APPENDIX A4 GUIDELINES FOR RRR PROJECTS

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SECTION 1 - GUIDELINES FOR RRR PROJECTS

OBJECTIVE

The objective of the Virginia RRR Guidelines is to provide guidelines in the selection of projects where, with minimal improvements, the service life of the existing highway can be extended for a fraction of the cost of complete reconstruction.

Resurfacing, restoration, and rehabilitation (RRR) projects primarily involve work on an existing roadway surface and/or subsurface. In addition to extending the service life of the roadway, the purpose of RRR projects includes providing additional pavement strength, restoring or improving the existing cross section, decreasing noise characteristics, improving the ride of the roadway, improving bridges, and enhancing safety through the implementation of appropriate safety improvements, bridge improvements and preventive maintenance of bridges on appropriate Federal-Aid roadways. Highway Bridge Replacement and Rehabilitation Program (HBRRP) Funds may be utilized for preventative maintenance (PM) for the purpose of system preservation activities on Federal-Aid roadways except for those classified as local roads or rural minor collectors. Routine maintenance remains the responsibility of VDOT and/or locality.*

Section 309 of the *National Highway System Designation Act of 1995* (23 USC 116) states: “A preventive maintenance activity shall be eligible for Federal assistance under this title if the State demonstrates through the use of a systematic process, such as a Bridge Management System, to the satisfaction of the Secretary that the activity is a cost-effective means of extending the useful life of a Federal-Aid highway.”

The scope of a RRR project is influenced by many factors. Factors include roadside conditions, environmental concerns, changing traffic and land use patterns, surface deterioration rate, accident rates, funding constraints and scenic/historic areas.

Although RRR type improvements are normally accomplished within the existing right of way, the acquisition of additional right of way may be necessary. Horizontal and vertical alignment modifications, when required, are generally minor.

* Rev. 1/06

AUTHORITY

The Transportation Research Board's *Special Report 214, Designing Safer Roads, Practices for Resurfacing, Restoration, and Rehabilitation, 1987*, was the result of a study on safety cost-effectiveness of highway geometric design standards for RRR projects. Virginia has developed and adopted this guideline for non-NHS RRR projects.

In the planning and design of any Secondary System improvements in rural areas, Virginia's RRR Guidelines shall be utilized to the extent possible.

Reconstruction under AASHTO design guidelines should be proposed on these projects only when the preliminary study report documents either:

1. The needed improvement is ineligible for development under the RRR concept.
   or
2. Extenuating circumstances preclude the use of the RRR Design concept.

Virginia RRR Guidelines may be utilized in improvements to urban streets for which the localities receive maintenance payments.

DEFINITIONS

These definitions apply to RRR projects and are not an attempt to be all-inclusive of other related activities.

Maintenance - This work is directed toward preservation of the existing roadway and related appurtenances as necessary for safe and efficient operation. Design improvements are not normally the intent of maintenance operations. Seal coats, overlays less than 2 inches* thick, crack sealing, etc., are considered maintenance items, and are not RRR activities.

Resurfacing - The addition of a layer, or layers, of paving material to provide additional structural integrity or improved serviceability and ride ability.

Restoration - Work performed on pavement, or bridge decks, to render them suitable for an additional stage of construction. This may include supplementing the existing roadway by increasing surfacing and paving courses to provide structural capability, and widening up to a total of ten feet. Restoration will generally be performed within the existing right of way.

Rehabilitation - Similar to "Restoration", except the work may include restoring structural integrity or correcting major safety defects of bridges, reworking or strengthening the base or subbase, recycling or reworking existing materials to improve their structural integrity, adding underdrains, improving or widening shoulders, and shifts in both vertical and horizontal alignment involving less than 50 percent of the project length. Rehabilitation may require acquisition of additional right of way.

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* Rev. 1/10

Reconstruction - This type of project is not considered RRR activity. A reconstruction project is designed in accordance with AASHTO design guidelines for new and major reconstruction projects and may include significant changes in cross section and shifts in both vertical and horizontal alignment. If 50 percent or more of the alignment changes, the project will be considered reconstruction. Reconstruction may require acquisition of additional right of way and may include all items of work usually associated with new construction.

PROJECT SELECTION

Projects are identified and selected based on a variety of factors with the pavement condition being of utmost importance. The pavement condition itself will not have a significant effect on the extent of geometric improvements included in the project. Geometric improvements will be initiated to fulfill traffic service/safety needs.

Logical project termini are to be set; and, at no time, are project exceptions for segments of roadway or bridge, etc., to be established within the project termini due to excessive cost to provide the required improvements.

ELIGIBILITY

Improvements to Existing Roadway*:

Eligible Items of Work *

- Minor alterations to vertical and/or horizontal alignment.
- Minor lane and/or shoulder widening.
- Pavement structure and joint repair.
- Resurfacing (non-maintenance activities).
- Removal or protection of roadside obstacles.
- Repairs to restore bridge structural integrity, installation of deck protective systems and upgrading substandard bridge rail.
- Culvert Extensions.
- Repair or replace culverts.
- Restoration & relocation of curbs and gutters, raised medians, storm sewers, and other urban type improvements.

* Rev. 1/06

- Some RRR-type projects may be funded with either regular Federal-Aid or separate categorical aid.

  Examples:

  Bridge rehabilitation project - RRR funding or the bridge replacement and rehabilitation program.

  Roadside hazard removal and guardrail installation - RRR funding or hazard elimination program funds.

Ineligible Items of Work

- National Highway System (NHS). However some projects may be eligible, see "PREVENTIVE MAINTENANCE (PM) PROJECTS / RRR PROJECTS UTILIZING FEDERAL FUNDING ON NATIONAL HIGHWAY SYSTEM (NHS) ROADWAYS" at the end of Section 1 for guidelines.
- New or additional through lanes.
- New Curbs and gutters, raised medians, storm sewers, and other new urban type improvements.

ACCIDENT RECORDS

Evaluation of accident records often reveals problems requiring special attention. In addition, relative accident rates can be an important factor in establishing both the priority and the scope of RRR projects.

The Project Manager must request from the Traffic Engineering Division that the accident history for the project area be compiled and compared to the statewide average accident rate for the same type of road. This data review can be an integral part of the RRR project development process so that feasible safety modifications can be incorporated into the project as necessary.

The accident analysis shall be completed prior to the project field inspection/review and available for field review by the Federal Highway Administration.

BRIDGE REHABILITATION OR REPLACEMENT SELECTION POLICY

See VOLUME V – PART 2 DESIGN AIDS AND TYPICAL DETAILS, Chapter 6 – Geometrics, which can be accessed at *http://www.virginiadot.org/business/bridge-manuals.asp.* *

ENVIRONMENTAL CONSIDERATIONS

An environmental evaluation and documentation thereof, is required on all RRR Federal participation projects in accordance with current guidelines.

* Rev. 1/12

Prints are transmitted to the Environmental Engineer via Form *LD-252*.

ACCESS CONTROL

Generally, a RRR project will not be designated as a limited access highway due to the project being along an existing corridor with access provided to adjoining properties.

The elimination of existing access to properties is beyond the scope of work for RRR projects.

Existing limited access roadways may qualify as a RRR project.

PROJECT DEVELOPMENT

It is desirable that these projects be designed to meet the standards for new construction. If meeting these standards is not practical, due to limited funding, right of way and/or environmental restrictions, etc., improvements in roadway widths should still be considered.

The design should not decrease the existing geometrics. Widths selected should be consistent throughout a given section. Minor lane and shoulder widening is acceptable. While additional new continuous traffic lanes are an ineligible type of work, the existing pavement may be widened up to a total of ten feet.

ROADWAY AND TRAVELWAY WIDTHS

The minimum roadway and travelway widths are shown under GEOMETRIC DESIGN CRITERIA, Table A4-1. Lane and shoulder width requirements are provided for roadways with 10% or more trucks and for roadways with less than 10% trucks.*

Wide lanes and shoulders provide motorists with increased separation between overtaking and meeting vehicles and an opportunity for safe recovery of vehicles leaving the road.

Additional safety benefits include reduced interruption of the traffic flow as the result of emergency stopping and road maintenance activities, less pavement and shoulder damage at the lane edge, and improved sight distance for horizontal curves.

* Rev. 7/12

DESIGN TRAFFIC VOLUMES

Traffic projections should be checked to assure that:

- The anticipated traffic being used is correct and that the roadway and travelway needs will be properly accommodated for the service life of the improvement.
- The project service life for RRR projects should be from 8 to 12 years.
- Turning movements are obtained at signalized and problem intersections and at major traffic generators.
- Future traffic generators that are anticipated to be established during the service life should be considered.

DESIGN SPEED

The design speed designated for a RRR project should be logical with respect to the character of terrain and type of highway and should be as high as practicable.

It is also important to consider the geometric conditions of adjacent sections of roadway when considering a RRR project. A uniform design speed should be maintained for a significant section of highway.

The design speed is a determining factor for required lane and shoulder widths.
The following two methods may be used to determine the project design speed:

(1) Select an overall project design speed that equals or exceeds the posted or regulatory speed on the section of highway being improved.

(2) The average running speed throughout the project based on the "low volume" off peak hour traffic.

Average running speed is the speed of a vehicle over a specified section of highway, being the distance traveled divided by the running time (the time the vehicle is in motion).

An equivalent average running speed can be obtained on an existing facility where flow is reasonably continuous by measuring the spot speed.

The average spot speed is the arithmetic mean of the speeds of all traffic at a specified point.

For short sections of highway on which speed characteristics do not vary materially, the average spot speed may be considered as being representative of the average running speed.

On longer stretches of rural highway, spot speeds measured at several points, where each represents the speed characteristics pertinent to a selected segment of highway, may be averaged (taking relative lengths into account) to represent the average running speed.

TERRAIN

Terrain is a significant factor which must be given strong consideration when establishing design criteria for a highway project. High design speeds (50 MPH and greater) can generally be achieved on flat terrain, and lower design speeds (45* MPH and lower) are generally dictated by rolling and mountainous terrain, (depending upon road classification). Intermediate design speeds are determined by a combination of these factors.

While terrain is an important factor to be considered when designing a new project, RRR projects must be designed considering all existing constraints, and held within RRR parameters. That is to say that eligible RRR elements, due to terrain and other constraints upon the original design, may not allow the desired speed and safety enhancements.

SAFETY

All safety elements of the project are to be given specific consideration. Accidents, accident types, and accident rates for the project length shall be examined and documented.

The documentation may indicate deficiencies in one or more of the following areas, however, each should be examined:

Horizontal and vertical alignment
Cross-sectional geometrics
Traffic control
Access
Railroad crossings
Pedestrian facilities
Bridges that remain in place
Illumination
Signing
Channelization
Intersections
Pavement edge drop offs
Pavement surface condition
Maintenance of traffic
Bicycle facilities

Improvements to the roadway surface may result in increased operating speeds. Geometrics should be examined and modified, if necessary, to maintain an acceptable level of operational safety.

Horizontal and vertical curvature and stopping sight distance are directly related to the speed of vehicles and major deviations from the desirable design may cause serious problems. These geometric characteristics can be the most difficult and costly to improve. Although every sight distance restriction can create a potential hazard, improvement on that basis alone may not be practical on every RRR project.

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* Rev. 7/12

If curvature is shown to be the cause of numerous accidents, some corrective action should be taken. This corrective action can range from some form of positive guidance, which may include placement of additional warning signs and markings, to reconstruction.

Alignment improvements should be undertaken when accident experience is high, and if previously installed warning signs, markings, or other devices have not proven effective. In many cases, under both rural and urban conditions, existing horizontal and vertical alignments may be retained if a careful analysis indicates they can be adequately signed and marked.

Sight distance on horizontal curves, and at intersections, can often be improved by minor cut slope flattening, selective clearing or both. If such work is done, the actual sight distance must be measured, the maximum safe speed determined, and the location signed and marked accordingly.

A completed Roadside Safety Assessment is required to be performed by the responsible District Traffic Engineer. [*] This will provide information regarding areas of potential concern relating to safety.

For safety, it is desirable to provide a roadside recovery area that is as wide as practical, but because of existing topographic features and right of way limitations associated with RRR work, considerable judgment must be used. The clear zone must be given particular attention at identified high roadside accident locations (fixed object and run-off-the-road accidents). An evaluation should be made to determine the consistency of the clear zone throughout the project limits.

Widening to provide more clear distance through short sections of rock cuts should be considered. In longer rock cuts, protrusions should be cut back or shielded if warranted. A review of accident data will help to define dangerous obstructions. Good engineering judgment, cost effectiveness, and consideration of community impact may also influence decisions.

[*] Rev. 1/17

Under urban conditions the minimum setback for any obstructions should be as close to the right of way line as possible or 1.5 feet behind the curb. Where sidewalks are to be included, it is desirable to locate all obstructions behind the sidewalk.

Safety items for reducing the severity of run-off-the-road accidents include traffic barriers (including bridge rails), flattening slopes to eliminate the need for either existing barrier or contemplated barrier placement, crash cushions, breakaway or yielding sign supports, and breakaway luminaire supports.

The priority for action relative to roadside hazards is to:

- Remove or redesign
- Relocate
- Make breakaway
- Redirect by using appropriate barrier
- Delineate

To enhance safety, all RRR projects should provide the following:

Evaluation of existing traffic barrier and end treatments to determine whether they are necessary and meet applicable guidelines and standards. The extent to which the barrier must be upgraded should be consistent.

Appropriate transition and connection of approach rail to bridge rail.

Mitered end sections for both parallel and cross-drain structures located in the clear zone.

Relocating, shielding, or providing breakaway features for sign supports and luminaires.

Protection for exposed bridge piers and abutments.

Drop inlets with traversable grates that are not a hazard to be used within the clear zone.

GEOMETRIC DESIGN CRITERIA

The design criteria in Table A4-1* for Minor Arterial, Collector and Local Road projects are based on the general approach in the "AASHTO Green Book" regarding functional classification and appropriate design volumes and recommendations presented in *TRB Special Report 214, Practices for Resurfacing, Restoration, and Rehabilitation.*

MINIMUM LANE AND SHOULDER WIDTH VALUES								
ARTERIAL/ COLLECTOR/ LOCAL ROAD AND STREET SYSTEMS								
DESIGN TRAFFIC VOLUME	DESIGN SPEED MPH	10% OR MORE TRUCKS (d)			LESS THAN 10% TRUCKS (d)			DITCH WIDTH 3:1 FRONT SLOPE
		LANE WIDTH		SHOULDER WIDTH (c)	LANE WIDTH		SHOULDER WIDTH (c)	
ADT		C&G	W/SHLD		C&G	W/SHLD		
(a)	(b)	(FT.)	(FT.)	(FT.)	(FT.)	(FT.)	(FT.)	(FT.)
1 - 750	< 50 ≥ 50	11 (e) 11	10 (e) 10	2 (i) 2 (i)	10 11	9 10	2 (i) 2 (i)	3 (h) 3 (h)
751 - 2000	< 50 ≥ 50	11 12	11 (f) 12 (g)	2 (i) 3 (i)	11 11	10 11	2 (i) 3 (i)	3 3
2001 - 4000	ALL	12	12	6	11	11	6	4
4001 - OVER	ALL	12	12	6	11	11	6	4

TABLE A4-1* GEOMETRIC DESIGN CRITERIA

(a) Design traffic volume is between 8 and 12 years from completion.
(b) Highway segments should be classified as "Under 50" only if most vehicles have an average running speed of less than 50 MPH over the length of the segment.
(c) Cut shoulder width may be reduced by one foot in mountainous terrain.
(d) Trucks are defined as heavy vehicles with six or more tires.
(e) Use 9' lane width for Rural/Local Road System with ADT of 1 - 250.
(9' lane width is equal to new construction standards for Rural/Local Road System)
Use 10' lane width with Curb and Gutter for Urban with ADT 1-250
(10' lane width is equal to new construction standards)
(f) Use 10' lane width for Collector Road and Local Road System in mountainous terrain. (10' lane width is equal to new construction standards.)
(g) Use 11' lane width for Collector Road and Local Road System in level terrain. (11' lane width is equal to new construction standards.)
(h) Use 2' ditch width with pavement depths (excluding cement stabilized courses) of 8" and less.
(i) Minimum width of 4' if roadside barrier is utilized (minimum 2' from edge of pavement to face of G.R.). (See Guardrail Installation Standard, Section 500, in VDOT Road and Bridge Standards).

NOTE: PAVEMENT AND SHOULDER WIDTHS NOTED ARE MINIMUMS FROM A DESIGN CRITERIA STANDPOINT. UNDER NO CIRCUMSTANCES SHALL THE EXISTING PAVEMENT OR SHOULDER WIDTHS BE REDUCED TO CONFORM TO THESE MINIMUM STANDARDS.

NOTE: FOR VALUES NOT SHOWN, SEE APPROPRIATE GEOMETRIC DESIGN STANDARD FOR THE FUNCTIONAL CLASSIFICATION OF ROADWAY (GS-2, GS-3 OR GS-4) CONTAINED IN THE VDOT *ROAD DESIGN MANUAL*, *APPENDIX A1, SECTION 1*.

NOTE: ROADSIDE HAZARDS AND PRIORITY FOR RELATIVE ACTION ARE COVERED IN RDM *APPENDIX A2**

NOTE: AUXILIARY / TURN LANES SHOULDERS ARE TO BE THE SAME AS THE MAINLINE. SEE CHART ABOVE; IF NOT A DESIGN WAIVER IS NEEDED.

* Rev. 10/20

CLEAR ZONES AND SLOPES

Wherever possible, existing side slopes should not be steepened when widening lanes and shoulders. When the initial slopes are relatively flat, however, the slope can be steepened to 6:1 with little effect, and steepening to 4:1 may be reasonable.

Consideration should be given to flattening side slopes of 3:1 or steeper at locations where run-off-the-road type accidents are likely to occur (e.g. on the outsides of horizontal curves). Accident data should be used (when available) to substantiate run-off-the-road accident locations.

Removing, relocating or shielding of isolated roadside obstacles should be evaluated in accordance with the Clear Zone and Traffic Barrier Guidelines contained in the *Road Design Manual*, *Appendix A2* and *Appendix A3.*

GRADES

Grades generally do not need to be flattened on RRR projects. Steep grades and restricted horizontal or vertical curvature in combination, however, may warrant corrective action.

CREST VERTICAL CURVES

An existing vertical curve may be retained as is, without further evaluation, if the existing design speed provides the stopping sight distance within 15 MPH of the overall project design speed and the average daily traffic volume is less than 750 vehicles per day.

Reconstruction of crest vertical curves is to be evaluated when the above speed and traffic volumes are exceeded and the vertical curve hides major hazards from view. Major hazards include, but are not limited to intersections or entrances, sharp horizontal curves and narrow bridges.

SAG VERTICAL CURVES

Substandard sag vertical curves should be investigated to ensure that potential hazards do not exist, especially ones that become apparent when weather conditions, or darkness, reduce visibility.

STOPPING SIGHT DISTANCES

Guidelines for determining the existing sight distances of vertical and horizontal curves are as follows:

- Existing road data to be determined from survey plan and profile sheets and/or old plans obtained from the plan library.
- Section 600 of the *Road and Bridge Standards SD-1 and SD-4* may be used to determine the sight distances using the following methods:

  Vertical curves - Determine algebraic differences of grades in percent and length of vertical curve in feet from the survey plans, or old project plans, and the sight distance may be obtained from Standard SD-4.

  Horizontal curves - Determine the existing degree of curve and the middle ordinate or radial distance from centerline of inside lane to obstruction to view and the sight distance may be obtained from Standard SD-1.
- Vertical and horizontal curve sight distances may be scaled from the plans using the following heights of driver's eye and object:

Sight Distance	Height of Eye	Height of Object
Stopping	3.5'	2’
Passing	3.5'	3.5'

HORIZONTAL CURVES

An existing horizontal curve may be retained as is, without further evaluation, if the existing curve design speed, with correct superelevation provided, corresponds to a speed that is within 15 MPH of the running speeds of approaching vehicles and the average daily traffic volume is less than 750 vehicles per day.

Reconstruction of horizontal curves should be considered and evaluated when the above speed and/or volume criteria are exceeded.

When a roadway segment consists of a series of reverse curves or curves connected by short tangents, the succession of curves shall be analyzed as a unit rather than as individual curves.

The first substandard curve in a series should receive special attention because this change in alignment prepares the driver for the remaining curves in the series.

Any intermediate curve in a series of substandard curves that is significantly worse than the others in the series should be analyzed individually.

These controlling curves can be used to determine the safety and/or other mitigation measures to apply throughout the series.

PAVEMENT CROSS SLOPE

Pavement resurfacing or rehabilitation will be accomplished such that the finished pavement on tangent sections will be crowned in accordance with new construction standards.

SUPERELEVATION REQUIREMENTS

Standard superelevation will be provided on all curves to comply with the project design speed unless the following conditions exist:

Excessive cost to provide superelevation.

Excessive property damage.

Superelevations may be provided for design speeds up to a maximum of 15 MPH less than the project design speed for current traffic volumes of 750 vehicles per day or less, if the above conditions exist, with appropriate signing:

Advisory curve signs and speed limit signs will be erected.

PAVEMENT EDGE DROP

Pavement edge drops usually are caused by resurfacing of pavement without regrading the existing shoulder or erosion of gravel, turf, or earth shoulder materials.

This hazard shall be eliminated or mitigated by utilizing one or more of the following practices:

Paving the full top width between shoulder breaks.

Selectively paving shoulders at points where vehicle encroachments are likely to create pavement edge drops, such as on the inside of horizontal curves.

Constructing a beveled or tapered pavement edge so that any edge drop that develops has a reduced impact on the recovery maneuver.

Reconstruction of shoulders.

INTERSECTIONS

Many intersection improvements can be made at a relatively low cost and are safety cost-effective, particularly at higher traffic volumes.

The intersection improvements must be tailored to site-specific conditions and rely heavily on professional judgment and experience along with current Department guidelines.

DESIGN EXCEPTIONS

All efforts should be made to adhere to the standards stated herein. However, it may be necessary to use values that are less than the minimum values shown. If lesser values are proposed for use, a design exception will be needed and approval by the State Location and Design Engineer and the Federal Highway Administration on Federal aid funded projects must be granted before developing the project further.

Methods of showing design exceptions on the plans are noted in Instructional and Informational Memorandum *IIM-LD-227*. Design Exceptions are to be requested on Form *LD-440*, maintained on the VDOT website at *http://vdotforms.vdot.virginia.gov/*. If approved, the completed Form *LD-440* is to be attached to *Form PM-100*[*] Scoping Report for submittal at advertisement stage.

PLANNING DRAINAGE DESIGN ELEMENTS

The hydraulic consequences of a highway improvement need to be addressed during the planning phase of the project.

Failure to assess the hydraulic aspects of the improvement could result in an increase in damages to adjacent property as well as the highway facility. Although detailed site information may not be required, it is important that a hydraulic assessment be made by a drainage engineer in the planning phase to determine that engineering and regulatory constraints can be met.

Items to be considered include:

- Hydraulic impacts
- Interaction with other agencies
- Utilities
- R/W and property owners' concerns
- Environmental concerns and permits

REPLACEMENT OR REHABILITATION OF DRAINAGE ELEMENTS

The decision to rehabilitate or replace a structure should not be made without checking hydraulic adequacy. Normally, the highway designs that improve upstream flooding conditions should generally result from meeting highway flooding criteria. Scour protection, spur dikes, or other protective measures should be included with the bridge rehabilitation.

The decision regarding the rehabilitation or replacement of existing bridges or culverts is often a structural or functional decision. Hydraulic input is important when the cost of the rehabilitation is high enough to consider replacement or where the contemplated rehabilitation involves a change in the roadway profile which, by lessening roadway overflow, could increase hydraulic stresses on the structure and change flow distribution.

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[*] Rev. 7/16

Rehabilitation or replacement of culverts often becomes necessary when the culvert is no longer structurally sound. Consideration of the remaining service life of the existing culvert is, therefore, a very important factor in deciding to rehabilitate or to replace it.

In some instances, structures may require replacement due to inadequate waterway area and subsequent frequent interruption of traffic due to flooding. Prolonged ponding behind an embankment caused by an inadequate culvert may also lead to embankment saturation or piping along the culvert.

HYDRAULIC CHARACTERISTICS

The hydraulic considerations for RRR improvement projects are, in many respects, the same as those for a highway on new alignment. The primary difference is that the hydraulic characteristics of the existing facility are already established. These hydraulic characteristics include:

- Culvert performance (inlet or outlet control or headwater at culvert sites).
- Culvert outlet velocities and scour tendencies.
- Flow lines and culvert alignment.
- Backwater at bridge sites.
- Flow distribution.
- Scour patterns at bridge piers, bridge abutments and adjacent banks.
- Skew and channel alignment.
- Storm drain systems and their performance.

The engineer must consider the need for changing and the consequences of changes to these hydraulic characteristics.

Most improvement projects will require some modification of the existing drainage structures. If the hydraulic performance of a drainage structure is changed, the change should be investigated for both upstream and downstream effects of the change.

Because the hydraulic effects of existing structures are usually well established, there is sometimes opposition to change from the landowner(s) affected. This is particularly true in developed areas.

Debris conditions may be changed and should be considered in design. Roadside ditch drainage patterns may be altered. These conditions should be thoroughly studied before any change is allowed.

SAFETY IMPROVEMENTS RELATIVE TO DRAINAGE DESIGN

Where the hazard is a culvert headwall, the options usually are to extend the culvert, protect traffic with guardrail, or construct a protective grate over the headwall. The alternative selected should be based on particular site conditions. Grates on cross culverts with the potential to collect significant debris are undesirable because of the potential hazard created for local flooding. A good way to evaluate the risk is to assume the grate will be plugged and then determine what flood hazard will be created. In all cases, it is very important that grates on culvert end be inspected frequently and always cleared of debris. Spaces between grate bars should be as large as practicable in order to lessen the probability of plugging.

The wide openings tend to minimize the flood hazard by reducing the potential of debris plugging the culvert.

BRIDGE RESTORATION

Hydraulically Equivalent Replacement Structure (HERS) definition:

- The waterway opening of the proposed structure provides the same height, width obstructions (piers) and geometric configuration as the existing structure.
- The proposed roadway grades on the approaches and the structure provide the same overtopping characteristics as the existing facility.
- Any of the above characteristics of the proposed facility are less restrictive to the passage of flood flows than are the characteristics of the existing facility.
- Every waterway crossing whose 1% exceedance probability discharge is anticipated, estimated or expected to be 500 cfs or greater **MUST** be reviewed by an appropriate river mechanics specialist. When the proposed facility is determined to be the hydraulic equivalent of the existing facility, no formal design analysis will be required.
- If a rehabilitation of the structure and/or its approach roadway does not conform to the HERS requirements, it must be treated as a bridge replacement, and an engineering analysis is required.

BRIDGE REHABILITATION

Bridge repairs are often required because of structural deterioration, damage from floods, and damage from vehicles. Bridge rehabilitation consists of physical changes to a bridge which are necessary because of inadequate width, structural capacity, hydraulic capacity, or because of scour or degradation.

Where bridge repair or rehabilitation is being considered, the cost of the repair should be compared with the cost of complete replacement. The hydraulic requirements of the bridge should also be reviewed when extensive repair or rehabilitation is being contemplated. This hydraulic review is particularly important if a change in the roadway profile is to be included in the rehabilitation.

In some cases, the grade may be raised so that roadway overflow is eliminated without changing the bridge size. This can be a deliberate change of the grade or a slow change, such as maintenance forces placing asphalt overlays on the grade over a period of years.

These changes should always be reviewed by the hydraulics design section for effect on flow distribution, on backwater, and on velocity through the bridges.

A replacement bridge may have a deeper superstructure and solid rails. These differences will affect a stream crossing unless compensating adjustments are made in the profile grade line.

Where the profile grade is raised, the effect may be to eliminate or lessen roadway overflow which could force more water to flow through the bridge opening. Solid rails can have the same effect. If the grade is lowered, the flow pattern and the amount of flow directed over the road and into downstream property could be increased.

When replacement bridges have shorter spans than the existing bridge, the resulting increase in the number of piers could add debris and scour problems or increase backwater.

CULVERT REPLACEMENT

When an existing culvert is to be replaced, an analysis should be made to see if the size of the existing culvert is either smaller or larger than necessary.

CULVERT REHABILITATION

A properly installed culvert generally loses its structural integrity through corrosion and/or abrasion of its invert, although overall loss of material in the pipe wall can occur, some installations due to the corrosive action of the backfill material or the water flowing through the culvert. Common restoration techniques include:

Provision for replacement of the culvert invert.

Threading of a smaller size culvert or liner plate through the original culvert and grouting of the voids between the two culverts.

Use of commercial products for relining pipe with epoxy-coated fabric materials.

Any proposed culvert rehabilitation scheme should be analyzed for hydraulic adequacy and outlet protection. Normally, the smaller cross sectional area resulting from culvert rehabilitation will lead to higher headwater elevation; however, this effect may be insignificant if there is storage upstream or if the potential for damage is minimal. Another consequence of a reduction in pipe size may be higher outlet velocities. This factor should also be assessed during the design of a culvert rehabilitation project.

Use of smooth linings, improved inlets, etc. may also improve the hydraulic performance of the relined culvert and essentially offset the loss of cross sectional area.

Many older culverts were built during a period when less attention was given to the need for accommodating fish passage. Such accommodations can often be incorporated by the addition of baffles in the culvert barrel; however, such designs should be checked to ensure that the revised design is hydraulically adequate.

CULVERT EXTENSIONS

The extension of an existing culvert can result in significant changes to the hydraulic performance. Extending the inlet of a culvert operating in inlet control establishes a higher inlet flow line, which will raise the inlet headwater elevation an equal amount. Extending a culvert which operates under outlet control may also increase the headwater because of head losses associated with the longer barrel.

Culvert extensions can cause the approach or the exit flow alignment to be unacceptable. This can usually be corrected by either extending the culvert on a skew angle that will fit the channel alignment or modifying the channel.

Long culvert extensions could cause the culvert to switch from inlet control to barrel (outlet) control, which will result in an increase in headwater.

In addition to the above noted changes, a long culvert extension may also create problems with fish passage through the culvert that should be addressed during the design.

SIGNING, SIGNALS AND PAVEMENT MARKINGS

Traffic control devices such as signing, signals, and pavement markings *shall be reviewed for conformance with the *Manual on Uniform Traffic Control Devices (MUTCD), Virginia Supplement to the MUTCD* and VDOT's *Road and Bridge Standards.*

While traffic control devices cannot fully mitigate all problems associated with substandard geometric features, they are a relatively low cost measure that can compensate for certain operational deficiencies.

Where roadway geometry or other roadway or roadside features are less than standard, do not meet the driver's expectancy, and reconstruction is not feasible, additional signs, markings, delineation and other devices beyond normal requirements of the *MUTCD* should be considered.

Judicious use of special traffic regulations, positive guidance techniques, and traffic operational improvements can often forestall expensive reconstruction by minimizing or eliminating adverse safety and operational features on or along existing highways.

Traffic signals should be installed where they are determined to be both warranted and justified in accordance with *IIM-TE-387*, (Requirements for Signal Justification Reports (SJRs) For New and Reconstructed Signals).

PLAN REVIEWS

Preliminary Plan Reviews and Field Inspections are to be held in accordance with the standard procedures. The Federal Highway Administration (FHWA) is to be notified of each and invited to attend.

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* Rev.1/19

PUBLIC INVOLVEMENT

RRR projects are to be developed utilizing the Department's Public Involvement Policy to keep the public sufficiently informed and involved as the project progresses so that a formal public hearing can be eliminated in most, if not all, cases.

RIGHT OF WAY

Although RRR type improvements are normally made within the existing right of way, additional right of way may be required to provide the necessary improvements.

Any required right of way and/or easements will normally be secured by donation. However, right of way may be acquired.

All right of way negotiations are to be conducted in accordance with the applicable statutes, regulations, policies, and procedures stipulated in the Right of Way and Utilities Division's Manual of Instructions and related memoranda.

UTILITIES (UNDERGROUND AND OVERHEAD)

Where utilities are involved on RRR projects, the Department's General Guidelines for Accommodating Utilities Within Highway Right of way are to be followed.

Relocation or adjustment may be required if the minimum clear zone requirements are not met or if the utility system conflicts with proposed RRR improvements and sufficient right of way is available. For Federally funded RRR projects, an exception request must be made if the project does not meet the minimum clear zone requirements.

In some cases, the utility system on RRR projects may be retained without adjustment or relocation if the accident history does not indicate the existence of a hazard or if the system has demonstrated adequate performance and does not conflict with proposed improvements.

TORT LIABILITY AND GEOMETRIC DESIGN

In recent years highway agency administrations have become increasingly concerned about the growth of tort claims. Such claims allege that highway agencies have committed a legal wrong by improper or negligent highway design, operation, or maintenance that became a cause or partial cause of a highway accident. Claims against highway agencies are part of a nationwide problem of rising liability insurance premiums and increasing costs of tort actions.

Studies indicate that the geometric design features covered in RRR standards are usually not the central focus of tort claims. Pavement features, traffic control devices, and roadside barriers account for the large majority of tort claims.

BACKGROUND ON TORT LIABILITY

Tort is defined as a civil wrong or injury, and a tort action seeks repayment for damages to property and injuries to an individual. If a defendant is found negligent in his actions, or lack

of action, he is liable for a tort claim and must compensate the plaintiff. State laws and rulings differ regarding tort claims against a governmental entity. In Virginia, as in most states, the courts or state legislatures have eliminated sovereign immunity (whereby an individual cannot sue the state or its agents for negligence).

Highway agencies are spending substantial sums as a result of tort claims. The costs of handling tort claims include not only the direct costs of judgment awards, settlements, and insurance, but also attorneys' fees and the cost of engineers' and other staff time.

Negligence can be alleged on two grounds particularly relevant to highway agencies:

- Agency (or person) improperly performs its duties (misfeasance).
- Agency (or person) fails to perform its duties (nonfeasance).

RRR IMPROVEMENTS AND TORT CLAIMS

Little is known about how frequently the geometric features addressed by RRR design standards are cited in tort claims against highway agencies. Few states maintain data on tort claims by alleged defect. Further, classifying tort lawsuits is difficult because most involve several defects that differ in importance.

Geometric features (such as cross-sections, alignment, and intersections) usually covered by RRR standards account for a small percentage of total claims filed against highway agencies. Of the cases in which a geometric feature is at issue, horizontal and vertical curves are the most often cited.

Pavement features including edge drops, potholes, surface deterioration and slippery pavements, account for large amounts of the settlement costs.

SUSCEPTIBILITY OF RRR PROJECTS AND STANDARDS TO TORT CLAIMS

The standards selected for RRR projects, the design process followed, and the scope of the improvements may influence the litigation of future tort claims. The issues that might arise in a tort action are:

- Did the project meet the appropriate design standards?
- Are the standards reasonable?
- Was the design process reasonable?
- Did the improvements correct existing dangers?
- Should unimproved roads be judged by standards used for roads that are improved?

The resolution of tort claims alleging an inadequate geometric design is contingent on determining the appropriate set of design standards used to assess negligence.

Determining whether a highway improvement project is sufficiently extensive to qualify as reconstruction can be a key issue in a tort claim because reconstruction projects usually must meet current new construction standards.

Deficient roadside signs or pavement markings and pavement edge-drop problems, which are often the basis of tort claims, can be routinely corrected on RRR projects.

DEFENSE OF A RRR PROJECT DESIGN

Although planning and design activities are exempt from liability in most states, this immunity has been held not to apply to decisions made without prior study or conscious deliberation.

Documentation of the planning process should be part of the state highway agency's defense.

For RRR projects, documentation should demonstrate that safety aspects of the roadway design were properly considered. Reports that identify deficiencies in existing roadways are potentially threatening to the public agency preparing the report if the deficiencies are not addressed. Thus, if any exception to an applicable design standard was granted, documentation should explain the reasons for the exception and show that logic and orderly procedures were followed in obtaining it.

When a highway agency contemplates a design exception for a geometric or roadside feature, it should be prepared to prove why the feature need not meet the same standards as other facets of the roadway design. Often, the best defense in this situation is to demonstrate that the safety cost-effectiveness of further upgrading the feature does not meet any reasonable criteria.

Courts seldom rule that the unavailability of funds is justification for not correcting an alleged defect, but he issue of availability of funds can be part of the defense in relation to the agency's programming procedures.

The following points are important to such a defense:

- The agency is aware of the condition of its facilities
- Deficiencies have been ranked on a logical basis
- Given the existing funding, items are being corrected in the order of priority
- Appropriate warnings or other temporary measures should be used to alert the public that deficiencies have not been corrected. The highway agency can then affirm that it has performed its duties in the best way possible with the available resources.

In order to receive immunity for planning and design activities, a state must thoroughly document the design process in order to defend challenges.

A rational and orderly process must be followed if a plan or design is to be considered immune from claims of negligence. If a feature built during construction was not called for in the plans or was altered from the specifications, it is open to a claim of negligence in a tort action.

RRR NOTES ON PROJECT TITLE SHEET

For applicable projects, the following note shall be placed on the plan Title Sheet under the Functional Classification and Traffic Data Block:

NOTE: THESE PLANS WERE DESIGNED IN ACCORDANCE WITH VIRGINIA RRR GUIDELINES.

PREVENTATIVE MAINTENANCE (PM) PROJECTS / RRR PROJECTS UTILIZING FEDERAL FUNDING ON NATIONAL HIGHWAY SYSTEM (NHS) ROADWAYS*

On April 28, 2009 VDOT and FHWA signed an Agreement for Maintenance Projects on the National Highway System (NHS) to utilize federal funding to perform maintenance/resurfacing, restoration, and rehabilitation (RRR) type work across the Commonwealth. A number of meetings were held between FHWA and VDOT's Location and Design and Maintenance Divisions to discuss the Scope for these type projects, establish a process for the development of these type projects, and to agree upon the level of involvement/oversight that the FHWA will provide. The FHWA and VDOT recognize the fact that the intent of these projects is to preserve the existing infrastructure and provide additional service life for the roadway and/or bridges through a particular corridor with the appropriate level of Preliminary Engineering expenses and a short design/construction time period. FHWA and VDOT agree that by developing guidelines that will provide clarification, flexibility and structure to the use of maintenance/RRR criteria, it will reduce inefficiencies in preliminary engineering and improve these types of projects across the Commonwealth.

It is agreed that FHWA will be invited to briefing/scoping meetings for all PM and RRR projects on the Interstate. Since many of these projects will not meet the thresholds for "Full Oversight", FHWA will maintain a programmatic review of the process.

* Rev.7/09

GUARDRAIL ON RRR PROJECTS

The guardrail for both RRR and Preventive Maintenance (PM) projects shall be reviewed for proper height. In cases where the guardrail height is less than 27 ¾ inches*, it shall be reset as part of the RRR project. The guardrail in preventive maintenance projects will be reset if the paving operations resulted in a reduction of guardrail height.

RRR PROJECT CATEGORIES

It is the intent of this policy is to identify the characteristics and document procedures to be used in the development of projects within each of the following two categories:

- Category 1: Preventative maintenance and resurfacing.
- Category 2: Heavy maintenance and RRR.

Category 1: **Preventative Maintenance and Resurfacing**:

The activities must be clearly of a preventative measure as opposed to reacting once a corrective action is required. Projects that address deficiencies in pavement structure or increase capacity of the facility are not considered preventive maintenance. All preventative maintenance projects shall maintain and preserve the current level of safety and accessibility and consider additional low cost safety improvements.

Procedural steps for the development of Category 1 projects:

- Identify high crash locations throughout the proposed corridor and conduct a field review to determine isolated or obvious deficiencies that should be addressed as part of a future project.
- Determine whether additional safety improvements such as upgrading guardrail and end treatments, installation of traffic signs and pavement markings, and edge line rumble strips should be included in the proposed project where they are determined to be a cost effective way to improve safety. In no way shall preventative maintenance type projects adversely impact the safety of the traveled way or its users.
- It is agreed that to maintain program flexibility, and in accordance with *23 U.S.C. 109(q),* safety improvements for preventative maintenance projects can be deferred and included in future projects in the Statewide Transportation Improvement Program (STIP). It is expected that safety improvements would be programmed within 2 years of the preventative maintenance project. However, extensions beyond the two years can be made with the approval of FHWA. Roadside hardware upgrades will be implemented in accordance with *Appendix I* in this manual.
- Projects shall have an appropriate environmental document to satisfy the National Environmental Policy Act (NEPA), generally a Programmatic Categorical Exclusion (PCE) prepared by the VDOT District Environmental Unit.

* Rev. 1/21

Examples of eligible activities under Category 1:

- Corrosion protection activities (Area wide program)
- Highway sign face cleaning (Area wide program)
- Any corrective, restorative or rehabilitative/reconstruction of highway pavement, which extends the service life of pavement for 5 – 15 years
- Milling and replacement of pavement materials
- Addition of a layer or layers of paving materials. (<2.0”)
- Replacing surface treatment materials with plant mix asphalt
- Concrete joint sealing
- Diamond grinding of concrete surface
- Thin concrete overlay
- Crack sealing of mainline asphalt pavement or shoulders
- Applying surface treatments to mainline asphalt pavement or shoulders (example: chip seals, slurry seals, latex/micro-surfacing, thin friction course, etc)
- Thin hot mix asphalt overlay (<2.0”)
- Grouting, mud jacking and under sealing
- Retro fitting of dowel bars
- Shoulder pulling and wedging for pavement edge drop-off mitigation

Eligible bridge related activities under Category 1:

- Seal or replace leaking joints, reconstruction of joint areas during joint replacement or elimination of deck joints.
- Deck overlays. (Thin bonded overlays, rigid overlays, and asphalt overlays with waterproof membranes).
- Spot and zone painting/coating of structural steel to include bearings for pre-stressed concrete members.
- Painting/coating of structural steel.
- Cathodic Protection (CP) Systems for Bridge Decks.
- Cathodic Protection Systems for Substructure Elements.
- Cathodic Protection Systems for Superstructure Elements other than decks.
- Electrochemical Chloride Extraction (ECE) Treatment for decks.*

* Rev 7/09

- Electrochemical Chloride Extraction Treatment for substructure elements.
- Scour countermeasures installation.
- Removing large debris from channels.
- Retrofit of fracture critical members.
- Retrofit of fatigue prone details. (Methods to increase the fatigue life of fatigue prone details, like using ultrasonic impact treatment on welds at ends of cover plates or connection plates welds not positively connected to flanges.)
- Concrete deck repairs in conjunction with installation of deck overlays, CP systems, or ECE treatment.
- Substructure concrete repairs in conjunction with installation of CP systems, ECE treatment, or galvanic anodes (when there are several sources or experimental basis when only one source). (Includes substructure units with cathodic protection jackets.)
- Application of sealants, coatings, and membranes for surface protection of the concrete.
- Bridge cleaning and/or washing service. (Decks, joints, drains, superstructure and substructure horizontal elements.)
- Place concrete mat along the flow line of steel pipe culverts.

NOTE: When eligible substructure work and/or painting/coating of ends of girders under joint locations are leaking, then it is required to have a contract for the work during the same year or the following year to seal the joints.

Category 2: Heavy Maintenance and RRR:

The purpose for this category project is to restore and rehabilitate the pavement structure to extend the service life of the corridor by 15 to 20 years. Projects will typically involve variable depth milling and pavement build up, minimal changes to the vertical and horizontal alignment, include guardrail and roadside hardware improvements and will stay within the existing right of way. The pavement structure may be removed and replaced in its entirety for up to 50% of the project length. Projects will not provide for additional capacity through the corridor. This work is not considered preventive maintenance because of the improvements to the pavement structure.*

* Rev. 7/09

Procedural steps for the development of Category 2 projects:*

- VDOT will review the proposed project to validate that the scope and purpose meets the intent of a RRR project as outlined in this letter.
- Engineering design and analysis will be done to ascertain locations of existing or potential congestion and safety concerns. This analysis will be conducted with the following in mind:

  (1) Early in the project development phase, VDOT will analyze the proposed project location to establish the applicable controlling design criteria. Any existing geometric features that are not brought up to current standards but meet the design standard during original construction/reconstruction will be documented by VDOT in the project files and copies sent to FHWA for their concurrence. The documentation will be in accordance with VDOT's *Road Design Manual*, *Appendix A4*, Guidelines for RRR Projects (or any subsequent revisions to the guidelines).

  (2) The controlling design criteria for Interstate projects are the design criteria used in the original construction or most recent reconstruction. For example, if a project was constructed in 1964, the standards in place at that time and any design exceptions approved at that time would be the allowable design criteria for the RRR project. This is allowed per AASHTO's *A Policy on Design Standards Interstate System.*

  (3) VDOT will provide formal design exceptions only for those instances where an existing geometric feature is made worse. In these instances, VDOT will provide the same level of engineering and documentation and follow the normal steps associated with processing a design exception for FHWA approval. However, every effort will be made to bring these substandard geometric features to current AASHTO design standards.

- Road Safety Audits will be conducted to identify low cost safety countermeasures such as Rumble Strips and Rumble Stripes, Median Barriers, Safety Edges, Left and Right Turn Lanes at Stop-controlled Intersections, Yellow Change Intervals, Medians and Pedestrian Refuge areas and Walkways and will be included in the proposed project where they are determined to be cost effective by the project manager and agreed to by the project team.

- Projects shall have an appropriate environmental document to satisfy NEPA, generally a Programmatic Categorical Exclusion (PCE) prepared by the VDOT District Environmental Unit.

* Rev. 7/09