FINAL GUIDANCE

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NCDOT/NCDENR Indirect and Cumulative Impact Assessment Guidance: Integrated NEPA/SEPA/401 Eight-Step ICI Assessment Process

1.0 Introduction

The purpose of this memorandum is to describe the manner in which the NCDOT/NCDENR Indirect and Cumulative Impact (ICI) Assessment Procedures can incorporate water quality considerations. The information contained in this memorandum was assembled from various sources including relevant procedures of other states, specifically, Florida, Maryland, and Wisconsin; applicable regulations; and published literature, primarily, the publication *National Management Measures to Control Non-point Source Pollution from Urban Areas – Draft* (July 2002).

Transportation projects can influence where and at what intensity development activity, or urbanization, occurs. Therefore, the primary concern for transportation project indirect and cumulative impacts from a water quality perspective is non-point source pollution from urban activities, i.e., urban runoff. Consequently, procedures to address non-point source pollution in the context of transportation project ICI assessment are the primary focus of this memorandum.

By incorporating such procedures into the ICI assessment guidance, the assessment can provide the basis for addressing cumulative impacts as required by the Department of Environment and Natural Resources, Division of Water Quality to implement Section 401 of the Clean Water Act.

2.0 Overview of How to Address Water Quality Impacts in the Eight Step ICI Assessment Process

The NCDOT/NCDENR Guidelines entail a systematic approach to indirect and cumulative impact assessment that includes the following steps:

1. Study area boundary (ies) – watershed/subwatershed boundaries are typically appropriate for assessing ICI downstream water quality impacts.
2. Study area needs, directions, goals – the planning context accounts for local watershed/subwatershed plans (or lack thereof), specifically, what entities are involved, the effectiveness of such plans, and how such plans relate to current and future land uses.
3. Notable features inventory – includes identification of potentially affected water bodies, their characteristics, water quality classifications, monitoring data, relevant water quality protection regulations, and extent of impervious cover in the study area.

4. Cause-effect relationships between past, present, and future actions and downstream water quality, i.e., what are the major sources of pollutant loadings and what measures have been taken to control these sources.
5. Identification of significant ICI issues – includes assessment based on Steps 1-4 of whether existing measures and controls are sufficient to protect downstream water quality in light of potential indirect and cumulative impacts. Note: Step 5 is where the decision is made between qualitative and quantitative analysis in accordance with the "NCDENR, Division of Water Quality policy regarding Cumulative Impacts and the 401 Water Quality Certification and Isolated Wetland Permit".
6. Detailed analysis (if significant issues are identified) – estimates of future land use changes through detailed analysis used as input to quantitative water quality analysis.
7. Assess results – reasonableness and sensitivity to varying assumptions.
8. Develop mitigation – to address needs for improved watershed management identified by the analysis.

3.0 The Relationship of Impervious Cover and Water Quality

Impervious surface refers to land cover, both natural and human-made, that cannot be penetrated by water. Precipitation that falls on impervious surfaces does not infiltrate into the soil. Instead, it either runs off to a pervious area where all or a portion of the runoff infiltrates into the soil or it continues to travel downslope on impervious surfaces until it is eventually conveyed to a receiving water, e.g., ditch, storm drain network, stream, lake, wetland, bay, etc.

Impervious cover is an inescapable attribute of development and a permanent part of the urban/suburban landscape. Impervious cover can be categorized as either rooftops or transport systems. Transport systems refer to impervious cover created by structures such as roads, sidewalks, driveways, and parking lots. Most of these structures are associated with the transportation of people or materials. In most areas, the transport systems component covers a larger percentage of land than the rooftops component.

As will be discussed in more detail below, there is a profound linear relationship between the percentage of a watershed's area covered by impervious surfaces and the hydrology, channel stability, water quality, and biodiversity of affected streams. Consequently, estimating the percentage of impervious surfaces is an important element of the eight-step ICI process.

4.0 Assessment Steps

4.1 Step 1: Establish Study Area Boundaries

The purpose of this step is to establish the outward spatial limits extending from the project within which data will need to be collected and assessment performed.

Generally, the appropriate hydrologic units for assessing urban runoff are the watershed and subwatershed. The watershed is generally the largest hydrologic management unit locally. The subwatershed comprises the land draining to the point where two second-order streams join, generally, an area between one and ten square miles. [Streams with no upstream tributaries are designated first-order streams; a second-order stream is formed when two first-order streams meet.]

The subwatershed is considered by the U.S. Environmental Protection Agency (USEPA; 2002) and others as the optimum scale for planning purposes at the local level for the following reasons:

- The influence of impervious cover on hydrology, channel stability, water quality, and biodiversity is most evident at the subwatershed scale because the receiving water body is typically a headwater stream.
- The subwatershed scale helps local officials more easily identify impacts of individual development projects and sources of pollutants.
- Subwatersheds are typically small enough to be within the borders of one or two political jurisdictions. This eases the manageability of implementing runoff controls under local regulatory authority.
- The subwatershed scale affords sufficient detail to provide useful management information and allows assessments and evaluations to be completed relatively quickly.

Subwatershed boundaries are defined by interpreting relief as conveyed by contour lines on topographic maps of an area, e.g., those produced by the U.S. Geological Survey (USGS). Subwatersheds for which boundaries should be established are those within the area potentially influenced by the transportation project, e.g., within approximately one mile of a new highway interchange or improved facility. The USGS topographic map also shows political jurisdictions and land use patterns at the time the map was prepared, as well as drainage patterns.

4.2 Step 2: Identify Study Area Needs, Directions, and Goals

The purpose of this step is to gain understanding of the local decision-making policy framework and planning processes with respect to watershed management. If the conclusion of the assessment is that additional controls are needed to manage indirect and cumulative water quality impacts, then development and implementation of such controls is generally accomplished within the local context.

The identification of water resource-related needs, directions, and goals of potentially affected subwatershed(s) begins with an examination of local watershed protection capabilities. The analyst should compare the local program with relevant State and federal requirements, e.g., via watershed-specific management plans for outstanding resource waters and high quality waters watersheds, where applicable. Other local planning activities related to watershed protection may include open space, parks, and greenway plans or growth management plans.

The stakeholders in local watershed management can include the following:

- Federal agencies, e.g., the USEPA, Army Corps of Engineers, U.S. Fish & Wildlife Service, and the Federal Emergency Management Agency.
- State and local agencies, e.g., the Department of Environment and Natural Resources (Divisions of Water Quality, Land Resources, Coastal Management, Environmental Health, and Marine Fisheries), the Wildlife Resources Commission, the Coastal Resources Commission, the Environmental Management Commission, the Department of Transportation, basin associations, municipal planning/zoning departments or boards, municipal public works departments.
- Non-governmental organizations, e.g., greenways coalitions, "friends of…" groups, watershed coalitions/foundations, volunteer organizations, recreation/hiking groups.
- Private organizations, e.g., consulting engineers, local businesses, real estate companies, builders/developers.
- Other stakeholders, e.g., local residents, schools.

These stakeholders can be consulted as part of the transportation project public involvement activities, specifically, to help gauge local watershed protection capabilities.

In examining local watershed protection capabilities, it is also important to note the extent to which runoff management is integrated with land use plans, Basin-wide Water Quality plans, Coastal Habitat Protection Plans, floodplain management plans, and wastewater management plans, where applicable.

4.3 Step 3: Inventory Notable Features

The purpose of this step is to gain understanding of watershed/subwatershed baseline conditions in the ICI study area and the factors which have, are currently, and potentially will influence these conditions.

The necessary items to inventory and document with respect to downstream water quality include the following:

- Baseline information, i.e., classification, ambient monitoring data, and natural and cultural features.
- Federal, state, and local water quality regulations apply to development activities in the subject study area.
- Imperviousness.

Each item is discussed in detail in the sections that follow.

4.3.1 Baseline Information

A fundamental question with respect to ICI assessment is what notable features are being impacted. The notable features inventory for downstream water quality considerations begins with identification of water bodies in the ICI study area.

4.3.1.1 Classifications

Once the water body(ies) of interest is identified the inventory then proceeds to identifying the appropriate classification(s) of the water body and the surrounding watershed (http://h2o.enr.state.nc.us/bims/Reports/reportsWB.html). Among possible classifications are the following (15A NCAC 02B.0101, http://h2o.enr.state.nc.us/admin/rules/rb010102.pdf):

- Freshwater classes C (secondary recreation, fishing, aquatic life propagation and survival and wildlife), B (all C uses plus primary recreation), WS-I to WS-V (waters protected as water supplies with WS-I being essentially in natural and undeveloped watersheds), and WL (wetlands)

- Tidal Salt Water classes SC (C uses for saltwater),SB (B uses for saltwater), SA (suitable for commercial shellfishing and all other saltwater uses), and SWL (coastal wetlands)

- Supplemental classifications Tr (trout waters), Sw (swamp waters), NSW (nutrient sensitive waters), HQW (high quality waters), ORW (outstanding resource waters), PNA (primary nursery areas), FWS (future water supply).

The notable features inventory should note the appropriate classification(s) for identified study area water bodies. A classification implies certain specific regulatory requirements. The regulatory requirements for these various classifications are summarized below in Section 4.3.2.

4.3.1.2 Ambient Monitoring Data

DWQ and others have ambient water quality data for many water bodies in the State (e.g., http://www.esb.enr.state.nc.us/stations/ams.htm). Data can be obtained by river basin, county, or STORET number. The notable features inventory should summarize recent ambient data and note any trends revealed by the data.

4.3.1.3 Natural and Cultural Features

The following natural and cultural information can be used to describe the area draining to the study area water body(ies):

- Floodplain boundaries

- Stream corridors
- Soils and geologic features
- Current and future land use (including major proposed new developments)
- Current and future transportation routes
- Riparian buffers
- Wetlands
- High Quality Resources
- Detention/retention ponds and other stormwater management practices
- Direction of drainage
- Water pollution control plants
- Industrial sources

In addition, there are four categories of "Areas of Environmental Concern" (AEC) in the 20 coastal counties including:

- Estuarine and ocean systems – estuarine waters, coastal wetlands, public trust areas, and estuarine and public trust shorelines.
- Ocean hazard areas – beaches, frontal dunes, and inlet lands.
- Public water supplies – small surface water supply watersheds and public water supply wellfields.
- Natural and cultural resource areas – coastal areas that sustain remnant species, coastal complex natural areas, and unique coastal geologic formations (plus significant coastal archaeological resources and significant coastal historic architectural resources).

Much of the baseline information is available from the NC Center for Geographic Information and Analysis (http://www.cgia.state.nc.us) and various reports and maps of the Division of Water Quality. Once the information is compiled it is useful to map linear and spatial features and prepare a narrative to characterize the study area water bodies, their classification(s), ambient water quality, and associated natural and cultural features.

4.3.2 Regulations

A variety of regulatory programs govern stormwater runoff management and protection of waters in North Carolina. This section gives brief descriptions of the primary programs and references to where further information about the programs can be found.

It is important to know which regulatory program(s) applies in the ICI study area, its status, and the activities over which it has jurisdiction. To that end, this section also describes current information about the geographic coverage of federal and state regulatory programs in North Carolina where such programs do not have statewide applicability. Practitioners should confirm whether or not the descriptions differ from that which existed at the time of this guidance by checking pertinent websites or other sources. At a minimum, the practitioner should list the classification of each surface water in the study area, and the protections that each is afforded under state and federal law.

In addition to these regulatory programs, many watersheds and water bodies are improved through funds from various State and federal programs, e.g., Section 319 Non-point Source Grants, the Clean Water Management Trust Fund, and programs administered by the USDA-Natural Resources Conservation Service.

4.3.2.1 Federal

The regulatory context to abate and control water pollution nationally is derived primarily from the Clean Water Act and the Safe Drinking Water Act both administered by USEPA. Following are brief descriptions of several of the key programs related to stormwater. More information about Clean Water Act programs is found on various USEPA websites including www.epa.gov/owow.

- Clean Water Act National Pollutant Discharge Elimination System or NPDES Permit Program – The NPDES Stormwater Program, enforced by the Division of Water Quality, uses a two-phased approach. For both phases, permit requirements generally include implementation of stormwater management programs/plans, minimum control measures (management practices), and evaluation and assessment efforts. Phase I, which went into effect in 1991 required operators of medium and large municipal separate storm sewers systems located in incorporated places and counties with populations of more than 100,000, certain industrial activities, and construction activities disturbing five acres or more to obtain an NPDES permit to discharge stormwater runoff. Phase I applied to six municipal separate storm sewer systems in the state.

  Phase II, which was published in the Federal Register on December 8, 1999, requires operators of small municipal separate storm sewers in urbanized areas and small construction activities disturbing between one and five acres of land to obtain an NPDES permit and develop stormwater management programs or plans. Further, DWQ may require operators of small municipal separate storm sewer systems not in urbanized areas and small construction activities disturbing less than one acre to obtain an NPDES permit if deemed necessary to protect water quality. DWQ has also designated all small municipal separate storm sewer systems located outside an urbanized area that are in areas with a population of at least 10,000 and a population density of 1,000 per square mile. DWQ has drafted the North Carolina Municipal NPDES Phase II Stormwater Strategy which designates communities for Phase II. These local governments will have to apply for a NPDES permit in accordance with a basin-wide cycle.

  The post-construction runoff control requirement is to be met through a program which is similar to other stormwater programs in the State such as those found in coastal counties and in high quality waters watersheds. An approved Water Supply Watershed Protection Plan will meet the requirements. Otherwise, the following baseline criteria will be required:

  - Post-construction controls apply to all new development and redevelopment that impacts one acre or more.
  - Local regulatory mechanisms must be implemented to ensure long-term operation and maintenance of structural and non-structural management practices.
  - Low-density option must meet the following:
    - Built-upon area of 30 percent or less;
    - Stormwater runoff conveyed through vegetated conveyances; and
    - 30-foot riparian buffer on all waters.
  - High-density option must meet the following:
    - Stormwater treatment of first inch of rainfall;
    - Stormwater treatment must remove 85 percent of total suspended solids;
    - Post-development runoff conditions must meet either of the following (1) runoff volume draws down to pre-storm stage within five days but not less than two days, or (2) the post-development discharge rate must be no larger than the pre-development discharge rate for the 1-year, 24-hour storm; and
    - For development within nutrient sensitive waters an alternatives analysis must be performed to ensure that the best practice for reducing nutrient loading is selected while still meeting other requirements. If DWQ has approved an urban stormwater NSW plan, the provisions of that plan will fulfill this requirement. (www.epa.gov/npdes/stormwater)

- Clean Water Act Section 303(d) Lists and Total Maximum Daily Loads – States are required to compile a list of impaired waters that fail to meet any of their applicable water quality standards or cannot support their designated or existing uses. This list, called a "303(d) list," is submitted to Congress every two years. States are required to develop a total maximum daily load (TMDL) for each pollutant causing impairment for water bodies on the list. TMDL's are calculations that determine the maximum amount of a given pollutant that a water body can assimilate and still maintain its uses. As part of the TMDL, the sources of the pollutant must be identified, and the allowable amount of the pollutant must be allocated among the various sources within the watershed. (www.epa.gov/owow/tmdl; http://www.h2o.enr.state.nc.us/tmdl/General_303d.htm)

- Clean Water Act Section 404 Permits for Discharge of Dredged or Fill Material – Under Section 404, persons planning to discharge dredged or fill material to wetlands or other waters of the United States generally must obtain an authorization for the discharge from the U.S. Army Corps of Engineers. (www.epa.gov/owow/wetlands)

- Rivers and Harbors Act of 1899 Section 10 Permits for Dredging in Navigable Waters – Under Section 10, persons planning to dredge in navigable waters

generally must obtain an authorization for the discharge from the U.S. Army Corps of Engineers. (www.epa.gov/owow)

- Clean Water Act Section 401 Water Quality Certification – Issued and administered by DWQ, Section 401 is a certification that a project will not violate the State's water quality standards.
  (http://ncrules.state.nc.us/ncadministrativ /title15aenviron /chapter02enviro /default.htm)

- Safe Drinking Water Act – The act requires states, among other things, to establish a Source Water Assessment Program (SWAP) and implement Source Water Protection Programs with the goal to maintain or improve the quality of surface and ground waters that are used as drinking water sources. The Division of Environmental Health submitted a plan to USEPA which was approved in 1999. This document outlines how the State will delineate source water protection areas, inventory significant contaminants within these areas, and determine the susceptibility of each public water supply to contamination. Final assessment reports must be completed by 2003. (www.epa.gov/safewater/protect.html)

- National Flood Insurance Program – This is a federal non-regulatory program managed by the Federal Emergency Management Agency (FEMA) that may afford some protection to stream riparian areas and wetlands and, thereby, protect water quality through floodplain management. An important element in making flood insurance available to home and business owners is a community's agreement to adopt and enforce floodplain management ordinances. FEMA requires that, at a minimum, drainage areas one square mile or larger be regulated by a community.

- National Estuary Program – States work together to evaluate water quality problems and their sources, collect and compile water quality data, and integrate management efforts to improve conditions in estuaries. So far 28 estuaries have been accepted into the program, including the Albemarle-Pamlico National Estuary Program.
  (www.epa.gov/owow/estuaries/nep.html and http://h2o.enr.state.nc.us/nep.html)

4.3.2.2 State

Included are the following:

- Coastal Management Rules (established through the Coastal Area Management Act) – Administered by the Division of Coastal Management, the rules include guidelines and a permit program that address the appropriate nature of development and uses in general, as well as within various types of "areas of environmental concern" (AEC) of the 20 coastal counties. No development is allowed in any AEC which would have a substantial likelihood of causing pollution of the waters of the state in which shellfishing is an existing use to the

extent that such waters would be officially closed to shellfishing or where a significant shellfish resource is present in an area that could be expected to be opened for shellfishing given reasonable efforts to control the existing sources of pollution. (http://dcm2.enr.state.nc.us/Rules)

- Neuse River Basin Nutrient Sensitive Waters (NSW) Management Strategies (15A NCAC 02B.0232 et seq.) – Rules have been in place since 1997 requiring the control of nutrients, particularly nitrogen, within the Neuse River Basin. The goal of these rules is to reduce loading of nitrogen to the river by 30 percent while still allowing opportunity for sustained development activities. Separate requirements apply for reducing nitrogen loading from wastewater, urban stormwater, and agricultural activities. Among relevant provisions, the Neuse NSW rules require that new developments maintain an existing 50-foot vegetated buffer on both sides of all intermittent and perennial streams, lakes, and ponds within the basin as mapped on the most recent soil or USGS topographic map. The Neuse NSW rules also require that counties and larger municipalities meet stormwater management requirements that hold nitrogen loading from new development at 70 percent of the average nitrogen load of the 1995 land use. The rules require no increase in peak flow leaving a new development site for the 1-year, 24-hour storm. In addition, plans for new development must be reviewed to ensure that the Neuse buffer requirements are met.

- Tar-Pamlico River Basin NSW Management Strategies (15A NCAC 02B.0229 et seq.) – include the following elements: nutrient offset payments for non-Tar-Pamlico Basin Association members, agricultural nutrient loading goals, agricultural nutrient control strategy, nutrient management, basin-wide stormwater requirements, protection and maintenance of existing riparian buffers (15A NCAC 02B.0259 et seq.).

- Catawba River Basin Protection and Maintenance of Existing Riparian Buffers and Mitigation Program for Protection and Maintenance of Existing Riparian Buffers (15A NCAC 02B.0243 et seq.).

- Water Supply Watershed Management Plans – The Environmental Management Commission adopted minimum statewide water supply protection standards and classified all surface water supply watersheds. The goals of the Water Supply Watershed Protection Program include (1) the protection of surface drinking water supplies in the State from non-point source and point source pollution, and (2) the provision of a cooperative program of watershed management and protection that is administered by local governments consistent with minimum statewide standards.

  DWQ manages the program through oversight of local ordinances and monitoring of land use activities. Local water supply watershed (WSWS) programs must be approved by the Environmental Management Commission.

The WSWS program requires local governments to adopt the following land use controls and limitations based on watershed classifications:

- Limitation of impervious surfaces or density limits around water supplies.
- Protection of riparian buffers (100-foot buffers in all development that exceeds the low density option, or 30-foot buffers along perennial waters for the low density option).
- Limitation on some land uses.
- Limitations on certain discharges (NPDES permits in certain situations).
- The use of clustering and density averaging is allowed to meet overall development density limits.
- Watersheds are classified WS-1 through WS-4 with WS-1 having the most restrictive controls.

- Randleman Lake Water Supply Watershed Rules (15A NCAC 02B.0248 et seq.) – include nutrient management strategy, wastewater discharge requirements, protection of waters, and stormwater management including riparian buffers.

- Sediment and Erosion Control Ordinances – Programs to control erosion and sedimentation caused by land disturbing activities on one or more acres of land are administered by the Division of Land Resources. Control measures must be planned, designed, and constructed to provide protection from the calculated peak rate of runoff from a 10-year storm, except for projects in High Quality Waters (HQW) zones, which require control of 25-year storms. Enforcement of the program is at the State level, but can be delegated to local governments (usually counties or large municipalities) with certified erosion control programs.

- Stormwater Management System Rules – These rules set forth the requirements for application and issuance of permits by DWQ for stormwater management systems to control pollutants associated with stormwater runoff from developed land. The rules apply to development activities located in the 20 coastal counties covered under the Coastal Area Management Act (CAMA), those draining to Outstanding Resource Waters, and those within one mile of and draining to High Quality Waters. The issuance of a CAMA permit or requirement to provide an approved sedimentation and pollution control plan will also trigger the requirements of the coastal stormwater rules.
(http://h2o.enr.state.nc.us/admin/rules/2H.1000.pdf).

Isolated Wetlands Rules (15A NCAC 02H.1301). These regulations pertain to those areas that are considered wetlands greater than one-third of an acre in size without a visible surface connection to other wetlands via streams, intermittent wetlands, or ditches.

4.3.2.3 Interagency Procedures

- Draft Internal Policy on Cumulative Impacts and the 401 Water Quality Certification and Isolated Wetlands Programs – Division of Water Quality draft

internal policy identifies DOT (and other public transportation) projects by type, and each type with the level of cumulative impact analysis anticipated in terms of its potential impact on downstream water quality standards and designated use. Generally, the levels of analysis include (1) generic description for small-scale widening projects, bridge replacement projects, and intersection improvement projects; (2) qualitative analysis for widening with new locations; and (3) quantitative analysis for new location projects. It should be noted that a widening project with a segment of roadway on new location (i.e., bypass) may still require a quantitative analysis; conversely, shorter projects on new location may not require a qualitative analysis. Therefore, the practitioner is encouraged to coordinate with the Division of Water Quality prior to undertaking an extensive quantitative assessment for the sole purpose of determining impacts to water quality. (http://h2o.enr.state.nc.us/ncwetlands/cipol.pdf)

- Memorandum of Understanding between DENR and DOT dated July 7, 1999 – Established a process to provide more effective wetland and stream mitigation for transportation construction projects through the development and implementation of local watershed restoration plans designed to improve water quality, fisheries and wildlife habitat, flood protection, and recreational opportunities by restoring, enhancing, preserving, and creating wetlands, streams, and riparian areas. (http://h2o.enr.state.nc.us/ncwetlands/mou.html)

- NPDES Permit issued to DOT to Discharge Stormwater and Borrow Pit Wastewater – The roadway drainage system often conveys stormwater runoff and other discharges from development sites. Among the pertinent requirements of the permit are:

    - Stormwater system inventory and prioritization highlighting outfalls to sensitive waters and the ability to retrofit management practices (BMP) to outfalls.
    - Implementation of BMP retrofits in each of the 14 DOT divisions.
    - Development of a BMP Toolbox.
    - Illicit connection and illegal dumping program.
    - New private sector development certification.
    - Compliance with all appropriate Nutrient Sensitive Water rules.
    - Educational and public participation program.
    - Sediment and erosion control program for all projects disturbing greater than one acre of land area.
    - Analytical monitoring program.
    - Roadside environmental management program.
    - Maintenance activity assessment.
    - Stormwater pollution awareness training.
    - Additional site controls.

  (http://www.doh.dot.state.nc.us/preconstruct/highway/hydro/gl0399web/pdf/permit.pdf)

4.3.2.4 Local

Local governments can implement programs to protect watersheds. For example, by encouraging better site design, local governments can accomplish three watershed management goals at each development site: (1) reduce the amount of impervious cover; (2) maintain or increase the supply of natural lands for conservation; and (3) use pervious areas for more effective stormwater treatment.

Local governments in the State have implemented several programs which can protect water quality by limiting imperviousness and conserving open space. These programs include the following:

- Riparian buffer ordinances – some local governments have expanded buffer requirements beyond those promulgated by the State (described above).

- Local ordinances and zoning – Many local governments allow cluster development, planned unit developments, or neo-traditional designs that provide for open space set-aside (typically, 10-25 percent of the land area to be developed). In addition, certain smaller communities not covered by the NPDES Phase I or II stormwater rules have adopted stormwater programs. Another example in this category are tree protection ordinances whereby incentives are provided to preserve trees and/or wooded buffers are required, e.g., between conflicting land uses, thoroughfare buffers, riparian buffers, 100-year floodplains, and historic or landmark trees.

- Open space, parks, and greenway plans – Open space preservation, when planned properly, can help preserve or restore water quality.

- Growth management plans – Growth management plans can be used to protect water resources, e.g., by protecting environmentally sensitive areas and directing growth to other areas.

- Phase II National Pollutant Discharge Elimination System Permits (see discussion under Section 4.3.2.1)

4.3.3 Imperviousness

The amount of impervious cover in a watershed or subwatershed is reported in two basic ways:

- Total or mapped impervious area – Includes all impervious cover, both rooftops and transport systems, in a watershed or subwatershed. It is usually expressed as a percentage of the total watershed or subwatershed area. It can be calculated by direct measurement from aerial photographs or satellite imagery, or by estimating the percentage based on land use, road density, population density, or another indicator.

- Effective impervious area – Represents the total impervious cover that is directly connected to the storm drain network. These surfaces usually include street surfaces and paved driveways and sidewalks connected to or immediately adjacent to them, parking lots, and rooftops that are hydraulically connected to the drainage network, e.g., downspouts that run directly to gutters or driveways. Effective impervious area is also expressed as a percentage of the total watershed or subwatershed area. It is the preferred statistic for use when estimating runoff volumes because it is the portion of the impervious cover that generates direct runoff.

Both the amount of impervious area and the relationship between total and effective impervious areas varies according to land use. For example, the low-density residential areas typically have both a lower amount of impervious area and lower effective total impervious area ratio as compared to commercial and industrial areas.

The USEPA notes that the Center for Watershed Protection designates three levels of classification based on impervious cover. It is useful for the ICI to further characterize study area watersheds by calculating the imperviousness and noting what runoff management measures are being undertaken.

- Sensitive subwatersheds –Generally, have less than 10 percent impervious cover. Streams found in sensitive subwatersheds are at or close to predevelopment conditions. Runoff strategies are typically focused on maintaining these conditions.

- Degrading subwatersheds – Generally, have between 11 and 25 percent impervious cover. Streams found in degrading subwatersheds likely have experienced degradation of key stream attributes or can be expected to experience such degradation over time. Some of the more sensitive organisms have probably disappeared or will disappear. Resource objectives are typically focused more on maintaining or restoring key conditions than on resource protection as a whole. Structural and nonstructural practices that deal with, or counteract, increased runoff are typically recommended.

- Non-supporting subwatersheds – Generally, have more than 26 percent impervious cover. Streams in non-supporting subwatersheds may never recover predevelopment conditions no matter how many management practices are implemented. Consequently, resource objectives are typically focused on reducing peak flows and the prevention and removal of urban pollutants so they will not be carried downstream. Restoration of some attributes such as increased biodiversity are sometimes achieved in limited amounts under the right circumstances. Pollution prevention and retrofitting in existing urban areas are the most frequently used practices.

4.4 Step 4: Identify Impact-Causing Activities

The purpose of this step is to reveal direct, indirect, and cumulative cause-effect relationships between the transportation project, historic and future land development, historic and future management practices, and downstream water quality.

4.4.1 Typical Effects of Development on Downstream Water Quality

Leopold organized impact-causing activities of development into several categories, including:

- Modification of regime
- Land transformation and construction
- Resource extraction
- Processing
- Resource renewal
- Changes in traffic
- Waste emplacement and treatment
- Chemical treatment.

Each of these activities effects water quality.

The typical cumulative effects of these activities on downstream water quality, many of which are irreversible, include:

- Bankfull and subbankful floods increase in magnitude and frequency
- Dimensions of the stream channel are no longer in equilibrium with its hydrologic regime
- Channels enlarge
- Stream channels are highly modified by human activity
- Upstream channel erosion contributes greater sediment load to the stream
- Dry weather flow in the stream declines
- Wetted perimeter of the stream declines
- In-stream habitat structure degrades
- Large woody debris is reduced
- Stream crossings and fish barriers increase
- Riparian forests become fragmented, narrower, and less diverse
- Water quality declines particularly from increased bacterial, nutrient (phosphorus and nitrogen), metals (e.g., copper, zinc), and/or sediment loadings
- Summer stream temperatures increase
- Aquatic diversity is reduced.

Imperviousness, in particular, affects several components of the water cycle. In natural landscapes, there is usually very little or no surface runoff. Water either percolates into

the ground or is returned to the atmosphere by evaporation and transpiration. As imperviousness increases,

- Runoff increases because the surface area of rooftops and transportation systems is increased.
- Soil percolation decreases because pervious areas are reduced.
- Evaporation decreases because there is less time for it to occur when runoff moves quickly off impervious surfaces.
- Transpiration decreases because vegetation has been removed.

There is a linear relationship between the amount of impervious surfaces in a given area and the amount of runoff generated. Depending on the degree of impervious cover, the annual volume of stormwater runoff can increase to anywhere from 2 to 16 times the predevelopment amount. Impervious surface coverage as low as ten percent can destabilize a stream channel, raise water temperature, and reduce water quality and biodiversity (USEPA, 1997). Development and increased impervious cover also lead to erosion and undercutting of stream banks, channel widening, and in-channel sediment deposition. In addition, decreased base flow occurs in dry weather because a greater portion of runoff flows off the surface, resulting in less infiltration to groundwater (which normally provides base flow to streams).

Impervious surfaces also provide a surface for pollutant deposition and accumulation, as well as a direct pathway for the accumulated pollutants to be washed off during storms into streams. The bio-chemical effects of these pollutants can include reduced dissolved oxygen levels, increased aquatic plant growth, as well as toxicity effects from metals attached to sediments.

4.4.2 Impacts of Transportation Systems

Transportation systems encompass all of the impact-causing activities listed in the previous section. These activities occur during construction and/or operation and maintenance. For example, construction activities expose soil that can become eroded and transported as sediment to water bodies. Vehicles deposit pollutants (metals, sediments, and hydrocarbons) from exhaust, tire and brake wear, and lubricants). Pavement wear also produces sediments. Right-of-way maintenance can involve the use of fertilizers, herbicides, and pesticides. Roadways, parking lots, building rooftops, and other impervious surfaces created for transportation systems add impervious cover which becomes transport systems for stormwater runoff.

Transportation systems can influence where land development occurs, in what type and at what density. Consequently, transportation systems can affect imperviousness beyond the right-of-way.

4.4.3 Impacts of Other Actions

Cumulative impacts include the impacts of the project combined with the past, present, and reasonably foreseeable future impacts of other actions. Impacts of other actions in the past are accounted for through historic water quality data and reports which often reveal trends. It is often useful to document historic trends for two time periods - pre- and post-Clean Water Act (1972). Existing water quality is demonstrated by the baseline inventory and characterization of water bodies and pertinent programs (Step 3). The documentation of past and current impacts on water quality should note major causes (sources), e.g., municipal sewage, industrial wastes, urban and agricultural non-point sources, etc.

Reasonably foreseeable other actions in the study area comprise the future no-build scenario for the ICI assessment. Included are,

- other public works projects, e.g., transportation projects, water and/or sewer system construction or extension, arenas, stadiums, airport construction or expansion, government complexes, etc. (Step 2)
- private development projects, e.g., industrial parks, office parks, residential subdivisions, retail centers, etc. (Step 2)
- population growth or decline from accepted population and employment forecasts (e.g., those of the Office of State Plan, Department of Labor, metropolitan planning organizations) (Step 2)
- comprehensive land use plans (Step 2)
- water/sewer service area plans (Step 2)
- future water supply waters (Step 3)
- regulatory programs that will take effect in the future, e.g., Phase II NPDES Stormwater permits (Step 3)

Expected land use trends, e.g., undeveloped to developed, agricultural to developed, developed to redeveloped to higher densities or other uses, etc., should be noted from this information and through interviews with demographic experts (Step 2). Similarly, the expected effectiveness of existing and planned water quality management practices to control, maintain, or reduce water pollution should be noted from this information and through interviews with watershed and water resources experts (Step 2).

4.5 Step 5: Identify Significant ICI Issues for Analysis

The purpose of this step is to compare the study area notable features identified in Step 3 with the potential magnitude of the indirect and cumulative impacts identified in Step 4 and assess whether or not a detailed analysis of the impacts, including 401 quantitative analysis, are warranted.

The key information to identify in Steps 3 and 4 for purposes of 401 Water Quality Certification per DWQ Draft Internal Policy in sequence is whether

1) growth will be induced by the project (Step 4);

2) waters in the study area contain threatened or endangered aquatic species or the study area contains impaired (303(d) listed) waters which are impaired by pollutants likely increased by development (such as bacteria, nutrients or sediment) or Class SA (commercial shellfishing) waters or Trout waters (Step 3); and

3) Existing regulatory programs are in place which can address these impacts (Steps 3 and 4).

The above criteria should be used as part of the assessment performed on all alternatives evaluated under the 404/NEPA Merger Process to contribute to the selection of the least environmentally damaging practicable alternative (LEDPA), where applicable. If the answers to questions 1 and 2 are yes and question 3 is no, then cumulative water quality impacts are likely and a detailed, quantitative analysis will be required (Step 6). Otherwise, a qualitative analysis should normally suffice for the 401 Certification. Where required, the detailed land use analysis would be performed on the LEDPA as part of the ICI assessment for the NEPA document while the detailed water quality analysis would be performed for the 401 Water Quality Certification.

For those situations where a qualitative analysis is required for the 401 Certification, the analyst should examine the consistency of the potential indirect and cumulative impacts identified in Step 4 with the area's water quality goals (Step 2). The key factor that would warrant detailed, quantitative analysis is a conclusion that project-induced land use changes would occur for which management practices will be inadequate, e.g., when the estimated development densities will exceed those on which the stormwater management plan is based.

A combination of qualitative and quantitative measures can be used to assess existing management practices, including:

- Evaluation by targeted groups (expert panel).
- Physical inspection/sampling of existing practices.
- Operation and maintenance activities.
- Reference condition (comparative) to a similar watershed/subwatershed which at present exhibits the study area's future scenario.
- Enforcement actions taken.
- Trend analysis using historic monitoring data to assess whether existing management practices have improved water quality.

Reasonable inferences can be drawn from using these factors to assess the effectiveness of management practices to protect downstream water quality from indirect and cumulative impacts. The confidence of the inferences generally increases when multiple factors are considered.

4.6 Step 6: Analyze Effects (if warranted)

- Conduct detailed land use effects analysis as per ICI Guidance on the LEDPA as part of the NEPA document.
- Conduct detailed, quantitative water quality modeling for the Section 401 Certification using model(s) approved by DWQ on projects that will contribute to substantial land use changes in an area having:

    1) waters that contain threatened or endangered aquatic species, and/or

    2) impaired waters (303(d) listed waters, class SA (commercial shellfishing) waters, or Trout waters, and/or

    3) Potential to exceed appropriate development density threshold (e.g., residences per square mile).

- Results of detailed ICI land use analysis used as input to detailed, quantitative water quality modeling.
- For circumstances where detailed, quantitative water quality modeling is required, DOT will conduct the modeling as part of the NEPA document under a timetable that provides adequate time to conduct the modeling, coordinate reviews of the results, and negotiate mitigation in advance of the anticipated construction let date. Otherwise, DOT to conduct modeling as part of project re-evaluation required under FHWA NEPA regulations (23 CFR 771).
- DWQ will maintain a list of approved models.

4.7 Step 7: Assess Analysis Results (if Step 6 warranted)

Since there are numerous assumptions made in the evaluation of indirect and cumulative impacts regarding the nature, timing, extent, and magnitude of those impacts, the practitioner should assess the reliability of the analysis results as per the NCDOT ICI Guidance. At a minimum, a disclosure of the underlying assumptions, causal factors, and data sources should be presented. More detailed assessments that include sensitivity or risk analyses may also be conducted. These are typically suggested when the analysis procedures are especially complex, or the sensitivity of notable features in the environment are high to relatively small margins of error in the outcomes of the analysis.

4.8 Step 8: Develop Impact Management Strategies (if warranted)

Based on results of analysis and coordinated planning between DWQ, the local community, DOT, and other stakeholders, mitigation strategies will be identified that are appropriate to the scale of anticipated impacts from the proposed project and that meet established environmental quality thresholds. The practitioner is encouraged to share the results of the ICI analysis, including mitigation, avoidance, and

enhancement strategies, as part of the public workshop/hearing process normally undertaken during project development.