

**PROGRAMMING STUDY
KY 88
HART AND GRAYSON COUNTIES
MUNFORDVILLE TO KY 479
ITEM NO. 4-8101.00**

I. INTRODUCTION

A. Study Purpose

The purpose of this Programming Study was to: (a) develop information for corridor improvements along KY 88 between US 31W in or near Munfordville and the intersection of KY 88 and KY 479 in Grayson County that can be used for future programming documents; (b) provide data to be used when and if the project enters the design phase; and (c) provide background information that can be utilized in the National Environmental Policy Act (NEPA) documentation for the project. Tasks undertaken as part of this effort included:

- Identifying project goals and issues
- Defining the need for the project
- Determining project termini and potential corridors
- Describing the conditions along the existing roadway
- Identifying preliminary environmental concerns
- Estimating the project costs
- Identifying priority segments for future programming activities
- Initiating contact with public officials and agencies

One of the steps in this process was the collection of technical and resource agency input concerning the project. This was accomplished by:

- Compiling information from existing data and reports
- Establishing a project team to provide direction and review for the study
- Coordinating with resource agencies and local officials

Information thus collected was evaluated to accomplish the following:

- Evaluate the project description and logical termini
- Address the geometrics, level of service, vehicle crashes, and other issues that are influencing the project
- Address, in general terms, the project design criteria
- Document known environmental concerns
- Develop a draft statement of project goals

B. Programming and Schedule

The project is described in the 2002 Kentucky Six-Year Highway Plan (FY 2003-2008) as a "Planning Study for KY 88 from Munfordville to Nolin Lake to Determine Scope and Priorities for Future Improvements". No future project phases are defined or scheduled at this time.

II. PROJECT LOCATION, EXISTING CONDITIONS, AND TRAFFIC

A. Project Location

The project termini, as originally described in the 2002 Kentucky Six-Year Highway Plan (see previous paragraph), were fairly general. The project team determined that the study area for the project would be defined as follows:

- On the east, along US 31W from the Green River to the junction of KY 1140 and then along KY 1140 northwesterly for approximately two miles;
- On the north, from KY 1140 approximately two miles northwest of its junction with US 31W to KY 728 approximately 2000 feet north of Cub Run;
- On the west, KY 479 from approximately 2000 north of KY 88 to approximately 2000 feet south of KY 88;
- On the south, from a point approximately 2000 feet south of the intersection of KY 88 and KY 479 easterly to KY 1827 approximately 2000 feet south of Cub Run to Forestville to US 31W at the Green River bridge in Munfordville.

The project area is shown in Exhibit 1 in Appendix A. The project termini were more specifically defined as US 31W in or near Munfordville on the east and the intersection of KY 88 and KY 479 on the west. Several photographs of the project area are shown in Appendix B.

B. Existing Highway Features

Data on the existing conditions along KY 88 were taken from the Division of Planning's Highway Information System (HIS) database and from roadway improvement plans of both the Kentucky Department of Highways (1935, 1937) and the U.S. Army Corps of Engineers (1961).

The KY 88 corridor is located in rolling terrain. Passing sight distance varies from ten percent to thirty percent. There are 38 horizontal curves and 97

vertical curves that do not meet current KYTC guidelines for a 55-mph design speed. The locations of these curves are shown in Tables 1 and 2.

**TABLE 1
HORIZONTAL CURVES WITH DESIGN SPEEDS < 55 MPH**

| County | Mile Point | Degree of Curve | Design Speed e = 8% |
|---------------|-------------------|------------------------|----------------------------|
| Hart | 1.494 | 10 | 44 MPH |
| Hart | 1.792 | 10 | 44 MPH |
| Hart | 2.109 | 12 | 40 MPH |
| Hart | 3.259 | 12 | 40 MPH |
| Hart | 3.396 | 12 | 40 MPH |
| Hart | 3.691 | 10 | 44 MPH |
| Hart | 3.990 | 12 | 40 MPH |
| Hart | 4.123 | 8 | 49 MPH |
| Hart | 4.299 | 12 | 40 MPH |
| Hart | 4.511 | 14 | 38 MPH |
| Hart | 5.075 | 8 | 49 MPH |
| Hart | 5.195 | 12 | 40 MPH |
| Hart | 5.769 | 10 | 44 MPH |
| Hart | 6.518 | 10 | 44 MPH |
| Hart | 6.837 | 8 | 49 MPH |
| Hart | 7.208 | 8 | 49 MPH |
| Hart | 7.941 | 10 | 44 MPH |
| Hart | 8.556 | 14 | 38 MPH |
| Hart | 9.465 | 8 | 49 MPH |
| Hart | 9.657 | 20 | 32 MPH |
| Hart | 9.857 | 10 | 44 MPH |
| Hart | 10.952 | 8 | 49 MPH |
| Hart | 11.870 | 8 | 49 MPH |
| Hart | 12.223 | 12 | 40 MPH |
| Hart | 12.623 | 11 | 42 MPH |
| Hart | 12.700 | 14 | 38 MPH |
| Hart | 12.848 | 18 | 33 MPH |
| Hart | 12.988 | 12 | 40 MPH |
| Hart | 13.839 | 8 | 49 MPH |
| Hart | 14.591 | 8 | 49 MPH |
| Hart | 14.804 | 8 | 49 MPH |
| Hart | 15.066 | 8 | 49 MPH |
| Hart | 15.498 | 12 | 40 MPH |
| Hart | 15.599 | 10 | 44 MPH |
| Hart | 15.694 | 8 | 49 MPH |
| Hart | 15.762 | 12 | 40 MPH |
| Hart | 15.892 | 12 | 40 MPH |
| Hart | 15.997 | 8 | 49 MPH |

**TABLE 2
VERTICAL CURVES WITH DESIGN SPEEDS< 55 MPH**

| County | Mile Point | Vertical Curve | Stopping Sight Distance | Design Speed |
|---------------|-------------------|-----------------------|--------------------------------|---------------------|
| Hart | 0.468 | Sag | 468 | 53 MPH |
| Hart | 0.781 | Sag | 484 | 54 MPH |
| Hart | 1.207 | Sag | 227 | 33 MPH |
| Hart | 1.368 | Crest | 339 | 43 MPH |
| Hart | 1.453 | Sag | 194 | 29 MPH |
| Hart | 1.737 | Crest | 481 | 54 MPH |
| Hart | 1.813 | Crest | 364 | 45 MPH |
| Hart | 1.974 | Crest | 470 | 53 MPH |
| Hart | 2.078 | Sag | 292 | 39 MPH |
| Hart | 2.145 | Crest | 344 | 43 MPH |
| Hart | 2.220 | Sag | 166 | 26 MPH |
| Hart | 2.675 | Crest | 333 | 42 MPH |
| Hart | 2.732 | Sag | 339 | 43 MPH |
| Hart | 2.826 | Sag | 197 | 30 MPH |
| Hart | 2.902 | Crest | 336 | 43 MPH |
| Hart | 2.987 | Crest | 330 | 42 MPH |
| Hart | 3.148 | Sag | 157 | 25 MPH |
| Hart | 3.291 | Sag | 240 | 34 MPH |
| Hart | 3.432 | Crest | 312 | 41 MPH |
| Hart | 3.537 | Sag | 142 | 24 MPH |
| Hart | 3.716 | Crest | 314 | 41 MPH |
| Hart | 3.830 | Crest | 303 | 40 MPH |
| Hart | 3.972 | Sag | 142 | 24 MPH |
| Hart | 4.048 | Crest | 332 | 42 MPH |
| Hart | 4.152 | Sag | 249 | 35 MPH |
| Hart | 4.275 | Crest | 465 | 53 MPH |
| Hart | 4.389 | Crest | 350 | 44 MPH |
| Hart | 4.853 | Sag | 234 | 33 MPH |
| Hart | 5.023 | Sag | 274 | 37 MPH |
| Hart | 5.066 | Crest | 253 | 35 MPH |
| Hart | 5.109 | Sag | 197 | 30 MPH |
| Hart | 5.667 | Crest | 343 | 43 MPH |
| Hart | 5.743 | Sag | 381 | 46 MPH |
| Hart | 5.876 | Sag | 243 | 34 MPH |
| Hart | 6.027 | Crest | 340 | 43 MPH |
| Hart | 6.093 | Sag | 257 | 35 MPH |
| Hart | 6.216 | Crest | 371 | 46 MPH |
| Hart | 6.321 | Sag | 279 | 38 MPH |
| Hart | 6.662 | Sag | 199 | 30 MPH |
| Hart | 6.766 | Crest | 364 | 45 MPH |

TABLE 2 (CONTINUED)
VERTICAL CURVES WITH DESIGN SPEEDS < 55 MPH

| County | Mile Point | Vertical Curve | Stopping Sight Distance | Design Speed |
|---------------|-------------------|-----------------------|--------------------------------|---------------------|
| Hart | 8.120 | Crest | 402 | 48 MPH |
| Hart | 8.191 | Sag | 198 | 30 MPH |
| Hart | 8.252 | Crest | 365 | 45 MPH |
| Hart | 8.537 | Crest | 378 | 46 MPH |
| Hart | 8.669 | Sag | 167 | 26 MPH |
| Hart | 8.754 | Crest | 348 | 44 MPH |
| Hart | 9.379 | Sag | 251 | 35 MPH |
| Hart | 9.446 | Crest | 280 | 37 MPH |
| Hart | 9.626 | Sag | 174 | 27 MPH |
| Hart | 9.692 | Crest | 396 | 48 MPH |
| Hart | 9.787 | Crest | 311 | 41 MPH |
| Hart | 9.843 | Sag | 190 | 29 MPH |
| Hart | 9.891 | Crest | 346 | 43 MPH |
| Hart | 9.976 | Sag | 200 | 30 MPH |
| Hart | 10.033 | Sag | 232 | 33 MPH |
| Hart | 10.184 | Crest | 327 | 42 MPH |
| Hart | 10.317 | Sag | 191 | 29 MPH |
| Hart | 10.402 | Crest | 321 | 41 MPH |
| Hart | 10.487 | Sag | 182 | 28 MPH |
| Hart | 10.554 | Crest | 382 | 46 MPH |
| Hart | 10.677 | Crest | 475 | 54 MPH |
| Hart | 10.961 | Crest | 471 | 53 MPH |
| Hart | 11.065 | Sag | 481 | 54 MPH |
| Hart | 11.321 | Sag | 449 | 52 MPH |
| Hart | 11.624 | Sag | 337 | 43 MPH |
| Hart | 11.794 | Crest | 406 | 48 MPH |
| Hart | 11.908 | Sag | 231 | 33 MPH |
| Hart | 11.974 | Crest | 366 | 45 MPH |
| Hart | 12.040 | Sag | 348 | 44 MPH |
| Hart | 12.590 | Sag | 197 | 30 MPH |
| Hart | 12.741 | Crest | 354 | 44 MPH |
| Hart | 12.893 | Crest | 316 | 41 MPH |
| Hart | 12.997 | Sag | 178 | 28 MPH |
| Hart | 13.073 | Crest | 270 | 37 MPH |
| Hart | 13.257 | Sag | 190 | 29 MPH |
| Hart | 13.404 | Crest | 432 | 51 MPH |
| Hart | 13.906 | Crest | 422 | 50 MPH |
| Hart | 14.057 | Sag | 281 | 38 MPH |
| Hart | 14.370 | Sag | 199 | 30 MPH |

**TABLE 2 (CONTINUED)
VERTICAL CURVES WITH DESIGN SPEEDS < 55 MPH**

| County | Mile Point | Vertical Curve | Stopping Sight Distance | Design Speed |
|---------------|-------------------|-----------------------|--------------------------------|---------------------|
| Hart | 14.498 | Crest | 314 | 41 MPH |
| Hart | 14.559 | Sag | 305 | 40 MPH |
| Hart | 14.635 | Crest | 388 | 47 MPH |
| Hart | 14.886 | Sag | 268 | 36 MPH |
| Hart | 15.023 | Crest | 450 | 52 MPH |
| Hart | 15.317 | Crest | 340 | 43 MPH |
| Hart | 15.610 | Sag | 229 | 33 MPH |
| Hart | 15.696 | Crest | 354 | 44 MPH |
| Hart | 15.800 | Sag | 451 | 52 MPH |
| Hart | 15.904 | Sag | 268 | 36 MPH |
| Hart | 16.150 | Sag | 272 | 37 MPH |
| Hart | 16.283 | Crest | 414 | 49 MPH |
| Hart | 16.392 | Crest | 368 | 45 MPH |
| Hart | 16.548 | Sag | 212 | 31 MPH |
| Hart | 16.766 | Crest | 346 | 43 MPH |
| Hart | 16.908 | Sag | 254 | 35 MPH |
| Hart | 17.002 | Sag | 254 | 35 MPH |
| Hart | 17.059 | Crest | 209 | 31 MPH |

KY 88 in the study segment is an undivided two-lane highway with nine-foot wide lanes for 9.5 miles at the west end and ten-foot wide lanes for 8.5 miles at the east end as shown in Table 3. Except for a very short segment with eight-foot wide shoulders near the junction of KY 88 and KY 728 at Cub Run, shoulder widths are either three feet or essentially non-existent. The driving surface is high flexible or mixed asphalt pavement; the most recent resurfacing date is shown in Table 3.

**TABLE 3
ROADWAY CROSS-SECTION**

| County | Beginning MP | End MP | Lane Width | Shoulder Width | Year Resurfaced |
|---------------|---------------------|---------------|-------------------|-----------------------|------------------------|
| Grayson | 13.555 | 14.538 | 9 Feet | 3 Feet | 2000 |
| Hart | 0.00 | 5.123 | 9 Feet | 3 Feet | 1997 |
| Hart | 5.123 | 5.230 | 9 Feet | 8 Feet | 1997 |
| Hart | 5.230 | 8.559 | 9 Feet | 3 Feet | 1997 |
| Hart | 8.559 | 12.179 | 10 Feet | 0 Feet | 1996 |
| Hart | 12.179 | 13.107 | 10 Feet | 3 Feet | 1994 |
| Hart | 13.107 | 17.075 | 10 Feet | 0 Feet | 1994 |

KY 88 in the study segment has only two structures, reflecting its ridgetop location. Both structures have bridge sufficiency ratings above 79, meaning that neither is considered in need of replacement; hence neither is eligible for replacement funding. Table 4 depicts detailed information about each of these structures. As noted therein, the structure over Nolin Lake at the west end of the study segment is listed as functionally obsolete with an extremely minor speed reduction. It is noted herein for emphasis that functional obsolescence describes a condition wherein the roadway geometrics do not meet current design standards and is separate and distinct from a condition of structural deficiency. Finally, neither of these bridges has historical significance.

**TABLE 4
BRIDGES**

| County | MP | Bridge Number | Length | Width | Sufficiency Rating | Other Information |
|---------------|-----------|----------------------|---------------|--------------|---------------------------|--|
| Hart | 0.001 | B00007 | 556' | 27.2' | 79.8 | Functionally Obsolete; Minor Speed Reduction |
| Hart | 16.527 | B00006 | 255' | 32' | 84.7 | |

Significant intersections with crossroads along the study segment of KY 88 are shown in Table 5. In addition to those listed therein, there are 52 minor crossroads or entrance roads and one railroad crossing. The rail line is operated by CSX Transportation and the segment crossing KY 88 is among the more heavily utilized rail lines in Kentucky with a freight traffic density of between 20 and 50 million gross ton-miles per mile annually. Further, the Department of Defense has designated this rail line as a part of the Strategic Rail Corridor Network, which provides rail connection to key military facilities. More information about this rail line can be found in the Kentucky Transportation Cabinet's 2002 Kentucky Statewide Rail Plan at this web site: <http://transportation.ky.gov/Multimodal/railsystems.htm>.

**TABLE 5
MAJOR CROSSROADS**

| County | MP | Description |
|---------------|-----------|--------------------|
| Grayson | 13.555 | KY 479 |
| Hart | 1.093 | KY 1015 |
| Hart | 5.123 | KY 728 |
| Hart | 12.179 | KY 2786 |
| Hart | 17.817 | US 31W |

C. Highway Systems

KY 88 in the study segment is functionally classified as a Rural Major Collector. This functional classification is used to describe highway segments that:

- Serve trips that are of relatively short distance
- Are of regional, rather than statewide or interstate, significance
- Serves both access and mobility functions
- Provides connections to county seats

For maintenance purposes, it is classified as a state secondary route. KY 88 in the study segment has a Truck Weight Class of "A" (44,000 pounds gross weight limit) and is not a part of either the Coal Haul or Extended Weight Systems. It is not part of the National Highway System, the National Truck Network, the Forest Highway System, the Appalachian Development Highway System, the Bicycle Route System, or the National or Kentucky Scenic Byway System.

D. Vehicle Crash Analysis

A total of thirty-six (36) vehicle crashes were recorded with valid reference points on KY 88 in the study segment during the five-year period between January 1, 1996 and December 31, 2000. Eighteen of the crashes produced injuries to at least one person, while three crashes resulted in one fatality each. Both segment and spot crash analyses for the study segment of KY 88 were conducted as depicted in Tables 6 and 7. None of the analysis segments, varying in length from one to seven miles, showed a crash critical rate factor over, at, or even approaching 1.0. One spot, the intersection of KY 88 and KY 479 in Grayson County, showed a critical crash rate factor over 1.0; however the sample size for the analysis at this spot was small. No definitive conclusions can be drawn regarding whether crashes at this location are random or causal without more detailed investigation.

E. Traffic and Level of Service

The average daily traffic volume (ADT) in the year 2002 varied from about 700 vehicles just east of the Grayson-Hart County line to almost 2200 vehicles near the CSX railroad crossing just outside of Munfordville (Table 8 and,

in Appendix A, Exhibit 2). Projected future year (2030) average daily traffic volumes, based on an annual growth rate of two percent, range from about 1200 vehicles just east of the Grayson-Hart County line to about 3800 vehicles near the CSX railroad crossing just outside of Munfordville (Table 8 and, in Appendix A, Exhibit 3). Current and projected future year truck volumes are six percent of total vehicular traffic.

**TABLE 6
SEGMENT CRASH ANALYSIS 1996-2000**

| County | Begin MP | End MP | Segment Length | Functional Class Rate | Number Crashes | HMVM | RC | Crash Rate | Critical Rate Factor |
|---------|----------|--------|----------------|-----------------------|----------------|------|-----|------------|----------------------|
| Grayson | 13.555 | 14.538 | 0.983 | 248 | 6 | 0.01 | 663 | 487 | 0.73 |
| Hart | 0.000 | 1.093 | 1.093 | 248 | 1 | 0.01 | 666 | 85 | 0.13 |
| Hart | 1.093 | 5.123 | 4.030 | 248 | 4 | 0.04 | 463 | 100 | 0.22 |
| Hart | 5.123 | 12.179 | 7.056 | 248 | 15 | 0.17 | 351 | 90 | 0.26 |
| Hart | 12.179 | 16.770 | 4.591 | 248 | 10 | 0.14 | 361 | 72 | 0.20 |

Source: Highway Information System (HIS) DataBase, KYTC and Analysis of Traffic Accident Data in Kentucky (1996 – 2000)
Kentucky Transportation Center, September 2001

**TABLE 7
SPOT CRASH ANALYSIS 1996-2000**

| County | Begin MP | End MP | Spot | Functional Class Rate | Number Crashes | MVM | RC | Crash Rate | Critical Rate Factor |
|---------|----------|--------|-------|-----------------------|----------------|------|------|------------|----------------------|
| Grayson | 13.575 | 13.675 | 0.100 | 0.25 | 3 | 1.28 | 1.78 | 2.3 | 1.3 |

Source: Highway Information System (HIS) DataBase, KYTC and Analysis of Traffic Accident Data in Kentucky (1996 – 2000)
Kentucky Transportation Center, September 2001

**TABLE 8
CURRENT (2002) AND PROJECTED FUTURE YEAR (2030)
AVERAGE DAILY TRAFFIC VOLUMES**

| County | Route | Begin Point | Begin MP | End Point | End MP | 2002 ADT | 2030 ADT |
|---------|-------|-------------|----------|-------------|--------|----------|----------|
| Grayson | KY 88 | KY 479 | 13.555 | County Line | 14.538 | 880 | 1530 |
| Hart | KY 88 | County Line | 0.000 | KY 1015 | 1.093 | 730 | 1270 |
| Hart | KY 88 | KY 1015 | 1.093 | KY 728 | 5.123 | 680 | 1180 |
| Hart | KY 88 | KY 728 | 5.123 | KY 2786 | 12.179 | 1610 | 2800 |
| Hart | KY 88 | KY 2786 | 12.179 | I-65 Bridge | 16.527 | 2060 | 3590 |
| Hart | KY 88 | I-65 Bridge | 16.527 | RR Crossing | 17.075 | 2190 | 3810 |

Source: Highway Information System (HIS) DataBase, KYTC

For purposes of Level of Service (LOS) determination, the study segment of KY 88 is considered to be a Class II highway. As shown in Table 9, the LOS is defined in terms of the percent of time spent by one vehicle following another.

**TABLE 9
LOS CRITERIA FOR TWO-LANE HIGHWAYS IN CLASS II**

| LOS | Percent Time-Spent-Following |
|-----|--|
| A | < 40 |
| B | >40 but <55 |
| C | >55 but <70 |
| D | >70 but <85 |
| E | >85 |
| F | Flow rate exceeds the segment capacity |

Given the low traffic volumes along the study segment of KY 88, one would expect a relatively high LOS and that indeed is the case. Tables 10 and 11 indicate the current year (2002) and future year (2030) LOS for KY 88.

**TABLE 10
EXISTING LEVEL OF SERVICE (2002)**

| County | Section | Begin MP | End MP | Segment Length | Average Travel Speed* | Percent Time Spent Following* | V/C | LOS |
|---------|---------|----------|--------|----------------|-----------------------|-------------------------------|------|-----|
| Grayson | 1 | 13.575 | 14.538 | 0.963 | 33.8 | 36.1 | 0.05 | A |
| Hart | 2 | 0.000 | 1.093 | 1.093 | 34.4 | 34.1 | 0.05 | A |
| Hart | 3 | 1.093 | 5.123 | 4.030 | 34.6 | 33.3 | 0.04 | A |
| Hart | 4 | 5.123 | 12.179 | 7.056 | 30.3 | 45.1 | 0.10 | B |
| Hart | 5 | 12.179 | 16.770 | 4.591 | 30.0 | 51.1 | 0.13 | B |
| Hart | 6 | 16.770 | 17.050 | 0.280 | 29.9 | 52.6 | 0.13 | B |

Source: Highway Capacity Manual 2000 Chapter 20 (See LOS Criteria in Table 9)

* Based on BFFS of 45 mph and 10 access points per mile

**TABLE 11
FUTURE LEVEL OF SERVICE (2030)****

| County | Section | Begin MP | End MP | Segment Length | Average Travel Speed* | Percent Time Spent Following* | V/C | LOS |
|---------|---------|----------|--------|----------------|-----------------------|-------------------------------|------|-----|
| Grayson | 1 | 13.575 | 14.538 | 0.963 | 31.7 | 44.7 | 0.09 | B |
| Hart | 2 | 0.000 | 1.093 | 1.093 | 32.4 | 41.4 | 0.08 | B |
| Hart | 3 | 1.093 | 5.123 | 4.030 | 32.7 | 40.2 | 0.07 | B |
| Hart | 4 | 5.123 | 12.179 | 7.056 | 28.3 | 56.5 | 0.17 | C |
| Hart | 5 | 12.179 | 16.770 | 4.591 | 29.3 | 58.0 | 0.17 | C |
| Hart | 6 | 16.770 | 17.050 | 0.280 | 29.2 | 59.5 | 0.18 | C |

Source: Highway Capacity Manual 2000 Chapter 20 (See LOS Criteria in Table 9)

* Based on BFFS of 45 mph and 10 access points per mile

** Without corridor improvements

III. CABINET, PUBLIC, AND AGENCY INPUT

A. Project Team Meeting

A programming study project team meeting was conducted on February 8, 2003. The purpose of this meeting was to discuss the project and to assist in determining issues and concerns to be addressed in the study. A copy of the meeting minutes is included in Appendix C. Issues and concerns discussed by the team with observations and conclusions are as follows:

- The consensus of the team was that the general project area is as follows:
 - On the east, along US 31W from the Green River to the junction of KY 1140 and then along KY 1140 northwesterly for approximately two miles;
 - On the north, from KY 1140 approximately two miles northwest of its junction with US 31W to KY 728 approximately 2000 feet north of Cub Run;
 - On the west, KY 479 from approximately 2000 north of KY 88 to approximately 2000 feet south of KY 88;
 - On the south, from a point approximately 2000 feet south of the intersection of KY 88 and KY 479 easterly to KY 1827 approximately 2000 feet south of Cub Run to Forestville to US 31W at the Green River bridge in Munfordville.
 - The project termini were more specifically defined as US 31W in or near Munfordville on the east and the intersection of KY 88 and KY 479 on the west.
- No previous reports have been found, and, while the roadway design plans for the route are available, the plans for the western 1.346 miles of the project built by the U.S. Army Corps of Engineers are not legible.
- Roadway geometrics do not meet current KYTC standards:
 - Deficient horizontal curvature
 - Deficient vertical curvature
 - Deficient lane widths
 - Deficient shoulder widths
 - Two 90 degree turns within the City of Munfordville
 - Congestion in small residential communities along the corridor
 - Horse and buggy traffic along the corridor
 - Problems created for recreational vehicle travel along the corridor

- Potential benefits of the project include:
 - Improved safety resulting from increased sight distance, increased stopping sight distance, and a wider roadway cross section.
 - Better access from I-65 to Nolin River Lake
 - Potentially improved access to areas of economic growth if the KY 88 corridor were relocated between Mt. Beulah and US 31W north and west of Munfordville.

- KYTC will solicit the assistance of the Barren River Area Development District in obtaining information pertaining to Environmental Justice.

- District 4 Right of Way personnel were asked to assist with a list of real estate questions provided by the KYTC Division of Environmental Analysis. This information is summarized in Appendix D.

- The primary goal is to address safety and traffic flow problems created by the unique traffic composition; i.e. cars, trucks, recreational vehicles, and horse drawn buggies. The short sight distances and the narrow cross section of the roadway increase these problems.

- The team decided that the priority segments should begin at Munfordville and extend to the west. There are two options for the first segment. The first option would begin at US 31W in Munfordville and follow the existing alignment, except for curve improvements, to near KY 2786. The second option for the first segment would begin at US 31W between the existing I-65 – US 31W interchange and the KY 1140 – US 31W intersection and would follow a new alignment to the existing alignment near Mt. Beulah, then along the existing alignment to near KY 2786. The second segment would follow the existing alignment, except for curve improvement, from KY 2786 to the West Side of Cub Run. This section is expected to follow the existing alignment through Kessinger and Cub Run. The third segment would be from the West Side of Cub Run to the intersection of KY 88 and KY 479 in Grayson County. This section would follow the existing alignment, except for curve improvement, and would use the existing bridge over Nolin River Lake. An alternative of spot improvements should also be considered for each of the three segments.

- The Environmental Footprint Area will be the same as the general project area agreed on by the team. QK4 has been retained to do the environmental study for this project.

- Probable design criteria with comments were included with the report sent to the team. After further discussion, the team agreed to recommend design criteria as follows:
 - The functional classification of KY 88 in Grayson and Hart Counties is currently rural major collector. The project team does not expect this to change as a result of improvements to the roadway.
 - The design year for this study will be 2030. The maximum traffic in 2030 is estimated to be 3810 ADT and 440 DHV.
 - The expected design speed will be 55 mph to match the posted speed limit. Since the posted speed limit along the roadway in the communities of Cub Run, Kessinger, and Munfordville is 35 mph, the design speed for these sections can be less than 55 mph, but not less than 35 mph, if necessary.
 - The typical cross-section for rural collector roads with an ADT of 2000 or greater is 12-foot lanes with 8-foot shoulders. The team agreed that due to the unique character of the traffic on KY 88; a cross section of 12-foot lanes and 12-foot shoulders (with 10 foot paved) would be recommended because of the horse and buggy traffic as well as the recreational vehicles traveling to the lake. Curb and gutter with sidewalks should be considered for the portions of the roadway that pass through Cub Run, Kessinger, and Munfordville due to the residential nature of these areas.
- The team did not identify an applicable ITS solution for this project.
- The team agreed that any needs for bicycle/pedestrian traffic would be provided for by the cross sections of 10 foot paved shoulders and/or the sidewalks in the residential areas.

B. Local Officials and Group Meetings

No public meetings were held during the course of this study since no further project development phases are currently funded. However, at the request of the Barren River Area Development District, a meeting was held with the Hart County Transportation Committee⁽¹⁾ in the Hart County Judge-Executive

(1) The Hart County Transportation Committee is an established entity that periodically meets to discuss transportation issues in the community. It was created, and is administratively supported, by the Barren River Area Development District as part of its regional transportation planning program in partnership with the Kentucky Transportation Cabinet.

Office on March 18, 2003. Officials from BRADD and KYTC explained the purpose of the study as outlined previously in this report. KYTC officials outlined the issues that the Planning Study Project Team had articulated for the KY 88 corridor:

- Roadway geometrics do not meet current KYTC standards
 - Deficient horizontal curvature
 - Deficient vertical curvature
 - Deficient lane widths
 - Deficient shoulder widths
 - Two 90 degree turns within the City of Munfordville
- Congestion in small residential communities along the corridor
- Horse and buggy traffic along the corridor
- Problems created for recreational vehicle travel along the corridor

The committee concurred with this listing of issues. KYTC officials listed the potential benefits of improvement to the KY 88 corridor that the Planning Study Project Team had discussed:

- Improved safety resulting from increased sight distance, increased stopping sight distance, and a wider roadway cross section.
- Better access from I-65 to Nolin River Lake
- Potentially improved access to areas of economic growth if the KY 88 corridor were relocated between Mt. Beulah and US 31W north and west of Munfordville.

The committee dissented from the third benefit statement and expressed a preference for a new interchange with I-65 at KY 88. The committee also felt that the projected 2% annual growth rate in vehicular traffic was too conservative.

C. Resource Agency Coordination

Early agency coordination letters were sent to various resource agencies, interested organizations, local officials, and internal Cabinet offices to obtain input and comments regarding the potential impacts associated with this project. Copies of request letters, mailing list, and the responses are included in Appendix E. Issues identified and concerns raised as a result of this process include:

- Geotechnical Engineering Branch, KYTC Division of Materials: Caves will likely be encountered in limestone beds underlying sandstone formations on the eastern side of the KY 88 corridor; special construction techniques on the eastern side of the KY 88 corridor, such as retention basins, grass line ditches, and/or avoidance of open sinkholes for drainage disposal, will likely be necessary to prevent highway runoff from entering the cave system associated with the Green River; chemical stabilization of soil subgrades will likely be necessary; KY 88 in the study segment is in Seismic Risk Zone 2 (which is defined as an area of moderate damage due to earthquake activity).
- Division of Forestry, Department for Natural Resources: There are no trees of historical or cultural significance nor any listed on the state Big Tree list along KY 88 in the study segment; within the study area there are several hundred acres of productive forestland and five existing and one proposed Stewardship Forest(s) (Appendix E).
- Kentucky State Nature Preserves Commission, Natural Resources and Environmental Protection Cabinet: Concerns include the karstic nature of the area including an underground basin that supports the Mammoth Cave Shrimp (*Palaemonias ganteri*), listed as endangered by the U.S. Fish and Wildlife Service; several caves that harbor rare bats and a species of cave beetle; the potential presence of Eggert's sunflower (*Helianthus eggertii*), listed as threatened by the USFWS; and a desire to minimize further fragmentation of forested tracts in the region.
- Natural Resources Conservation Service, U.S. Department of Agriculture: expressed a general concern about potential impacts on prime farmland soils and farmlands of statewide importance.
- Department of Fish and Wildlife Resources, Kentucky Tourism Development Cabinet: Notes likely presence of Indiana bat (*Myotis sodalis*) and Gray bat (*Myotis grisescens*) in the KY 88 study segment and recommends procedural and mitigational efforts during subsequent project development phases in that regard; recommends procedural techniques to be employed during subsequent project development phases concerning intermittent or perennial streams.
- Division of Air Quality, Department for Environmental Protection: Noted general concerns about Fugitive Emissions, open burning, and air quality conformity. (Note: neither Hart nor Grayson County is currently listed as a non-attainment area).

- Kentucky Geological Survey, University of Kentucky: General comments, similar to those of the Geotechnical Engineering Branch of the KYTC Division of Materials.
- Permits Branch, KYTC Division of Traffic Operations: Urges that if roadway is significantly reconstructed it be as a partially or fully controlled access facility and discusses procedural requirements if this happens; recommends that design speed used in subsequent project development phases be the same as anticipated posted speed; recommends construction of access control fence.
- KYTC Division of Environmental Analysis: Indicated that many of the identified wetlands are in a karst plain with no surface connectivity and thus would not be considered "jurisdictional"; indicates likely presence of Indiana bat, gray bat, Eggert's Sunflower, Price's Potato Bean, and mussels; noted several potentially eligible/listed cultural historic sites and recommended full baseline study in subsequent project development phases; indicated potential for several UST/HAZ sites and recommended a phase one study in subsequent project development phases; noted likely impact on ephemeral streams; indicated that noise and air aspects of the project should not be a cause for concern.
- Resource Conservation and Local Assistance Branch, Division of Waste Management, Department for Environmental Protection: Requests the use of pulverized glass aggregates in roadbed construction during subsequent project development phases.
- Superfund Branch, Division of Waste Management, Department for Environmental Protection: There are sixteen Superfund sites listed in Grayson County and seventeen Superfund sites listed in Hart County (Appendix E). A quick perusal of the descriptions of the specific site locations appears to indicate that few, if any, of the listed sites in Grayson County and fewer than six of the listed sites in Hart County may be in the KY 88 project corridor. A more detailed analysis of these features will be conducted as a part of any future project development activities.
- Underground Storage Tank Branch, Division of Waste Management, Department for Environmental Protection: There are 142 underground storage tank (UST) sites listed in Grayson County and 119 UST sites listed in Hart County (Appendix E). A quick perusal of the descriptions of the specific site locations appears to indicate that many of these are located outside the KY 88 project corridor. A more detailed analysis of these features will be conducted as a part of any future project development activities.

- Fish and Wildlife Service, U.S. Department of the Interior: Encouraged use of Best Management Practices during future construction; indicated the possible presence of four Threatened or Endangered Species (Indiana bat, gray bat, Eggert's sunflower (each mentioned by others) and the Kentucky cave shrimp) and outlined procedures to follow associated with those in future project development phases.
- Kentucky Cabinet for Workforce Development: Supported concept of project.
- Office of Environmental Services, Kentucky Department of Agriculture: Stated preference for alternative improvement concepts that would disrupt the least amount of farmland.
- Centers for Disease Control and Prevention, Public Health Service, U. S. Department of Health and Human Services: Outlined issues that they want considered as a part of future project development phases, including air quality, water quality and quantity; wetlands and floodplains, hazardous materials and wastes, non-hazardous solid wastes and other materials, noise, occupational health and safety, land use and housing, and environmental justice.
- The following agencies responded to KYTC's solicitation for comments, but indicated that they had none at this time:
 - Department for Surface Mining Reclamation and Enforcement
 - Department of Military Affairs
 - Kentucky Cabinet for Health Services
 - Barren River District Health Department (Note: this response is incorporated in that of the Cabinet for Health Services.)

IV. ENVIRONMENTAL AND SOCIOECONOMIC OVERVIEW

A. Environmental Footprint

Presnell Associates, Inc. (d/b/a "QK4"), under contract to assist the Division of Planning, developed an Environmental Overview Report as shown in Appendix F. Included in that report was environmental resource data portrayed graphically on both USGS topographic and KYOGIS orthographic base maps. Issues identified as possibly requiring particular consideration in subsequent project development phases include:

- Potential impacts on surface and ground water sources and karst features.
- Culturally sensitive locations:
 - Fifteen cemeteries
 - Numerous churches
 - Munfordville Elementary School
- Tourist and recreation areas:
 - Nolin Lake Reservoir and Wildlife Management Areas
 - Wax Recreational Area
 - Nolin Lake State Park
 - Mammoth Cave National Park
- Three properties listed on the National Register of Historic Places, two of which are located within a potential historic district, as well as nineteen additional sites potentially eligible for designation.
- Additional archaeological investigations will be required.
- Sixty-five surface streams
- The requirement for development of a non-point source pollution control plan.
- Issues related to the Green River and Mammoth Cave National Park
- Numerous wetlands
- Various permits
 - Nationwide or individual permit from the U.S. Army Corps of Engineers
 - Kentucky Pollutant Discharge Elimination System General Stormwater Permit
 - (Possibly) a Floodplain Construction Permit
 - Water Quality Certification
- Construction restrictions/conditions associated with the likely presence of the Indiana bat and/or the gray bat
- Four "managed land" areas
- Twenty-seven possible contamination sites

B. Environmental Justice

The Barren River Area Development District conducted a review of the 2000 Census data for the purpose of identifying environmental justice and community impact issues. The purpose of this review was to assist the Kentucky Transportation Cabinet in meeting the requirements of Federal Executive Order 12898, which states that "...each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations..." and hence to ensure equal environmental protection to all groups potentially impacted by the KY 88 project. Although EO 12898 does not specifically address consideration of the elderly population, the U. S. Department of Transportation encourages the consideration of this demographic subset in Environmental Justice discussions. A copy of BRADD's Environmental Justice and Community Impact Report is included in Appendix G.

The BRADD study concludes that the potential for disproportionately high and/or adverse affects on minority populations impacted by the KY 88 project is very small. However, a concentration of low-income persons may exist in the Kessinger area along KY 88, and the potential impacts of a KY 88 project would need to be considered in greater detail in subsequent phases of project development. No other areas with a potential concentration of low-income persons along the KY 88 corridor were identified. Finally, a concentration of elderly persons may exist within the Munfordville portion of the KY 88 project; the potential impacts on elderly persons in Munfordville would need to be considered in greater detail in subsequent phases of project development.

Although not specifically identified in Federal Environmental Justice language, BRADD took the commendable step of including an analysis of potential impacts on Amish families within the KY 88 corridor in its report. Included in the BRADD report is a map showing concentrations of Amish families along Logsdon Valley Road and the Forestville area near KY 88. Further, an Amish school (Cedar Lane) is located along KY 88. Discussions with members of the community indicated that horse and buggy traffic is concentrated from the Logsdon Valley and Forestville areas into the City of Munfordville with peak travel times on Sundays and Thursdays. Specific consideration of this factor would need to be considered in greater detail in subsequent phases of project development.

V. TERMINI AND LENGTH

As indicated above, the project termini were defined to be US 31W in or near Munfordville on the east and the intersection of KY 88 and KY 479 on the west, a distance of 18.8 miles along the existing route.

VI. DRAFT PROJECT GOALS

Inasmuch as existing and projected future traffic volumes along the study segment of KY 88 do not portend systemic congestion problems, it does not appear that additional through lanes of travel are needed. However, the somewhat unique mixture of vehicular traffic composition traveling on the geometric deficiencies of the existing through lanes creates a roadway environment of less than optimal safety conditions. Thus, improving safety for all roadway users is the principal project goal.

VII. RECOMMENDATIONS

A. Geometric Design Features

Probable design criteria were discussed by the KY 88 project team, which agreed to the following recommendations:

- The functional classification of KY 88 in Grayson and Hart Counties is currently rural major collector. The project team does not expect this to change as a result of improvements to the roadway.
- The design year for this study will be 2030. The average daily vehicular traffic in 2030 ranges from about 1200 vehicles just east of the Grayson-Hart County line to about 3800 vehicles near the CSX railroad crossing just outside of Munfordville (Table 8 and, in Appendix A, Exhibit 3) with a design hour volume (DHV) of approximately 440.
- The expected design speed will be 55 mph to match the posted speed limit. Since the posted speed limit along the roadway in the communities of Cub Run, Kessinger, and Munfordville is 35 mph, the design speed for these sections could be less than 55 mph, but not less than 35 mph, if necessary.
- The typical cross-section for rural collector roads with an ADT of 2000 or greater is 12-foot lanes with 8-foot shoulders. The KY 88 project team agreed that, due to the unique character of the traffic on KY 88, a cross section of 12-foot lanes and 12-foot shoulders (with 10 foot paved) would be recommended because of the horse and buggy traffic as well as the recreational vehicles traveling to Nolin Lake. Curb and gutter with sidewalks should be considered for the portions of the roadway that pass through Cub

Run, Kessinger, and Munfordville due to the residential nature of these areas.

B. Priority Segments and Cost Estimates

The KY 88 project team recommended that the priority segments should begin at Munfordville and extend to the west. There are two options for the first segment. The first option would begin at US 31W in Munfordville and follow the existing alignment, except for curve improvements, to near KY 2786. The second option for the first segment would begin at US 31W between the existing I-65 – US 31W interchange and the KY 1140 – US 31W intersection and would follow a new alignment to the existing alignment near Mt. Beulah, then along the existing alignment to near KY 2786. The second segment would follow the existing alignment, except for curve improvement, from KY 2786 to the West Side of Cub Run. This section is expected to follow the existing alignment through Kessinger and Cub Run. The third segment would be from the West Side of Cub Run to the intersection of KY 88 and KY 479 in Grayson County. This section would follow the existing alignment, except for curve improvement, and would use the existing bridge over Nolin River Lake. The KY 88 project team also recommended that an alternative of spot improvements should also be considered for each of the three segments. Cost estimates for these segments and alternatives are depicted in Table 12.

C. Programming Estimates

For programming purposes, two alternative cost estimates for the priority section (Segment 1) are recommended. One of these estimates is for the spot improvements option. As shown in Table 12, the phase cost estimates for this alternative are as follows:

| | |
|---------------|---------------|
| Design: | \$ 700,000 |
| Right-of-Way: | \$ 1,000,000 |
| Utilities: | \$ 330,000 |
| Construction: | \$ 9,170,000 |
| Total: | \$ 11,200,000 |

For the full construction cost estimate, no decision is made at this stage regarding the inclusion of a grade separation at the railroad crossing; this decision would be made during the Design phase. The programming cost estimate, however, assumes that a grade separation would be included. Further, since no public meetings or hearings were conducted as a part of this limited analysis, an assumption is made that KY 88 would be reconstructed along the existing alignment. This, too, is a decision that would be made during the Project

TABLE 12
COST ESTIMATES BY SECTION

| Segment Number | SEGMENT DESCRIPTION | | TYPE OF IMPROVEMENT | APPROXIMATE LENGTH (MILES) | Phase Cost Estimates (Millions) | | | | | Total Cost Estimate (Millions) | Estimated Cost per Mile (Millions) |
|----------------|---|----------------------|---|----------------------------|-------------------------------------|-----------------|--------|-----------|--------------|--------------------------------|------------------------------------|
| | EASTERN TERMINUS | WESTERN TERMINUS | | | Project Planning/ Location Approval | Phase II Design | R/W | Utilities | Construction | | |
| 1 | US 31W in Munfordville | KY 2786 | Reconstruction without grade separation @ RR crossing | 5.6 | \$0.60 | \$1.50 | \$3.00 | \$1.00 | \$11.00 | \$17.10 | \$3.05 |
| 1 | US 31W in Munfordville | KY 2786 | Reconstruction with grade separation @ RR crossing | 5.6 | \$0.75 | \$1.70 | \$4.00 | \$1.00 | \$12.50 | \$19.95 | \$3.56 |
| 1a | US 31W between the existing I-65 - US 31W interchange and the KY 1140 - US 31W intersection | KY 2786 | Reconstruction without grade separation @ RR crossing | 3.7 | \$0.40 | \$1.00 | \$2.00 | \$0.50 | \$8.50 | \$12.40 | \$3.35 |
| 1a | US 31W between the existing I-65 - US 31W interchange and the KY 1140 - US 31W intersection | KY 2786 | Reconstruction with grade separation @ RR crossing | 3.7 | \$0.40 | \$1.20 | \$2.00 | \$0.50 | \$10.00 | \$14.10 | \$3.81 |
| 2 | KY 2786 | West Side of Cub Run | Reconstruction | 7.1 | \$0.75 | \$1.75 | \$3.50 | \$1.10 | \$12.50 | \$19.60 | \$2.76 |
| 3 | West Side of Cub Run | KY 479 | Reconstruction | 6.1 | \$1.00 | \$1.50 | \$3.00 | \$1.00 | \$13.00 | \$19.50 | \$3.20 |
| 1 | US 31W in Munfordville | KY 2786 | Spot Improvements | 5.6 | \$0.00 | \$0.70 | \$1.00 | \$0.33 | \$9.17 | \$11.20 | \$2.00 |
| 2 | KY 2786 | West Side of Cub Run | Spot Improvements | 7.1 | \$0.00 | \$0.69 | \$1.17 | \$0.37 | \$11.78 | \$14.20 | \$2.00 |
| 3 | West Side of Cub Run | KY 479 | Spot Improvements | 6.1 | \$0.00 | \$0.76 | \$1.00 | \$0.33 | \$10.10 | \$12.20 | \$2.00 |

Planning/Location Approval phase of any subsequent project development activities:

| | |
|-------------------------------------|---------------|
| Project Planning/Location Approval: | \$ 750,000 |
| Design: | \$ 1,700,000 |
| Right-of-Way: | \$ 4,000,000 |
| Utilities: | \$ 1,000,000 |
| Construction: | \$ 12,500,000 |
| Total: | \$ 19,950,000 |

The cumulative effect of these two assumptions is the use of a liberal cost estimator for the full reconstruction of Segment 1; alternate decisions about the alignment east of KY 2786 and/or the use of a grade separation at the railroad crossing would result in a cost estimate lower than that presented here.

VIII. ACKNOWLEDGEMENTS

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IX. CONTACTS

The following persons may be contacted if additional information is needed concerning the project or the programming study process:

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