7.2.2 Livestock Access to Streams

Livestock with access to streams have been documented as a concern because they deposit fecal material in or near streams making them potential source of *E. coli*. The livestock also walk over stream banks causing stream bank erosion and deposition of sediment into streams or increases in total suspended solids (TSS). Livestock in or with access to streams was noted in 27 of the 30 subwatersheds. A simple rating system of 'frequent' and 'moderate' was developed to gauge the relative frequency of livestock with access to streams. Six of the subwatersheds have 'frequent' numbers of observations (greater than eight) of livestock with access to streams. Eight of the subwatersheds have 'moderate' numbers of observations (greater than five but less than eight) (Figure Z). Figure Z also depicts the location of Confined Feeding Operations (CFOs) in each subwatershed. This environmental feature was included to assist in better understanding of livestock concentrations in the watershed relative to the locations where livestock were observed in the stream.

Frequent Livestock in the Stream Subwatersheds – "Purple"

- Big Walnut Creek – Plum Creek/Bledsoe Branch – Subwatershed F
- Big Walnut Creek – Snake Creek/Maiden Run – Subwatershed G
- Clear Creek – Miller Creek – Subwatershed I
- Deer Creek – Little Deer Creek – Subwatershed L
- Deer Creek – Owl Branch – Subwatershed N
- West Fork Big Walnut Creek – Lower – Subwatershed DD

These watersheds have a combined total of nine CFOs

Moderate to Frequent Livestock in the Stream Subwatersheds – "Tan"

- Big Walnut Creek – Greencastle – Subwatershed D
- Clear Creek – Headwaters (Putnam) – Subwatershed H
- Deer Creek – Headwaters – Subwatershed J
- Hunt Creek – Subwatershed R
- Jones Creek – Subwatershed S
- Limestone Creek – Subwatershed T
- Little Walnut Creek – Long Branch – Subwatershed W
- Ramp Run – East Fork Outlet – Subwatershed BB

These watersheds have a combined total of thirteen CFOs

8.0 SELECTION OF CRITICAL AREAS (PRIORITY SUBWATERSHEDS)

A variety of criteria were used to develop Critical Areas (i.e. Priority Subwatersheds) in the larger watershed. Nutrient and sediment loads were calculated using concentration and flow data from each site for each of the sample sites on each sample date and then compared against values recognized by water quality professionals to be indicative of healthy conditions. In addition to relative load information, the subwatersheds were scored against information collected during windshield surveys such as lack of buffered streams present and cattle with access to the streams, as well as the presence of NPDES dischargers, significant water users,

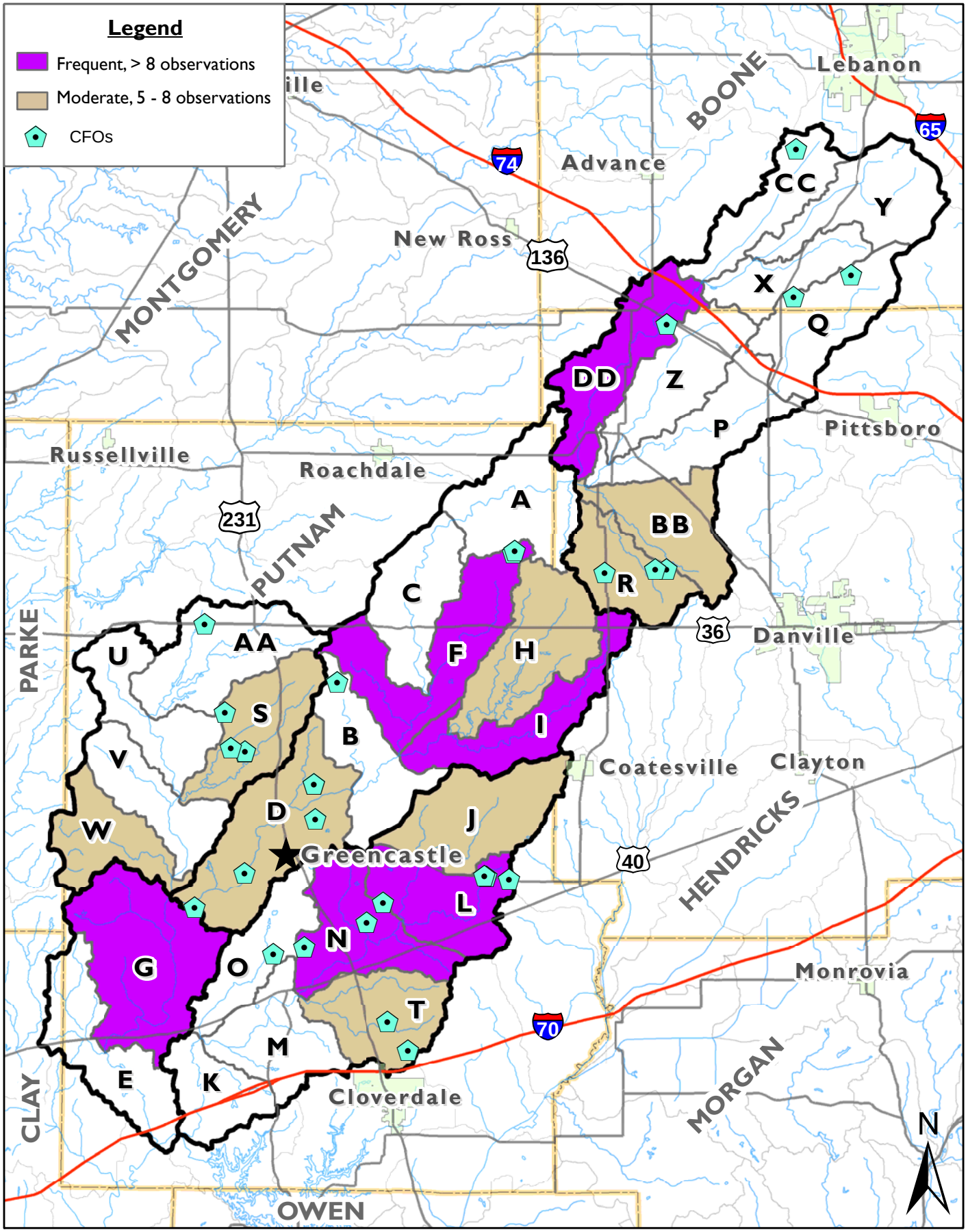

Figure Z - Livestock Access to Streams
Dec 2007- March 2008
Big Walnut Creek Watershed
Boone, Clay, Hendricks, Parke, & Putnam Counties, Indiana

and historic knowledge of Steering Committee members. Each subwatershed was listed in a spreadsheet and scored against twelve criteria based upon the aforementioned data (Table 18).

The original "1" and "2" scores (red and yellow coding) came from the relative impact that each subwatershed displayed for each parameter over the six sampling events (Shown as highlighted values in Tables 8-16). The Steering Committee then applied some discretion when reviewing the weighted scores by adjusting the importance of some parameters relative to others (e.g. double weighting the macroinvertebrate score since they are a more reliable long-term indicator than the individual chemical parameters). The scores for each subwatershed were totaled across the parameters to arrive at a total relative score. Subwatersheds associated with sample sites that showed elevated concentrations for multiple parameters, especially parameters that grossly exceeded state standards, targets, or were representative of multiple ecological concerns received a high score in the ranking table, those with a moderate concern, a low score, and those of little to no concerns were not given scores (Table 18). Since higher scored were assigned to higher concerns, those subwatershed with the highest total score (greater than nine) were identified as priority subwatershed for restoration and/or BMP implementation. In addition to the subwatersheds scoring nine or higher, some subwatersheds were also selected as priority watersheds based on concerns and knowledge of the Steering Committee. For example, Subwatershed O was selected as a 'moderate' (yellow) priority watershed because it was surrounded by four 'high' (red colored) priority Subwatersheds D, G, M, and N and implementing conservation practices with landowners in that area will likely require work in Subwatershed O. For the purposes of visual depiction and communication, the subwatersheds with highest concern (weighted score) were assigned a red status/color, while those with 'moderate' concern were assigned a "yellow" status/color. All remaining subwatersheds with lesser or limited concerns are white. A final status/color distinction was made regarding subwatersheds of exceptional quality and/or ecological function. These subwatersheds were colored green and will be further discussed in Section 8.2. A summary map showing the priority subwatersheds is represented in Figure AA.

The highest priority subwatersheds (shown in red on Figure AA) and their individual parameters of concern include:

<u>Big Walnut Creek – Greencastle (Subwatershed D)</u>

Total Suspended Solids, *E. coli*, Total Phosphorus, Nitrate, Biochemical Oxygen Demand, Macroinvertebrates, Livestock in Streams, Confined Feeding Operations, NPDES Noncompliance, and Significant Water Users

<u>Big Walnut Creek – Snake Creek/Maiden Run (Subwatershed G)</u>

Total Suspended Solids, *E. coli*, Total Phosphorus, Nitrate, Biochemical Oxygen Demand, Livestock in Streams, and NPDES Noncompliance

<u>Clear Creek - Headwaters (Subwatershed H)</u>

Total Suspended Solids, *E. coli*, Dissolved Oxygen, Macroinvertebrates, Livestock in Streams, and NPDES Noncompliance

Clear Creek – Miller Creek (Subwatershed I)

Total Suspended Solids, *E. coli*, Total Phosphorus, Dissolved Oxygen, Biochemical Oxygen Demand, Livestock in Streams, and Buffers

Deer Creek – Mosquito Creek (Subwatershed M)

Total Suspended Solids, Total Phosphorus, Nitrate, Biochemical Oxygen Demand, Macroinvertebrates, and NPDES Noncompliance

Deer Creek – Owl Branch (Subwatershed N)

Total Suspended Solids, *E. coli*, Total Phosphorus, Nitrate, Biochemical Oxygen Demand, Macroinvertebrates, Livestock in Streams, and Confined Feeding Operations

West Fork Big Walnut Creek – Lower (Subwatershed DD)

Total Suspended Solids, Total Phosphorus, Nitrate, Biochemical Oxygen Demand, Livestock in Streams, Confined Feeding Operations, and NPDES Noncompliance

Subwatersheds ranked as 'moderate' priorities (shown in yellow on Figure AA) and their individual parameters of concern include:

Big Walnut Creek – Dry Branch (Subwatershed B)

Total Suspended Solids, Total Phosphorus, Nitrate, Biochemical Oxygen Demand, and Confined Feeding Operations

Deer Creek – Leatherwood Creek (Subwatershed K)

Total Suspended Solids, Total Phosphorus, Nitrate, Biochemical Oxygen Demand, and Macroinvertebrates

Deweese Creek (Subwatershed O)

E. coli, Confined Feeding Operations, NPDES Noncompliance, and Significant Water Users

Jones Creek (Subwatershed S)

Dissolved Oxygen, Macroinvertebrates, Livestock in Streams, and Confined Feeding Operations

Limestone Creek (Subwatershed T)

Total Suspended Solids, Dissolved Oxygen, Macroinvertebrates, Livestock in Streams, Confined Feeding Operations, NPDES Noncompliance, and Significant Water Users

Main Edlin Ditch – Grassy Branch (Subwatershed X)

Total Suspended Solids, *E. coli*, Nitrate, Macroinvertebrates, and Buffers

Main Edlin Ditch – Smith Ditch (Subwatershed Y)

Total Suspended Solids, *E. coli*, Nitrate, Macroinvertebrates, and Buffers

Owl Creek (Subwatershed AA)

Confined Feeding Operations, NPDES Noncompliance, and Significant Water Users

West Fork Big Walnut Creek – Headwaters (Subwatershed CC)

Dissolved Oxygen, Macroinvertebrates, Buffers, and Confined Feeding Operations

Finally, the remaining subwatersheds (shown in white on Figure AA) are considered, at this point, to be lower priorities from a water quality perspective. However, it is important to note that some areas shown in white have limited sample sites and therefore limited water quality data with which to draw conclusions. Even though these are lower priority subwatersheds areas it does not mean that protection of high quality land and other best management practices are not important in these areas.

8.1 Comparison with Dr. Gammon's Data

As part of the background investigation into historical Big Walnut Creek Watershed data, Dr. Gammon's macroinvertebrate and fish work was used to develop historical priority subwatersheds. These priority subwatersheds were assigned similar relative rankings and assigned the same red and yellow status/color system (i.e. 'red' representing those subwatersheds that are most impaired or degraded and therefore, high priorities). This historic summary of Dr. Gammon's work is based primarily on fish IBI while our priority subwatersheds are based on a combination of biological and chemical factors, as well as field observation. Figure BB shows these watershed priorities side-by-side with current subwatershed priorities.

From Figure BB, one can see that many of the critical subwatersheds that Dr. Gammon noted are the same ones that remain areas of concern today based on current and varied data. The current priority subwatersheds map includes more subwatersheds than Dr. Gammon's primarily because more factors were considered in the evaluation. Dr. Gammon's priority subwatersheds are all subwatersheds that current data reflects as having low QHEI scores. This comparison makes logical sense, as the criteria that make up the QHEI evaluation are parameters that denote favorable for fish habitat.

8.2 Additional Priority Subwatersheds

Analysis of the water quality monitoring data collected revealed an interesting, reoccurring circumstance along one particular segment of Big Walnut Creek. Between sample points 6 and 7, both along mainstem Big Walnut, there was a reduction in nutrient and sediment loads. Typically a nutrient and sediment load increase is expected as a stream flows downstream and picks up more drainage area and the influence of numerous tributaries. It is interesting to note that because of the work of IDNR-DNP, CILTI, and TNC, much of the land adjacent to Big Walnut between points 6 and 7 is in nature preserves or conservation easements. This area has notable, wide forested buffers, intact floodplains and some contiguous wetland. The important functional nature of this area for both water quality and habitat makes it a critical area to continue protecting and restoring. For this reason, Subwatersheds A, C, and F are also listed as priority subwatersheds (Figure AA). Figure CC shows priority Subwatersheds A, C, and F along with the nature preserves and conservation areas along the Big Walnut Creek Corridor that are currently being protected in addition to those lands that are priorities to be protected.

Table 18: Watershed Priority Ranking

Sub	TSS	E.coli	TP	Nitrate	DO	BOD	Macro-invertebrates	Livestock in Streams	Buffers	CFOs	NPDES Non-Compliance	Significant Water Users	Score	Subwatershed priority
A	1												1	A
B	2		2	2		2				1			9	B
C	1										2		3	C
D	2	1	2	2		2	2	2		2	2	1	18	D
E	2		2	1		2						1	8	E
F	1	2					2	4	2	1			12	F
G	2	2	2	1		2		4			2		15	G
H	1	6			2		2	2	1		1		15	H
I	2	1	2		2	1		4	1				13	I
J			1					2					3	J
K	2		2	2		2	2						10	K
L			1					4		2			7	L
M	2		2	2		2	2				1		11	M
N	2	2	2	2		2	2	4		1			17	N
O		1								1	2	1	5	O
P	1		2	1		1					2		7	P
Q	1		2	1		1			1	1			7	Q
R				1	1			2					4	R
S					2		4	2		2			10	S
T	1				1		4	2		1	2	1	12	T
U	2	1	2	2		1							8	U
V	2		2	2		1							7	V
W					1			2					3	W
X	1	1		1			2		1				6	X
Y	1	1		1			2		2				7	Y
Z											1	0.5	1.5	Z
AA										1	1	0.5	2.5	AA
BB				1	1			2		1			5	BB
CC					2		2		1	1			6	CC
DD	2		2	2		2		4		1	1		14	DD

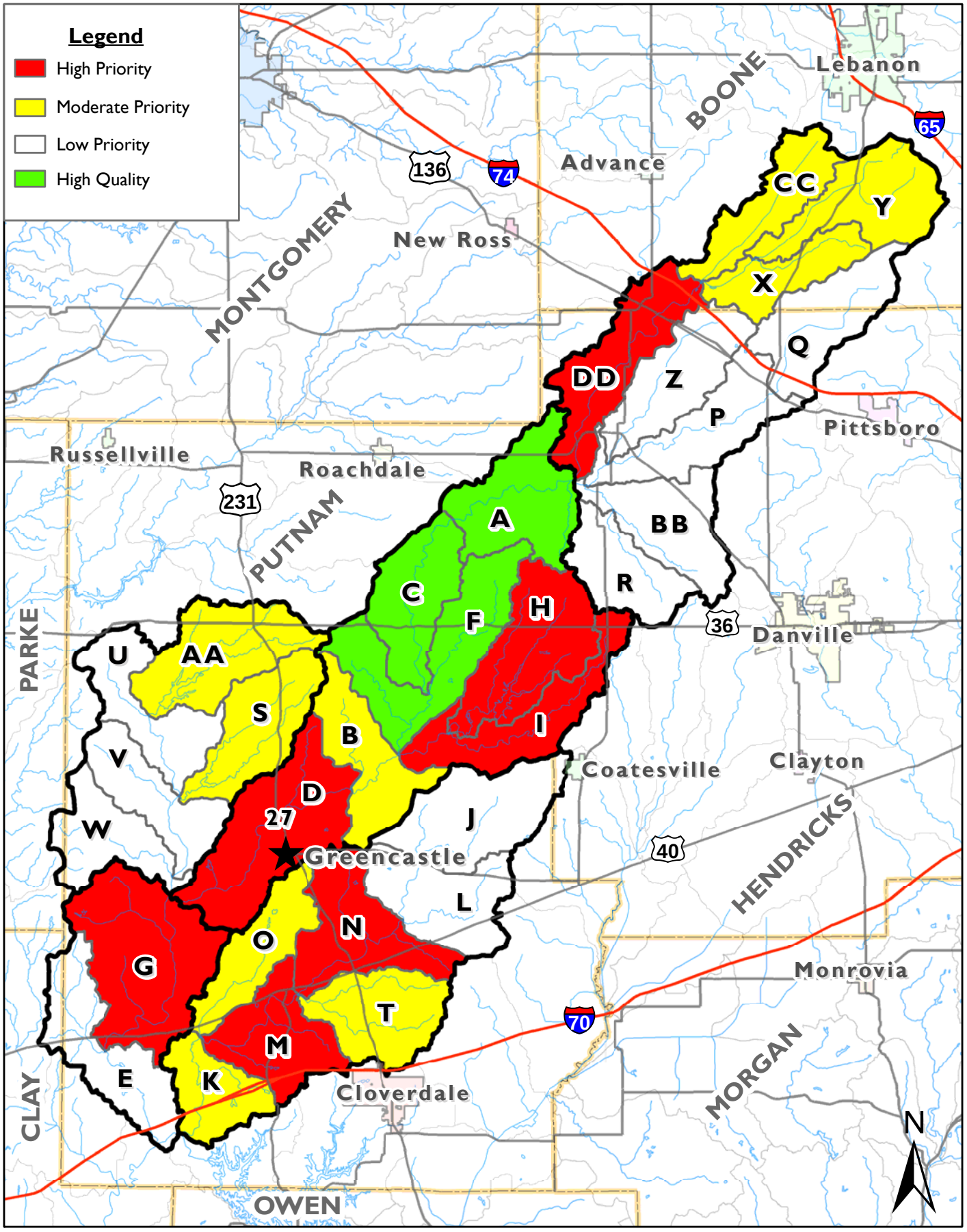

Figure AA - Priority Subwatersheds

Big Walnut Creek Watershed

Boone, Clay, Hendricks, Parke, & Putnam Counties, Indiana

8.3 New HUC Boundaries for Priority Subwatersheds

In 2008 new watershed boundaries were released and implemented as standard nomenclature for State and Federal projects in Indiana. These new watershed definitions are on a 10-digit and 12-digit scale. The new boundaries are intended to replace the currently used 11-digit and 14-digit scale watersheds. With the release of these new boundaries, the priority subwatersheds for this project will slightly change. Instead of 16 of the 30 14-digit subwatershed being defined as priority subwatersheds, 9 of the new 15 12-digit scale subwatersheds will be considered priority subwatersheds for this project. This change is being shown in this plan only for the purpose of future grant funding. Subwatershed analysis will not be reevaluated for this plan on the 10 and 12-digit scale. The new subwatersheds are shown on Figures DD1-DD6 and are listed below.

- Town of Barnard – Big Walnut Creek (Subwatershed A1)
- Clear Creek (Subwatershed B1)
- Deweese Branch – Deer Creek (Subwatershed C1)
- Dry Branch – Big Walnut Creek (Subwatershed D1)
- Edlin Ditch (Subwatershed E1)
- Owl Creek (Subwatershed G1)
- Owl Branch (Subwatershed I1)
- Headwaters Little Walnut Creek (Subwatershed J1)
- Snake Creek – Big Walnut Creek (Subwatershed M1)
- Bledsoe Branch – Big Walnut Creek (Subwatershed N1)
- West Fork Big Walnut Creek (Subwatershed O1)

8.4 Supplemental Hydraulics and Hydrology Assessment

The heavy rains of June 2008 which caused severe flooding across much the Big Walnut Creek and Deer Creek Watersheds raised concerns about floodplain protection, relief, and water quality in some of the subwatersheds. With funding from United Way, a floodplain assessment was performed on nine (9) subwatersheds where flood waters were found to have caused the most damage to land and streambanks.

V3 Companies, an environmental consulting firm, was hired to perform a cursory hydrologic assessment using watershed flow statistics, basin characteristics and peak flow storm events for nine (9) subwatersheds. These subwatersheds include: subwatersheds B, D and G along Big Walnut Creek; subwatershed E along Eel River; and subwatersheds J, K, L, M and N along Deer Creek. V3 also performed cursory hydraulic assessments at an accessible location near the downstream most portion of the nine subwatersheds during site visits on December 15th and 16th, 2008.

The purpose of the floodplain assessment evaluation was to contribute to the understanding of subwatershed prioritization for flood prevention planning of implementation projects. Subwatershed priority target areas for planning of flood prevention projects have been identified and an engineer's opinion of probable costs has been provided as part of the report. The entire Floodplain Assessment Report by V3 can be found in Appendix I.

The Floodplain Assessment performed by V3 found that subwatershed L was in the worst condition and subwatershed E was in the best condition relative to flood impacts and stream restrictions. The subwatersheds were prioritized based on the sum value of the hydrologic and hydraulic assessment scores. The prioritization order from worst condition to best conditions is as follows: L, J, N, M, K, B, G, D, and E. The Floodplain Assessment will be used to help target future watershed best management practices to lessen the water quality and quantities impacts in previously identified priority subwatersheds.

9.0 PUBLIC INPUT AND LOCAL CONCERNS

9.1 Stakeholders

An introductory public meeting was held on April 19th, 2007 at the Commissioner's Court in Greencastle, Indiana at 7 pm. Initial public concerns identified at this meeting included:

- Saving Soil
- Land use and practices in headwaters (Boone and Hendricks Counties)
- Economic Development (tax base for Bainbridge, Cloverdale, Greencastle)
- Flood Prevention – role of bridges, control structures, etc. Cost/benefit of structures
- Sedimentation (brown water)
- Growth rate and sewers – need for commercial growth
- Trail Connections (along streams, public access)
- Patterns of Flooding (road impairments, small storms lend big effect)
- Mining Activities (quarries)
- Historic Bridges
- Isolated approach to solving local problems (Conservancy District Boundaries)

Upon reviewing the above list and water quality data collected as part of this project, the Steering Committee identified the following additional or related concerns:

- E. coli bacteria levels higher than the State standards in many locations
- Elevated nutrient levels especially in the headwaters and around Greencastle
- High loads of organic matter (elevated BOD at some locations)
- Habitat is degraded in certain areas/habitat improvement may improve water quality
- Ground water withdrawal and recharge
- Lack of public education on environmental topics (timing of impacts, who is affected and how, drinkability and recreation potential or limitations)
- Land use practices (impacts on velocity of water and erosion)
- Erosion from in-stream meandering, bridge building, and location of erodible soils
- Increased run-off from urban areas
- Location, connection, and protection of conservation areas/natural areas
- Failing septic systems (homeowner regulatory fears, cost or repairs, no cost share programs, education on maintenance practices)
- Corridor and floodplain protection
- Strategic placement/planning for development (i.e. "controlled sprawl")
- Low flow water quality (stagnant water, algae blooms)