledge germane to road impacts. Even if managers did adopt our impact matrix to organize their assessments, the scientific literature pertinent to some cells would be disconcertingly sparse, especially for post-construction impacts and biotic interactions. Thus, ecologists need to do a better job of calling attention to the importance of road impacts for aquatic biota by conducting and publishing studies that demonstrate impacts at individual, population, and community levels of organization. Our review of the literature identified several gaps in scientific knowledge that cut across cells in our impact matrix and warrant additional study (Table 1). The ranks (high versus low) assigned to the cells in our matrix are effectively hypotheses about the magnitude of vari-

Figure 3. Hypothetical matrix of road impacts that could be used to scope potential impacts or to evaluate completeness of impact assessments. Cells are ranked as high (H) or low (L) likelihood of significant impacts occurring. Assigned ranks would be based on region-specific conditions. The two cells addressed in the I-73 draft environmental impact statement are indicated by bold letters.

	Construction	Presence	Urbanization
Habitat structure	**H**	L	H
Water chemistry	**L**	H	H
Flow regime	L	H	H
Energy source	L	L	H
Biotic interactions	L	L	H

ous impacts. A major goal of the science related to road impacts, including research and monitoring, should be to distinguish confidently between high- and low-impact cells. Generating the relevant knowledge will require scientists and managers to take fuller advantage of rural areas where additional road-building is imminent and to create areas where road removal is politically feasible. Both scenarios could provide valuable experimental opportunities to learn about biotic responses to roads. Other opportunities to build scientific knowledge could come from experimental studies of the efficacy of the many protective and restorative measures available to agencies. In all cases, knowledge of long-term and/or large-scale relations would be especially valuable. However, building reliable knowledge will require a much greater fiscal and philosophical commitment to scientific assessment of road impacts than is currently in force.

Socio-political Constraints

We observed a major discrepancy between the greatest threats posed by I-73 and the focus of its DEIS. In particular, threats to Roanoke logperch and ecosystem health stemmed primarily from long-term, large-scale effects, especially those due to urbanization, but the DEIS addressed only certain short-term, small-scale effects of road construction. This discrepancy reflects the range of interpretations available for what constitutes biological threat in the context of official impact assessments and underscores the inadequacy of conventional interpretations for protecting aquatic biota. Interpretations of "threat" have important consequences for how legislation is implemented. For example, under Section 7 of the Endangered Species Act habitat impairment associated with roads is usually considered "incidental take" (unintended harm). Incidental take during road construction is minimized via time-of-year restrictions and implementation of various "best management practices," but incidental take during the more harmful post-construction phases of road development typically is not addressed. A more comprehensive interpretation of threat and management of the associated incidental take would enable more effective conservation of imperiled species. However, the process of defining threat and impact for regulatory purposes is driven more by politics than by science.

The narrow focus maintained by state and federal agencies on short-term, small-scale impacts reflects a broader fundamental problem with the implementation of environmental policy in the United States. Several federal laws, including the Federal-Aid Highway Acts, the Intermodal Surface Transportation Efficiency Act, and the Transportation Equity Act for the 21st Century, call for systematic consideration of social, economic, and environmental impacts of roads and for more public engagement in transportation planning (TRB 2002). States have much flexibility in satisfying these mandates but traditionally have given environmental concerns less weight than short-term economic and political priorities in highway-planning decisions (Atkinson and Cairns 1992). The NEPA requires agencies that use federal funds for road-building to develop EISs that consider all reasonably foreseeable environmental effects, including direct and indirect effects (FHA 2002). Because little formal federal oversight has been provided (e.g., by the CEQ), agencies independently have developed protocols for analyzing cumulative effects of roads (CEQ 1997). Unfortunately, a consistent pattern is that "road impacts" have been constrained to mean "road construction impacts" in the context of NEPA implementation. Effects of road construction are viewed as direct effects, whereas effects of road presence and urbanization, although quite foreseeable, are relegated to indirect (or secondary) effects. Thus, agencies generally abrogate their responsibilities to address environmental consequences beyond the actual building of roads.

Although many experts agree that environmental assessments of new highways should include direct, indirect, and cumulative effects (Atkinson and Cairns 1992; FHA 2002; TRB 2002), progress in making such assessments standard practice has been dismayingly slow. Knowledge of many indirect effects of roads has existed for decades and guidelines for considering these effects in assessments have been available for more than ten years, but agency protocols for explicitly addressing indirect effects in impact assessments remain largely undeveloped and these effects rarely influence project decisions (FHA 1992). Also, the CEQ has not yet promulgated legally binding guidance to protect against cumulative effects or the loss of biodiversity

Table 1. Key topics needing additional scientific study relevant to assessments of road impacts on individuals, populations, and communities of aquatic biota.

1. Role of road-crossings in impairing movement/dispersal by individuals.
2. Role of roads in facilitating spread of non-native individuals via human vectors.
3. Relative importance of the three road-development phases in influencing population dynamics.
4. Contribution of roads to local extinction and regional imperilment of populations.
5. Type, magnitude, and direction of shifts in functional composition (e.g., trophic or reproductive traits) of communities in response to roads.
6. Influence of zoogeographical and regional contexts on impacts of roads.
7. Interactions (synergistic and antagonistic) between impacts of roads and impacts of other anthropogenic activities.
8. Effectiveness of protective and restorative measures in preventing/reducing impacts of roads.
9. Timeframes for recovery of biota following mitigation of road impacts.
10. Biotic responses to road removal.

associated with road development (CEQ 1993, FHA 2002). Thus, current assessment tools do not incorporate the best available science and are inadequate to ensure informed decisions on highway planning (TRB 2002), as illustrated by our analysis of the I-73 DEIS (Figure 3). Additional research on the environmental effects of roads and on protocols for assessing those effects has some potential to improve the information value of conventional impact assessments. However, we suspect that agencies' lack of commitment to environmental concerns rather than a lack of scientific knowledge currently limits effectiveness of assessments of road impacts. Agency commitment to protecting aquatic biota reflects the mores of society at large. Public agencies will provide real protection to aquatic biota only when the public holds those agencies accountable for the continual decline in biological integrity and in the many ecological services that intact biota provide to society.

Conclusions

Roads have major impacts on aquatic biota but these impacts traditionally have been grossly underassessed. Ignoring long-term, large-scale environmental impacts of roads, which are often severe and foreseeable, clearly fails to fulfill the intent of key federal legislation on environmental protection. The public has not held road-building agencies accountable for meeting its mandate to fully assess road impacts. Rectifying this problem requires fundamental changes in how road impacts are defined, measured, and incorporated into policy decisions. In particular, the spatial and temporal extent of assessments must be expanded to match the scales over which the most serious biological impacts of road development are manifest.

Aquatic science should play a more prominent role in assessing road impacts. Investment by transportation agencies in research on environmental consequences of roads has been too small relative to the extent and severity of impacts (TRB 2002). Many effects of roads on aquatic biota are poorly studied, especially over large spatial and temporal scales. Agencies also need to do a better job of finding, disseminating, and using the scientific knowledge that is already available. Important sources of relevant scientific knowledge include scientists themselves, scientific literature, and other agencies involved in environmental issues. Although the impacts of a particular road on nearby areas are not precisely predictable, we present a conceptual framework to help managers organize the many common impacts of roads on aquatic biota.

The purpose of an environmental impact assessment is to describe the likely consequences of a human action so that society can make an informed decision about its desirability (i.e., cost versus benefit). Lack of attention to long-term, large-scale impacts (i.e., major costs), as is common in assessments of roads, precludes fair assessments of desirability. Thus, decisions are biased in favor of more road building, which contributes to the continued, unsustainable urbanization of landscapes. Because remediation of most road impacts is infeasible, efforts to protect aquatic ecosystems are best applied to changing the decision-making processes that precede road building rather than to fixing the damage caused by roads while and after they are built. Indirect and cumulative effects of a road on environmental quality should be considered explicitly in the planning stages, especially if the road's purpose includes spurring economic development (FHA 1992). More complete assessments of the real environmental costs of roads would likely result in less road building and slower rates of urban sprawl. Our conceptual framework is designed to facilitate development of complete assessments of the biological impacts of roads.

Given the tremendous social, economic, and environmental costs of new roads, especially highways, we believe that more thorough approaches to assessing biotic impacts are long overdue. The proliferation of roads (and their attendant impacts) now occurring in the United States is not an inevitable condition of modern society, but a policy outcome. Road policy can be changed. Agency ideology, not scientific knowledge, is the main factor limiting the completeness of environmental assessments. Although scientists should continue to generate new knowledge and tools relevant to assessing road impacts, the main breakthrough needed is in societal commitment to protecting intact biota and fully functional ecosystems. It remains up to the agencies and the publics they serve to muster the political will to reinvent road policy.

Acknowledgments

A.P. Wheeler's review of the literature on aquatic impacts of roads was supported by Virginians for Appropriate Roads. We thank William Hester, Than Hitt, Kim Mattson, and three anonymous reviewers for helpful comments on early drafts of the manuscript.

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STATE OF MISSOURI
Matt Blunt, Governor • Michael D. Wells, Acting Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

February 2, 2005

Kenny Pointer
Missouri State Regulatory Office
221 Bolivar Street, Suite 103
Jefferson City, Missouri 65101

Re: Missouri Department of Transportation Application No. 200402229 (COE & FHWA) Boone County, Missouri

Dear Mr. Pointer:

Thank you for submitting information on the above referenced project for our review pursuant to Section 106 of the National Historic Preservation Act (P.L. 89-665, as amended) and the Advisory Council on Historic Preservation's regulation 36 CFR Part 800, which requires identification and evaluation of cultural resources.

We have reviewed the information provided concerning the above referenced project. The U.S. Federal Highway Administration and Missouri Department of Transportation have already initiated the Section 106 review and comment process. We have no additional comments at this time.

Please be advised that, should project plans change, information documenting the revisions should be submitted to this office for further review. In the event that cultural materials are encountered during project activities, all construction should be halted, and this office notified as soon as possible in order to determine the appropriate course of action.

If you have any questions, please write Judith Deel at State Historic Preservation Office, P.O. Box 176, Jefferson City, Missouri 65102 or call 573/751-7862. Please be sure to include the SHPO Log Number **(013-BO-05)** on all future correspondence or inquiries relating to this project.

Sincerely,

STATE HISTORIC PRESERVATION OFFICE

Mark A. Miles
Director and Deputy State
Historic Preservation Officer

MAM:jd

c Joe Cothern, EPA
Peggy Casey, FHWA
Bob Reeder, MoDOT

Prairie Band Potawatomi Nation
Government Center

February 7, 2005

Kansas City District
US Army Corps of Engineers
700 Federal Building, 601 East 12th Street
Kansas City, Missouri 64106-2896

Dear **Sir of Madam:**

I am writing to inform you that I am in receipt of your recent National Historic Preservation Act (NHPA), Section 106 and Section 110 correspondence.

After reviewing the contents of your recent mailing we would like to inform that we have no objections to the following project(s):

Project(s): Permit Nos. 200500428, 200500440, 200402229, and 200402232

At this time we are unaware of any historical cultural resources in the proposed development area. However, we do request to be immediately contacted if any inadvertent discoveries are uncovered at anytime throughout the various phases of the project.

Please feel free to call me at (785) 966-4007 or additional information can be faxed to (785) 966-4009. We look forward to working with you.

Respectfully,

Zach Pahmahmie
Tribal Chairman
NAGPRA Representative
Prairie Band Potawatomi Nation

ZP/vrs

Iowa Tribe of Oklahoma

R.R. 1, Box 721
Perkins, Oklahoma 74059
(405) 547-2402
Fax: (405) 547-5294

2/10/2005

US Army Corps of Engineers
Attn: Kenny Pointer
221 Bolivar St., Ste 103
Jefferson City, MO 65101

Re: Project 200402229

Dear Kenny Pointer,

We received the notification of the of your districts improvement program. I understand that some of the project is a previous improvement and you do not foresee any impact of Native American or Euro-American archaeological resources. Please keep the Iowa Tribe of Oklahoma informed if anything new is discovered.

The historical preservation of the Iowa Tribe of Oklahoma is very important. Many religious and cultural artifacts have been discovered. During excavation if anything is unearthed please give me a call at 405-547-2402 ext. 323 or e-mail me at etipton@iowanation.org.

Thank you for your cooperation in this matter.

Sincerely,

E Tipton

Erin C. Tipton
Historical Preservation
Iowa Tribe of Oklahoma

EASTERN SHAWNEE TRIBE
OF OKLAHOMA

P.O. Box 350 · Seneca, MO 64865 · (918) 666-2435 · FAX (918) 666-2186

February 17, 2005

Missouri State Regulatory Office
Attention: Mr. Kenny Pointer
221 Bolivar Street
Suite 103
Jefferson City 65101

RE: 220402232, Montgomery, Warren, and St. Charles Counties, MO
RE: 200402229, Boone County, MO
RE: 200500565, Harrison County, MO
RE: 200401552, Grundy County, MO

To Whom It May Concern:

Thank you for notice of the referenced project(s). The Eastern Shawnee Tribe of Oklahoma is currently unaware of any documentation directly linking Indian Religious Sites to the proposed construction. In the event any items falling under the Native American Graves Protection and Repatriation Act (NAGPRA) are discovered during construction, the Eastern Shawnee Tribe request notification and further consultation.

The Eastern Shawnee Tribe has no objection to the proposed construction. However, if any human skeletal remains and/or any objects falling under NAGPRA are uncovered during construction, the construction should stop immediately, and the appropriate persons, including state and tribal NAGPRA representatives contacted.

Sincerely,

Jo Ann Beckham

Jo Ann Beckham
Administrative Assistant

Charles Enyart, Chief
Eastern Shawnee Tribe of Oklahoma

Sac & Fox Nation of Missouri in Kansas & Nebraska

305 North Main St., Reserve, KS 66434
Phone: (785) 742-7471 Fax: (785) 742-3785

May 19, 2005

Kenny Pointer
U.S. Army Corps of Engineers
Missouri State Regulatory Office
221 Bolivar Street, Suite 103
Jefferson City MO 65101

Dear Mr. Pointer;

Thank you for your letter, which is in compliance with Section 106 of the National Historic Preservation Act, and Section 110. I apologize for the late response to your letter.

Project: Permit No. 200402229
Boone County, MO

The Sac and Fox Nation of Missouri in Kansas and Nebraska NAGPRA department have determined the above project as:

No objections. However, if human skeletal remains and/or any objects falling under NAGPRA are uncovered during construction, please stop immediately and notify NAGPRA representative Deanne Bahr, at the address above.

There are two other bands of Sac and Fox that also need to be contacted, the Sac and Fox Nation of Oklahoma and the Sac and Fox of the Mississippi in Iowa.

Johnathan Buffalo
Sac and Fox of the Mississippi in Iowa
349 Meskwaki Rd.
Tama, IA 52339-9629

Sandra Massey
Sac and Fox Nation of Oklahoma
Rt. 2, Box 246
Stroud, OK 74079

If you have any questions, please contact me at the number or address above.

Sincerely,

Deanne Bahr
Sac and Fox Nation of Missouri in Kansas and Nebraska
NAGPRA Contact Representative

PUBLIC NOTICE

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Permit No. 200402229
Issue Date: January 21, 2005
Expiration Date: March 28, 2005

US Army Corps
of Engineers
Kansas City District

JOINT PUBLIC NOTICE: This public notice is issued jointly with the Missouri Department of Natural Resources, Water Pollution Control Program. The Department of Natural Resources will use the comments to this notice in deciding whether to grant Section 401 water quality certification. Commenters are requested to furnish a copy of their comments to the Missouri Department of Natural Resources, P.O. Box 176, Jefferson City, Missouri 65102.

APPLICANT: Missouri Department of Transportation
Post Office 270
Jefferson City, MO 65102

PROJECT LOCATION (As shown on the attached drawings): Interstate 70, Section of Independent Utility (SIU) 4. SIU 4 is an approximate 18-mile-section of I-70 located in Boone County from just east of, but not including, the Route BB interchange (exit/mile marker 115), east through the City of Columbia, to just east of the Route Z interchange (exit/mile marker 133).

AUTHORITY: Section 404 of the Clean Water Act (33 USC 1344).

ACTIVITY (As shown on the attached drawings)**:** Widening and reconstruction of approximately 18 miles of the existing I-70 facility for six travel lanes outside of Columbia (three lanes in each direction), eight travel lanes through Columbia (four lanes in each direction), frontage roads, and reconstructed interchanges. An undetermined amount of fill material (consisting of soil, rock and concrete) would be discharged into waters of the U.S., including streams, wetlands and jurisdictional ponds for the construction of the roadway embankments and culverts for the additional travel lanes, frontage roads and reconstructed interchanges of the I-70 facility. All of the stream crossings except two are to utilize reinforced concrete box (RCB) culverts or culvert extensions, and reinforced concrete pipes (RCP) or pipe extensions with the placement of riprap or concrete at culvert outlets. Two new bridges would be constructed, one crossing over Perche Creek and the other crossing over Hinkson Creek. A total of 21,600 linear feet of stream, 2.2 acres of jurisdictional ponds and 8.3 acres of wetlands would be filled. The purpose of the proposed work activities for SIU 4 are to accommodate existing and future traffic volumes on I-70, improve existing I-70 design, accommodate all users of I-70, and to improve user safety. SIU 4 is one of seven SIU's for a study that is being performed on improvements to I-70 for an approximate 200-mile portion between Kansas City and St. Louis.

WETLANDS: An estimate of approximately 8.3 acres of wetlands would be filled (based on NWI mapping/Draft Environmental Impact Statement). Detailed delineations of wetlands and other waters of the U.S. are to be performed for the preferred alignment and the results are to be presented in the Final Environmental Impact Statement.

ADDITIONAL INFORMATION: Additional information about this application may be obtained by writing Kenny Pointer, U.S. Army Corps of Engineers; Missouri State Regulatory Office; 221 Bolivar Street, Suite 103; Jefferson City, Missouri 65101, by calling 573-634-2248 extension 104 (FAX 573-634-7960) or via email at james.k.pointer@usace.army.mil. All comments to this public notice should be directed to the above address.

CULTURAL RESOURCES: Kansas City District will comply with the National Historic Preservation Act of 1966 and 36 CFR 800. An architectural and historic investigation was conducted for the SIU 4 project area and four properties were determined to be eligible for listing in the National Register of Historic Places (NRHP) and one property (the Candlelight Lodge Retirement Center) is currently listed on the NRHP. Based on information that we have received, MoDOT concluded that the proposed project would impact one architectural resource, the Bowling Napier Estate. This is the extent of our knowledge about historic properties in the permit area at this time. However, we will evaluate input by the State Historic Preservation Officer and the public in response to this public notice, and we may conduct or require a reconnaissance survey of the permit area to check for unknown historic properties, if warranted.

ENDANGERED SPECIES: The federally-listed endangered Indiana Bat (Myotis sodalis) may occur within the project area. In order to complete our evaluation of this activity, comments are solicited from the U.S. Fish and Wildlife Service and other interested agencies and individuals.

FLOODPLAINS: This activity is being reviewed in accordance with Executive Order 11988, Floodplain Management, which discourages direct or indirect support of floodplain development whenever there is a practicable alternative. By this public notice, comments are requested from individuals and agencies that believe the described work will adversely impact the floodplain.

WATER QUALITY CERTIFICATION: Section 401 of the Clean Water Act (33 USC 1341) requires that all discharges of dredged or fill material must be certified by the appropriate state agency as complying with applicable effluent limitations and water quality standards. This public notice serves as an application to the state in which the discharge site is located for certification of the discharge. The discharge must be certified before a Department of the Army permit can be issued. Certification, if issued, expresses the state's opinion that the discharge will not violate applicable water quality standards.

PUBLIC INTEREST REVIEW: The decision to issue a permit will be based on an evaluation of the probable impact including the cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefits which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including the cumulative effects thereof; among those are conservation, economics, esthetics, general environmental concerns, wetlands, cultural

values, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs and, in general, the needs and welfare of the people. The evaluation of the impact of the activity on the public interest will include application of the guidelines promulgated by the Administrator, Environmental Protection Agency under authority of Section 404(b) of the Clean Water Act (33 USC 1344). The Corps of Engineers is soliciting comments from the public; Federal, state, and local agencies and officials; Indian Tribes; and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments are used in preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

NATIONAL ENVIRONMENTAL POLICY ACT: The Corps of Engineers, Kansas City District (Corps) is a cooperating agency for preparation of a Second Tier Environmental Impact Statement (EIS) for this project by the Federal Highway Administration (FHWA) and the Missouri Department of Transportation (MoDOT). If we accept the Final Second Tier EIS for SIU 4, it will satisfy the requirements of the National Environmental Policy Act pertaining to Corps review of this project. Copies of the Draft Second Tier EIS for SIU 4 are available for review beginning January 14, 2005 at the following locations:

- Missouri Department of Transportation, General Headquarters, 105 West Capitol Avenue, Jefferson City, MO 65102
- Missouri Department of Transportation, District 5 Office, 1511 Missouri Boulevard, Jefferson City, MO 65102
- Columbia Planning and Development Department, 701 E. Broadway, Columbia, MO 65205
- Columbia Chamber of Commerce, 300 South Providence, Columbia, MO 65203
- Commission Office, Boone County Government Center, 801 E. Walnut, Columbia, MO 65201
- Columbia Public Library, 100 West Broadway, Columbia, MO 65203

COMMENTS: This notice is provided to outline details of the above-described activity so this District may consider all pertinent comments prior to determining if issuance of a permit would be in the public interest. Any interested party is invited to submit to this office written facts or objections relative to the activity on or before the public notice expiration date. Comments both favorable and unfavorable will be accepted and made a part of the record and will receive full consideration in determining whether it would be in the public interest to issue the Department of the Army permit. Copies of all comments, including names and addresses of commenters, may be provided to the applicant. Comments should be mailed to the address shown on page 2 of this public notice.

PUBLIC HEARING: The Corps of Engineers, Kansas City District will hold a joint public hearing with the FHWA and MoDOT at the following time and location:

Wednesday, February 23, 2005
4-7 p.m. Open House
Knights of Columbus Hall
2525 North Stadium Boulevard
Columbia, MO 65202

As required by an agreement between the Department of the Army, the Department of Transportation and the Environmental Protection Agency to implement the Intermodal Surface Transportation Efficiency Act of 1991, the Corps' public interest review is being merged with the FHWA's National Environmental Policy Act review and the applicant's corridor improvement study. The scheduled hearing will serve for all three agencies reviews. For the Corps, the public hearings will provide an opportunity for all concerned persons to present information which will be used by the Corps to complete the evaluation of the application for a Department of the Army permit. Officials of other agencies, local governments and all other persons will have an opportunity to express their views. The public is invited to contribute additional information concerning the proposed project. Oral and/or written statements are welcome. Written statements may either be presented to the Presiding Officer or any representative of the Corps, FHWA or MoDOT at the hearing, or mailed to the Kansas City District, Corps of Engineers no later than March 28, 2005.

The application for a Department of the Army Permit is on file and may be inspected at the Missouri State Regulatory Office, U.S. Army Corps of Engineers, 221 Bolivar Street, Suite 103, Jefferson City, Missouri, between 7:30 a.m. and 4:00 p.m., Monday through Friday.

NOTICE TO EDITORS: This notice is provided as background information for your use in formatting new stories. This notice is not a contract for classified display advertising.

Examination of historic files find no properties documented within project area that meet criteria of traditional value. Archaeological material could likely be encountered which requires immediate notification.

Date 1/25/05

Project ID# FE-20040229

Approved by Kathleen A. Welch

WYANDOTTE NATION, WYANDOTTE, OK