

4.0 DETAILED ASSESSMENT SCOPING

The next phase of this study will address *Missing Data* as appropriate and focus field effort on *Preliminary Targeted Subwatersheds*. Proposed *Objectives* of the Detailed Assessment tasks (in terms of hydrology, water quality, and habitat) and *Recommended Indicators and Methods* are outlined below.

4.1 MISSING DATA

Missing data and resources are summarized in Appendix A, Table 6. Missing data include information pertaining to culverts, greenway areas (except Mecklenburg County), utility crossings, cleared riparian buffers, infrared images, local topography, and animal operations. Although data exist regarding utility infrastructure (e.g., municipal discharge points, sewer pipes, water pipes, etc.), it is typically incomplete. Information regarding the condition of riparian buffers has been subsequently generated via GIS analysis of 2001-2002 aerial imagery (see Appendix B, Figures 3 through 5). In addition, available NCCGIA land cover information is somewhat dated (i.e., 1996) and is, subsequently, of limited utility given the rapid development characteristic of much of the study area. As a result, MACTEC will conduct additional land use and cover analyses for representative targeted subwatersheds using more recent (i.e., 1999-2002) aerial photography in later tasks. These analyses will provide a more current characterization of IC, as well as facilitate office inventory efforts and the development of the build-out / resource degradation model.

4.2 PRELIMINARY TARGETED SUBWATERSHEDS

Table 15 summarizes criteria used to develop subwatershed scores for the purposes of preliminarily identifying and targeting areas for detailed field review. Data used in the scoring were obtained from historical data and reports (including existing GIS coverages); aerial analyses; GIS analyses; preliminary field investigations; and stakeholder input. Data are summarized in Table 1 through Table 13 in Sections 2.1.1, 2.2.1, 2.3.1, and 2.4.1. A number (1-35) was assigned to each subwatershed based upon its standing within the study area (which currently includes 35 subwatersheds). For example, the subwatershed with the highest percent IC (Subwatershed MC07) was given a rank of 35 while the subwatershed with lowest percent IC (Subwatershed CC17) was ranked 1.

In general, categories indicative of impacts to hydrology, water quality, and habitat (e.g., increase in urban landuse within riparian zones) received the highest ranking for the highest percentage. Criteria indicative of potential preservation opportunities (e.g., subwatershed with highest percent wetland)

received the lowest ranking for the highest percentage. For example, the subwatershed with the highest percent wetland (Subwatershed RR02) was ranked number 1, while the subwatershed with lowest percent wetland (Subwatershed CC05) was ranked 35. Rankings were multiplied by a weighting factor to establish the final (weighted) score.

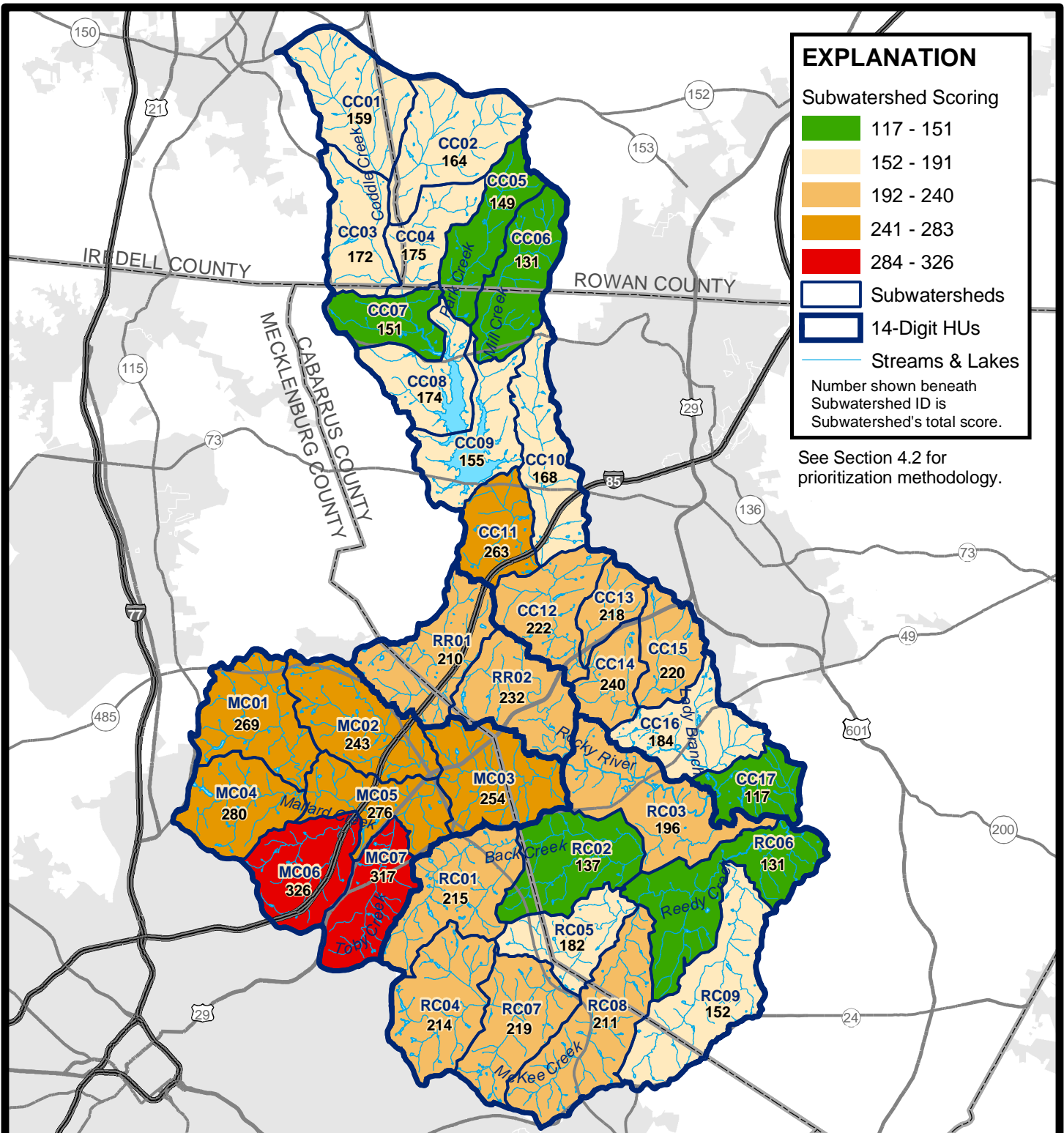
Weighting factors of 20, 10, 3, 2, 1, and -10 were assigned based upon the estimated impact of the criterion to hydrology, water quality and/or habitat, as well as the expected utility of the data. For example, IC received a relatively high weighting factor of 3 due to relatively well-established impacts to hydrology, water quality, and habitat associated with IC (CWP, 2003). Larger absolute factors (i.e., 20, 10, and -10) were used for criteria with characteristically low raw scores (e.g., number of major NPDES dischargers). Other criteria (e.g., percent wetland) received lower weighting factors (i.e., 1) due to potential inaccuracies associated with the data. For example, the source material used to produce NWI data is derived from high altitude aerial photography. There is a margin of error inherent in the use of aerial photography and field analysis may result in the revision of wetland boundaries. Smaller wetlands and those obscured by forest cover may be absent from NWI coverage (NWI, 2003). In addition, the date of data collection for NWI base maps varies considerably and is, therefore, often not representative of current conditions. Consequently/ the margin of error inherent in aerial photograph interpretation and the number of years having passed since the information was gathered limit the utility of NWI data. Total scores were established according to the following formula:

$$\begin{aligned} \text{Total Score} = & 3 \times (\text{Impervious Cover Rank}) \\ & + 1 \times (\text{Riparian Forest Change Rank}) \\ & + 1 \times (\text{Riparian Agricultural Change Rank}) \\ & + 1 \times (\text{Riparian Urban Change Rank}) \\ & + 2 \times (\text{Floodplain Encroachment Rank}) \\ & + 2 \times (\text{Wetland Loss Rank}) \\ & + 1 \times (\text{Percent Wetlands Rank}) \\ & + 20 \times (\text{Number of Major NPDES Dischargers}) \\ & + 10 \times (\text{Number of Minor NPDES Dischargers}) \\ & - 10 \times (\text{Number of NHP Occurrences}) \end{aligned}$$

Table 15: Subwatershed Scoring

SUB-WATERSHED	IMPERVIOUS COVER	URBAN RIPARIAN CHANGE	FORESTED RIPARIAN CHANGE	AGRICULTURAL RIPARIAN CHANGE	FLOODPLAIN DEVELOPMENT	WETLAND AREA	WETLAND LOSS	NHP OCCURRENCES	NPDES DISCHARGERS	TOTAL
CC01	15	2	19	34	12	31	46	0	0	159
CC02	30	10	26	32	12	8	46	0	0	164
CC03	24	1	24	35	12	30	46	0	0	172
CC04	21	7	23	33	12	33	46	0	0	175
CC05	6	9	13	28	12	35	46	0	0	149
CC06	9	12	12	18	12	32	46	-10	0	131
CC07	18	16	9	11	22	29	46	0	0	151
CC08	12	8	28	22	52	6	46	0	0	174
CC09	36	4	27	6	44	2	56	-30	10	155
CC10	48	21	16	20	28	9	46	-20	0	168
CC11	84	19	34	31	62	7	46	-30	10	263
CC12	63	25	17	11	48	4	64	-10	0	222
CC13	90	24	5	2	22	5	70	0	0	218
CC14	81	27	21	7	36	12	66	-10	0	240
CC15	96	18	2	1	22	27	54	0	0	220
CC16	69	23	1	3	50	28	50	-40	0	184
CC17	3	13	3	4	22	26	46	0	0	117
MC01	66	35	35	28	34	25	46	0	0	269
MC02	54	29	26	20	54	34	46	-20	0	243
MC03	78	11	14	29	56	20	46	-40	40	254
MC04	87	34	33	13	60	17	46	-10	0	280
MC05	93	32	31	26	64	14	46	-30	0	276
MC06	102	30	31	25	68	24	46	0	0	326
MC07	105	33	29	11	70	13	46	0	10	317
RC01	75	31	33	25	42	23	46	-60	0	215
RC02	57	17	11	12	30	22	48	-70	10	137
RC03	51	20	7	8	40	18	62	-50	40	196
RC04	60	26	21	18	32	21	46	-10	0	214
RC05	33	15	15	22	22	19	46	-20	30	182
RC06	27	3	5	25	24	15	52	-40	20	131
RC07	42	28	23	16	38	16	46	-10	20	219
RC08	45	5	9	30	46	10	46	0	20	211
RC09	39	6	6	16	26	11	58	-30	20	152
RR01	72	14	19	14	58	3	60	-30	0	210
RR02	99	22	11	5	66	1	68	-60	20	232

Subwatershed scores are presented in Figure 41. Higher scoring subwatersheds (shown in red) are associated with evidence of potential impacts to hydrology, water quality, and habitat while lower scoring subwatersheds (green) are indicative of fewer impacts to subwatershed integrity. Note that the higher scores tend to follow development patterns within the study area. These scores may be refined as additional subwatershed-specific data are collected in future tasks.



EXPLANATION

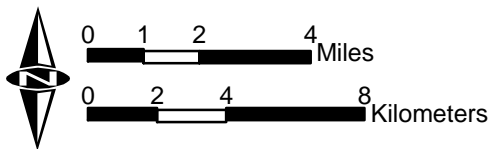
Subwatershed Scoring

- 117 - 151
- 152 - 191
- 192 - 240
- 241 - 283
- 284 - 326

- Subwatersheds
- 14-Digit HUs
- Streams & Lakes

Number shown beneath Subwatershed ID is Subwatershed's total score.

See Section 4.2 for prioritization methodology.



Data Source(s): NCCGIA, USFWS, NRCS, Cabarrus, Iredell, Mecklenburg & Rowan Counties
 Prepared / Date:
 Checked / Date:

NC Wetland Restoration Program
 Lower Yadkin LWP (Phase II)
 Rocky River Subbasin (03040105)



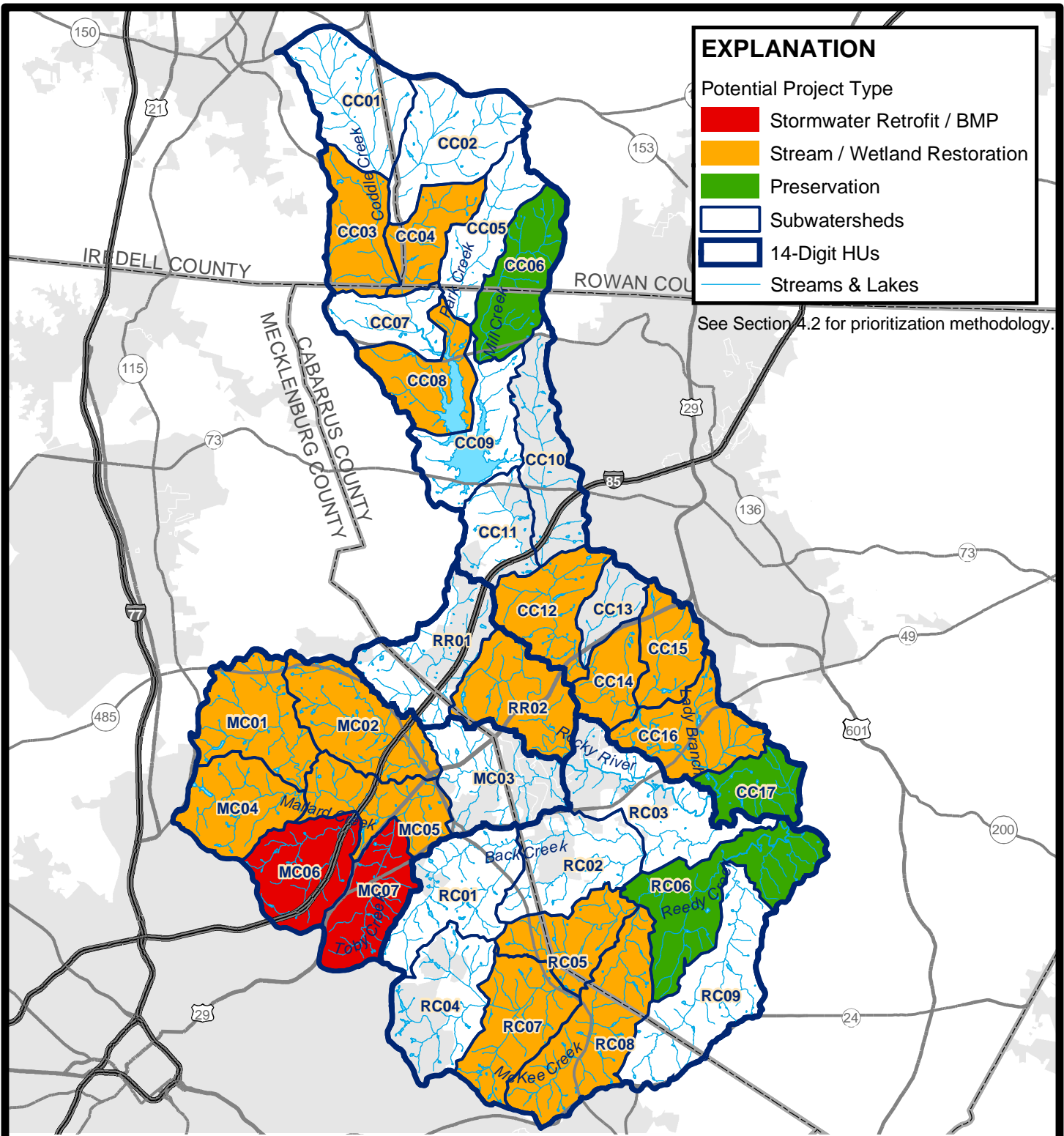
Subwatershed Scores
 Project 6470030020 Figure 41

Following subwatershed score tabulation, MACTEC used the optimal method (i.e., “natural breaks” in ArcView®) to group similar values together and determine the appropriate number of categories. This statistical analysis established five categories (I through V) of subwatershed scores (Table 16, Figure 42). These five categories are representative of conditions encountered throughout the study area: highly impacted (Category I, shown in red); moderately impacted (Categories II through IV, shown in orange); and, minimally impacted (Category V, shown in green). The establishment of representative categories of subwatersheds helps ensure that a range of habitats and potential mitigation opportunities will be reviewed. For example, highly developed / impacted subwatersheds (Category I) may present more stormwater retrofit opportunities while moderately impacted subwatersheds (Categories II through IV) may present more traditional stream and / or wetland restoration opportunities. Similarly, less impacted subwatersheds (Category V) may present potential preservation opportunities. However, mitigation opportunities of any type (e.g., stormwater retrofits, enhancement, restoration, preservation, etc.) may be found within any subwatershed regardless of score or classification.

Table 16: Subwatershed Categorization

	SCORE RANGE	SUBWATERSHED
I	28 - 32	MC06, MC07
II	24 - 28 1 - 3	MC04, MC05, MC01, CC11, MC03, MC02
III	19 - 24 2 - 0	CC14, RR02, CC12, CC15, RC07, CC13, RC01, RC04, RC08, RR01, RC03
IV	15 - 19 2 - 1	CC16, RC05, CC04, CC08, CC03, CC10, CC02, CC01, CC04, RC09
V	11 - 15 7 - 1	CC07, CC05, RC02, CC06, RC06, CC17

MACTEC targeted specific subwatersheds for additional assessment (including office inventory and stream / wetland visual assessment) by selecting representative subwatersheds from each of the five categories. The selection of representative subwatersheds will facilitate the efficient allocation of resources and help focus field efforts within subwatersheds that will likely provide significant project opportunities. In general, MACTEC selected the higher scoring subwatersheds (approximately top 50%) from each category as representative of conditions within that category (boldface text in Table 16). Since there are only two subwatersheds within Category I, both are selected. Selections from Category I and selections from Category V include lower scoring subwatersheds as representative of less impacted conditions.

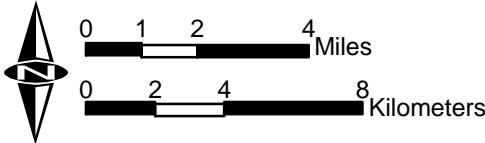


EXPLANATION

Potential Project Type

- Stormwater Retrofit / BMP
- Stream / Wetland Restoration
- Preservation
- Subwatersheds
- 14-Digit HUs
- Streams & Lakes

See Section 4.2 for prioritization methodology.



Data Source(s): NCCGIA, USFWS, NRCS, Cabarrus, Iredell, Mecklenburg & Rowan Counties
 Prepared / Date:
 Checked / Date:

NC Wetland Restoration Program
 Lower Yadkin LWP (Phase II)
 Rocky River Subbasin (03040105)



Preliminary Targeted
 Subwatersheds
 Project 6470030020 Figure 42

Eighteen subwatersheds were targeted through the selection process. These subwatersheds were cross-referenced with data from stakeholders as well as preliminary field reconnaissance results. Most of the targeted subwatersheds contained potential restoration sites identified by stakeholders and/ or preliminary field reconnaissance. However, two additional subwatersheds (RC08 and MC02) were selected based exclusively on information provided by stakeholder input for a total of 20 targeted subwatersheds. The final targeted subwatersheds are presented in Table 17.

Table 17: Targeted Subwatersheds

LOCAL WATERSHED	TARGETED SUBWATERSHED(S)
Coddle Creek	CC03, CC04, CC06, CC08, CC12, CC14, CC15, CC16, CC17
Mallard Creek	MC01, MC02, MC04, MC05, MC06, MC07
Reedy Creek	RC05, RC06, RC07, RC08
Rocky River	RR02

4.3 OBJECTIVES

Unless otherwise stated, the following objectives apply to all of the targeted subwatersheds throughout the study area.

4.3.1 Hydrology

Objective 1: Identify representative catchments (up to five per subwatershed) with indications of hydrological stress typical of both urbanizing (i.e., high development, channel straightening, piping, etc.) and agricultural (i.e., potential livestock access, denuded vegetative cover, etc.) areas. Representative areas in which hydrological stressors are confirmed by aerial imagery, field observation, or stakeholder input will be scheduled for field evaluation.

Objective 2: Perform additional IC analyses using more recent (i.e., 1999-2002) aerial photography on all targeted subwatersheds. These analyses will provide a more current characterization of IC in representative subwatersheds, as well as facilitate office inventory efforts and the development of the build-out / resource degradation model as part of later tasks.

4.3.2 Water Quality

Objective 1: Identify potential “hot spots” (i.e., specific threats) that may be contributing to water quality degradation within the Lake Howell water supply watershed (Subwatersheds CC01-CC09). Continue to compile and evaluate NCDWQ water quality monitoring data (including benthic macroinvertebrate data) as it becomes available to aid in identification of potential sources of water quality degradation. Identify livestock and poultry operations and other potential sources of fecal contamination, nutrients, sediment, and other pollutants entering WS-II streams. Representative streams in targeted subwatersheds within the water supply watershed (i.e., CC03, CC04, CC06, CC08) adjacent to confirmed livestock and poultry operations will be scheduled for field evaluation.

Objective 2: Select two subwatersheds (to be determined) within the Lake Howell water supply watershed (WS-II) and compare USGS stream coverage to additional stream coverage(s) (e.g., NRCS Soil Survey stream coverage) and/or arials to evaluate the potential for inadequate protection of 1st order streams. Previous MACTEC experience within a water supply watershed indicates that NRCS Soil Survey maps may more accurately depict the location of stream channels versus USGS stream coverage (City of Greensboro Stormwater Management, 2003). A comparison of USGS vs. NRCS Soil Survey stream coverage within the water supply watershed may provide evidence of potentially inadequate buffering of perennial streams.

Objective 3: Continue to compile and evaluate water quality monitoring data as it becomes available. NCDWQ is scheduled to collect water quality data through April 2004. Results of NCDWQ benthic macroinvertebrate sampling conducted in July 2003 should be available by December 2003.

4.3.3 Habitat

Objective 1: Identify stream segments, wetlands and/or riparian areas where aquatic or riparian habitat has been impacted by stream instability/modification or encroachment. Identify potential easements that include significant floodplain and/or transitional upland areas (stream corridor protection). Areas in which stream and/or buffer disturbance is confirmed by aerial imagery will be scheduled for field evaluation.

Objective 2: Document the presence of aquatic barriers to movement (e.g., culverts) and invasive species (e.g., kudzu) infestation within riparian corridors when traversing the local watershed for field surveys.

Objective 3: Conduct field evaluations in subwatersheds with documented occurrences (current) of State-designated (per NHP) endangered mussel species (MC04, RC02).

Objective 4: Identify undisturbed tracts of wetlands / streams / riparian corridors for potential preservation.

4.4 RECOMMENDED INDICATORS AND METHODS

Investigations of prioritized subwatersheds are designed to: 1) Identify causes and sources of hydrological, water quality, and aquatic habitat degradation, and 2) Define potential opportunities for restoration and other water quality projects in the local watersheds. The two main efforts in this task include *Riparian Inventory*, and *Detailed Analyses of Prioritized Subwatersheds*. MACTEC will also *Identify Restoration and Management Opportunities*.

4.4.1 Riparian Inventory

MACTEC will complete *Office Inventory*, *Stream Visual Assessments*, *Assessments of General Causes and Effects of Degradation*, and

Documentation of Findings subtasks in order to identify potential sources of water quality, hydrological, and habitat degradation and inventory specific projects associated with local watershed health.

4.4.1.1. Office Inventory

MACTEC will conduct an initial office assessment for each of the targeted subwatersheds, using available aerial photography as the primary data source for the effort. The office assessment will consist of the identification of up to five reaches or potential mitigation sites per targeted subwatershed for visual assessment. Additional information, including location of NPDES dischargers, NCDOT TIP projects, NCDOT road coverage, utility / infrastructure location, parcel disposition, hydric soils, and NWI coverage will supplement aerial photography in the selection of specific locations for visual assessment. Recommended indicators and methods are summarized in Table 18.

Table 18: Office Inventory Indicators

INDICATOR	METHOD	PURPOSE
Stream / wetland / riparian buffer disturbance	Aerial analysis	Site selection for additional assessment
Stakeholder information	Solicitation of stakeholder input	Site selection for additional assessment
NPDES dischargers NCDOT TIP projects NCDOT road coverage Utility / infrastructure location Parcel disposition Hydric soils NWI coverage	GIS	Identify potential site impacts, suitability, and/or constraints

4.4.1.2. Stream Visual Assessments

MACTEC will review the office assessment results with NCWRP staff (and stakeholders, as directed) to help identify specific reaches within targeted subwatersheds for visual assessments. MACTEC will use a modified version of the NRCS Stream Visual Assessment Protocol (SVAP) as a primary guide for this overall assessment effort. This procedure includes an overall reach description as well as characterization/scoring of various assessment elements. These elements include: channel condition, hydrologic alteration, riparian zone, bank stability, nutrient enrichment, instream habitat, canopy cover, manure presence, riffle embeddedness, and macroinvertebrates. The assessment reach will generally be 12 times the active channel width (i.e., stream width at bankfull discharge) and only applicable elements will be scored. The field team will take representative photographs as appropriate.

MACTEC will develop a visual assessment rating for each reach (or comparable assessment area) and this information will be entered into a database for each subwatershed. The database will facilitate the characterization and selection of specific locations (e.g., stream reaches, wetlands) targeted for potential restoration or other project activity. Although MACTEC will conduct the majority of stream visual assessments within targeted subwatersheds, additional assessments may be conducted at specific sites outside of targeted subwatersheds pending stakeholder input. Recommended indicators and methods are summarized in Table 19.

Table 19: Stream Visual Assessment Indicators

INDICATOR	METHOD	PURPOSE
Channel condition; Hydrologic alteration; Riparian zone; Bank stability; Nutrient enrichment; In-stream habitat; Canopy coverage; Manure presence; Riffle embeddedness; Macroinvertebrates	SVAP	Characterization / scoring

4.4.1.3. Assessments of General Causes and Effects of Degradation

The final aspect of this effort will be to assess the office and field observations to develop statements about the perceived nature, causes, and effects of water quality degradation, aquatic habitat loss, and other areas of functional loss in the watershed. Our efforts will focus on factors currently causing stream instability, water quality degradation, and habitat degradation. This will include correlating available GIS data and general basin land use data with the observed conditions to ascertain the apparent relative impacts of both point and non-point sources of pollution. Recommended indicators and methods are summarized in Table 20.

Table 20: Degradation Indicators

INDICATOR	METHOD	PURPOSE
SVAP score	Field assessment rating/notes	Identify potential causes of degradation
Land use	Aerial imagery, GIS	Identify potential causes of degradation
Stream / wetland / riparian buffer disturbance	Aerial imagery, GIS	Identify potential causes of degradation
Water quality data	NCDWQ physical/chemical monitoring	Characterization
Benthic macroinvertebrate community	NCDWQ sampling	Characterization

4.4.1.4. Documentation of Findings

The findings and conclusions of this effort will be summarized and presented using GIS coverages, as well as text, tables, and exhibits as appropriate.

4.4.2 Detailed Analyses of Prioritized Subwatersheds

MACTEC will coordinate with the NCWRP and other stakeholders on the findings and conclusions of the Riparian Inventory and Reconnaissance efforts to determine where more detailed analyses for each subwatershed are needed to better understand changing basin conditions and their impacts. These more detailed analyses may include Water Quantity Modeling, Stormwater System Outfall Review, and/or Compile / Collect Stream Geomorphology Data. The simulation of each watershed will consist of subdivision into catchments of appropriate areas/sizes based on available project resources. HEC-HMS

will be used as the selected hydrologic model, without model hydraulic simulation. No surveying is included for hydraulic modeling and no water quality modeling effort is included.

4.4.2.1. Water Quantity Modeling

MACTEC will coordinate with the NCWRP to specifically define the level of detail needed to adequately assess the subwatershed catchment drainage interactions. This coordination will focus on NCWRP current and anticipated future goals relative to water quantity issues as they relate to water quality. Based on this coordination, MACTEC will define the software needed to meet current and future needs. For example, HEC-HMS or WMS hydrologic software may be used in conjunction with steady-state hydraulic software (HEC-RAS) to perform an initial assessment of the subwatershed catchment drainage interactions. The primary focus of the modeling effort will be to assess/quantify flood storage, basin retention, wetlands drainage and residence time, and relative contributions by storm sewer systems to rates of flow and volumes.

MACTEC will utilize available land use, soils, and topographic data supplemented by collected field data where needed, to develop this hydrologic model. Once the hydrologic model has been created and debugged, we will then calibrate/verify model results to the extent possible, based on available recorded data and historical observed data. This verified model will characterize the hydrology for the detailed stream study site within the current subwatershed, and establish a baseline to evaluate relative impacts from projected basin build-out conditions.

If further evaluation determines that a complex quantity/quality model (e.g., XP-SWMM) or a more comprehensive water quantity/quality oriented modeling system is necessary (e.g., BASINS2), then the data developed as part of this initial effort may still be incorporated into the overall modeling process. Budget requirements for this process will be presented. Recommended indicators and methods are summarized in Table 21.

Table 21: Water Quantity Modeling Indicators

INDICATOR	METHOD	PURPOSE
Subwatershed ranking	Modeling software (TBD)	Quantify hydrology in representative subwatersheds
Subwatershed ranking	Geomorphological investigation	Characterization
Land use / disposition	GIS	Characterization
Soil erodibility	GIS	Characterization

4.4.2.2. Stormwater System Outfall Review

MACTEC will obtain stormwater information, particularly system outfall data (open channel and closed systems) for selected detailed stream study sites as available. This information will be evaluated for completeness, and if supplementation is needed, MACTEC will coordinate with NCWRP to determine whether additional stormwater inventory surveys will be required. If such inventory surveys are required, per discussions with NCWRP, MACTEC will approach the relevant community for possible assistance in developing an inventory of their stormwater system. In the event that such assistance is not forthcoming, the extent of the stormwater system survey will be assessed in terms of effort required to inventory the system for the detailed stream study site.

The resulting information will be compiled and assessments of the contributions of stormwater systems relative to the entire subwatershed will be made (i.e., what percent of the subwatershed has altered drainage, and what percent of flow in the catchment is from storm sewer systems). The result of this effort will be an objective characterization of the stormwater systems serving urban areas and their relative role in the watershed function. Recommended indicators and methods are summarized in Table 22.

Table 22: Stormwater System Indicators

INDICATOR	METHOD	PURPOSE
Percent imperviousness	GIS	Characterization
Peak flow data	Stormwater system inventory	Characterization

4.4.2.3. Compile / Collect Stream Geomorphology Data

MACTEC will coordinate with the NCWRP staff to identify stream segments where more detailed geomorphological information is needed for a complete assessment of conditions. Once these stream segments have been identified, MACTEC will conduct modified Rosgen Stream Classification Assessments for each appropriate segment. This effort will supplement stream data previously collected in the Riparian Inventory and Reconnaissance task with additional field-measured data. The data to be compiled in this task will be used to identify potential restoration opportunities (degree of impairment, need, benefits). Data will be limited to one riffle cross section, a short (two to three pools and two to

three riffles) longitudinal section, and an abbreviated (50 pebbles) pebble count. This information will be extrapolated to compute geomorphological parameters for each segment. Recommended indicators and methods are summarized in Table 23.

Table 23: Stream Geomorphology Indicators

INDICATOR	METHOD	PURPOSE
Channel slope	Rosgen-based geomorphic description	Characterization
Channel shape	Rosgen-based geomorphic description	Characterization
Channel materials	Rosgen-based geomorphic description	Characterization
Flood prone width	Rosgen-based geomorphic description	Characterization
Entrenchment	Rosgen-based geomorphic description	Characterization
Width/depth ratio	Rosgen-based geomorphic description	Characterization

4.4.3 Identify Restoration and Management Opportunities

MACTEC will rank Priority Opportunities identified within each of the four local watersheds and coordinate with the stakeholders and NCWRP to develop ranking criteria from which to develop a list of Capital Improvement Projects (CIPs) for each priority subwatershed. Opportunities will be prioritized according to need, feasibility, and cost. In addition, ranking criteria should be consistent with the goals developed for targeted subwatersheds and/or local watersheds per stakeholder and NCWRP input. For example, ranking criteria for targeted subwatersheds within the water supply watershed might emphasize projects that improve water quality functions. These might include projects that are more likely to reduce potential nonpoint source pollution loadings identified by recent NCDWQ water quality monitoring. As a result, ranking criteria may emphasize suitability for projects that provide opportunities for the implementation of water quality improvement/protection measures (e.g., cattle exclusion, buffer restoration). Similarly, urban areas with degraded, unstable stream channels (as indicated by bank stability, hydrologic alteration, and channel condition indices) may benefit from stream restoration and/or stormwater retrofit projects designed to reduce bank instability/erosion and associated property loss. Areas determined to be threatened by future development / land uses may benefit from projects designed to improve or protect habitat functions. Consequently, ranking criteria may emphasize opportunities for the establishment of habitat continuity, expansion of ecologically significant habitats (e.g., Natural Heritage Areas), or preservation of areas with high-quality habitats for wildlife. Written opinions of costs and estimated benefits (quantified for analysis) predicted for each restoration project will be developed in order to assist NCWRP in deciding where and with what combination of projects optimal watershed

benefits can be obtained. Individual subwatershed reports will be developed for later inclusion in Watershed Management Plan(s). Restoration recommendations for traditional (e.g., restoration sites) and non-traditional (e.g., BMPs, retrofits) mitigation projects will be developed and provided to NCWRP.

MACTEC will utilize the data and maps collected to develop subwatershed map products identifying areas for:

- Wetland and stream restoration projects which may meet compensatory mitigation requirements;
- Other types of strategies including BMPs, preservation (presence of open space), enhancement, stormwater retrofits, as well as other activities that would address the causes of degradation.

MACTEC will present this information by prioritized subwatershed using GIS, photographs, and by submitting a written description / package of the benefits each restoration project or strategy will provide for its subwatershed and within the Local Watershed. MACTEC will also outline how each recommended project or strategy specifically addresses the identified causes of degradation. MACTEC will use the data gathered to make restoration recommendations for specific wetland, stream, and riparian area deficiencies. These recommendations will be based on the following:

- Ranking criteria developed in conjunction with stakeholder feedback (the criteria will be used to rank the deficiencies and prioritize them in the catchment areas and from this ranking develop a CIP list and a cost schedule for each improvement);
- Greatest impact on water quality and aquatic and riparian habitat improvement and cost associated with the improvement (economic viability);
- Aesthetic value of the improvement;
- Overall watershed benefit of the improvement (quantity and quality upgrades).

MACTEC will also compare the relative cost/benefit effectiveness of stormwater BMPs and/or retrofits with traditional restoration projects. MACTEC will emphasize the implementation of a basin-wide (regional) stormwater management approach for targeted subwatersheds. BMPs and/or retrofits that preserve or restore the storm hydrograph upstream of identified restoration sites (especially in urban areas) will be given due consideration.

An opinion of cost for each of the projects and/or strategies identified will also be provided (excluding land costs for compensatory mitigation). These recommendations and cost opinions will be described in narrative text and summarized in table format for each of the individual subwatershed reports within the final Watershed Management Plan.

5.0 REFERENCES

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