Biological Assessment of Subwatersheds of the Big Sandy River Basin: Beaver Creek, Newcombe Creek and Ice Dam Creek, Kentucky, 2002

Kentucky Department for Environmental Protection
Division of Water
Watershed Management Branch
Nonpoint Source Section

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Cover photograph descriptions, clockwise from top left: *coal being transported by train, abandoned mine spoil, muddy water entering from tributary stream after a rain event, urban Land-use.*

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Biological Assessment of Subwatersheds of the Big Sandy River Basin: Beaver Creek, Newcombe Creek and Ice Dam Creek, Kentucky, 2002

By

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EXECUTIVE SUMMARY

In order to define problem areas in the Big Sandy Basin Management unit, Nonpoint Source staff selected three watersheds for 303(d)-listed tributary monitoring. These watersheds included Beaver Creek Watershed, Newcombe Creek Watershed and the Ice Dam Creek Watershed. The specific objectives for this project were to delineate specific impacts within these larger watersheds. Fish and macroinvertebrates were collected at each site using methods and protocols described in KDOW (KDOW 2002) for high-gradient streams. Twenty-eight stations were sampled in the Beaver Creek Watershed. One station obtained full-use aquatic life designation (Caney Fork 01022022). All other stations receive a partial support or nonsupport aquatic life rating (Figure 5). Nine stations were sampled in the Newcombe Creek Watershed. Two stations obtained full-use aquatic life designation, and one station received a threatened designation. All other stations receive a partial support for aquatic life. Three stations were sampled in the Ice Dam Creek Watershed. All stations received a nonsupport aquatic life use designation. Two Land-uses of concern in the Beaver, Newcombe and Ice Dam Creek watersheds include mining and urban Land-uses or the combination of mining and urban in the same sub watershed. These two Land-uses have stressed aquatic communities to the point that the majority of streams in all watersheds are impaired. Subwatersheds within the larger watersheds that have low or no residential uses and no mining should be considered priority areas for protection status. Best management practices should be evaluated and implemented as appropriate. Further investigation into appropriate locations for BMPs should occur within the Beaver, Newcombe and Ice Dam Creek watersheds. All data has been analyzed, interpreted and aquatic life use determinations included in the *2004 Kentucky Report to Congress on Water Quality*. Agency partners, watershed groups and others through the Big Sandy River Basin Team will continue to be encouraged to evaluate opportunities for watershed restoration projects to improve water quality.

INTRODUCTION

To more effectively evaluate the status of Kentucky's waterbodies and to improve restoration coordination, the Kentucky Division of Water (KDOW) initiated the Kentucky Watershed Management Approach. This approach follows a five-year schedule to evaluate current conditions, prioritize waterbodies, develop and implement strategies to remedy identified problems and finally to again assess water quality conditions. Because of the number of waterbodies in the state, it was necessary to focus water quality monitoring on 4th order watersheds. However, it has proven difficult to implement BMPs and show demonstrable changes in water quality in 4th order watersheds. To more effectively evaluate nonpoint source (NPS) impacts and remediation in Kentucky, it is necessary to concentrate on smaller watersheds. Smaller problem watersheds within the larger drainages need to be identified in order to establish nonpoint source grant funding priorities under §319(h) of the Clean Water Act. In order to define problem areas in the Big Sandy Basin Management unit, Nonpoint Source staff selected three watersheds for 303(d)-listed tributary monitoring. These watersheds included Beaver Creek Watershed, Newcombe Creek Watershed and the Ice Dam Creek Watershed. The specific objectives for this project were to delineate specific impacts within these larger watersheds. Aquatic life use determinations were included in the *2004 Kentucky Report to Congress on Water Quality* (KDOW 2004).

MATERIALS AND METHODS

Study Area

Beaver Creek Watershed (Figure 1) is located in the Dissected Appalachian Plateau (69d) of the Central Appalachian Ecoregion. Narrow ridges, deep coves and narrow valleys that are mostly forested characterize this ecoregion. High-gradient streams with cobble and boulder are common. Coal mining (surface and underground), gas and oil wells, and logging have degraded streams in this ecoregion (Woods et al. 2002). Twenty-eight stations were collected for biological (macroinvertebrates and fish), habitat, chemical or a combination of the above variables (Table 1, Figure 2).

Newcombe Creek Watershed (Figure 1) is located in the Ohio/Kentucky Carboniferous Plateau (70f) of the Western Allegheny Plateau Ecoregion. A mosaic of woodland, pastureland and cropland characterize this ecoregion. Biological diversity is high in good quality streams. However mining (surface and underground), logging, agriculture and oil production have degraded many streams within this ecoregion (Woods et al. 2002). Nine stations were collected for biological, habitat, chemical or a combination of the above variables (Table 1, Figure 3).

Ice Dam Creek Watershed (Figure 1) is located in the Monongahela Transition Zone (70b) of the Western Allegheny Plateau Ecoregion. Clayey soils are common and easily erodible after disturbance. Mixed deciduous-evergreen forests inhabit ridges while

farmland persists on gentle slopes and valleys (Woods et al. 2002). Three stations were collected for biological (macroinvertebrates and fish), habitat, chemical or a combination of the above variables (Table 1, Figure 4).

Fish and Macroinvertebrate Data Collection

Fish and macroinvertebrates were collected at each site using methods and protocols described in KDOW (KDOW 2002) for high-gradient streams. Macroinvertebrate samples were cleaned in the field of large debris (leaves, sticks, rocks, etc.), and the entire sample was returned to the laboratory for sorting and identification. Easily identified fish specimens were identified in the field; all others were preserved in 10% formaldehyde and returned to the laboratory for identification (KDOW 2002, Barbour et al. 1997). All organisms were identified to the lowest practical taxonomic level (usually genus and/or species). Habitat was assessed at each site using habitat assessment protocols described in Barbour et al. (1997) and KDOW (2002). For consistency, scores for each habitat category were determined by the same investigator(s) at all monitoring stations. Category scores were summed to provide a habitat assessment score for each site. Water samples for physicochemical analyses were collected with protocols described in the KDOW standard operating procedures manuals (KDOW 1993 and 1995). Water samples were analyzed for several bulk (alkalinity, total suspended solids, organic carbon, sulfate), nutrient (total phosphorus, nitrate, total kjeldhal nitrogen and ammonia) and metal parameters (aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium and zinc) following standard methodology (APHA et al. 1998, KDOW 1993 and 1995). In situ field parameters such as temperature, dissolved oxygen, pH and conductivity were measured with a Hydrolab® Surveyor 4/MiniSonde (Hydrolab-Hach Company, Loveland, Colo.). The collections of all samples occurred during the spring and summer index periods (late March to August).

Fish, Macroinvertebrate and Land-Use Data Analysis

The Kentucky Division of Water analyzed fish and macroinvertebrates with multimetric indices. Land-use data was compared from current data (2001) (http://gisdata.usgs.net/website/MRLC/) and historic land-use (1994) (MARCS 1998).

The KDOW's metric selection process uses statistical properties of redundancy and sensitivity to evaluate the power of metrics that can discriminate between impaired and unimpaired sites. Metric scoring criteria are established using percentiles of the reference and non-reference data distribution (KDOW 2002).

IBI Calculation equations used to compute individual metrics (M. Compton, personal communication):

NS* = [[x- 10.123(log10(catchment) + 4.4279)+20.49]/28.2]*100

DMS = [[x-2.967(log10(catchment)+1.5037)+6.21]/9.3]*100

INT = [[x-2.6679(log10(catchment)-0.1395)+4.09]/7.7]*100

SL = [[x-4.4162(log10(catchment)+0.9526)+7.96]/12.5]*100

P_INSCT = [[x-(-10.326(log10(catchment)^2+44.989(log10(catchment)+17.575)+58.88]/87.8]*100

P_TOL=[[(100-x)-(-5.4568(log10(catchment)^2+31.379(log10(catchment)+41.6)+77.65]/101.5]*100

P_FHW*=[[x-(8.9128(catchment)^2-59.151(catchment)+98.557)+27.14]/61.4]*100

* Note NAT for wadeable streams and P_FHW for headwater

Where: x = raw metric score, and catchment = drainage area in mi^2

Final IBI score was computed by the following equation (M. Compton, personal communication):

IBI=(NS(or %FHW)+DMS+INT+SL+P_INSCT+P_TOL)÷6

IBI scoring

Classification	Score
Excellent	≥ 71
Good	59 – 70
Fair	39 – 58
Poor	19 – 38
Very Poor	0 – 18

MBI Calculation equations used to compute individual metrics (KDOW 2002):

TR=(x/95th%ile)*100

EPT=(x/95th%ile)*100

PEPT=(x/95th%ile)*100

HBI2=((10-x)/95th%ile)*100

P_Clng=(x/95th%ile)*100

P_CO=((100-x)/(100-5th%ile))*100

where:

x = raw metric score, and

%ile provided by (G. Pond, personal communication)

Final MBI score was computed by the following equation:

MBI=((TR+EPT+PEPT+HBI2+P_Clng+P_CO)/6)*100

RESULTS

Beaver Creek Watershed

Twenty-eight stations were sampled in the Beaver Creek Watershed (Table 1, 3, 4, 5 and Figure 2). Overall one station obtained full-use designation (Caney Fork 01022022). All other stations receive a partial support or nonsupport rating (Figure 5). Land-use analysis indicates a change in the landscape. For instance, a decline occurred in the percent forest in the watershed from 1994 to 2001 (84% – 79%) as well as a decline in percent forest within the riparian zone along Beaver Creek and its tributaries (57% – 39%). Loss of forest in the watershed can be attributed to urbanization (i.e., roads, residential, etc.). Within the Beaver Creek Watershed overall percent land cover classified as urban has increased from 2% to 9%. This trend in urbanization is also present in the riparian zone (10% – 42%).

Arkansas (Site ID: 01022010)

Arkansas Creek Watershed drains 2.8 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There are two permitted active mine sites and 3 hollowfills were located. It received a poor rating for the MBI (31) and IBI (36) and a nonsupport habitat score (104). Land use classified as urban has increased from 1994 to 2001 (2% – 10%). Specific conductance was elevated at this site (640µs/cm). Land-use activities of concern in this watershed were urban and mining.

Arnold Fork (Site ID: 01022026)

Arnold Fork Watershed drains 3.5 mi.^{2} and is located in Knott County. This watershed received nonsupport of aquatic life use. There are eight permitted active mine sites and three hollowfills were located. It received a poor rating for the MBI (37) and IBI (19) and a nonsupport habitat score (131). Land use classified as urban has increased from 1994 to 2001 (1% – 7%). Specific conductance was elevated at this site (1157µs/cm). Land-use activities of concern in this watershed were urban and mining.

Bill D Branch (Site ID: 01022024)

Bill D Branch Watershed drains 3.7 mi.^{2} and is located in Knott County. This watershed received a nonsupport of aquatic life use. There is one permitted active mine site and one hollowfill is located. It received a poor rating for the MBI (40) and fair rating for the IBI (43) and a nonsupport habitat score (117). Land use classified as urban has increased from 1994 to 2001 (2% – 10%). Specific conductance was somewhat elevated at this site (320 µs/cm). Land-use activities of concern in this watershed were urban and mining.

Buck Branch (Site ID: 01022011)

Buck Branch Watershed drains 2.1 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There are no permitted active mine sites and two hollowfills are located. It received a poor rating for the MBI (33) and IBI (35) and a nonsupport habitat score (113). Land use classified as urban has increased from 1994 to 2001 (2% –8%). Land-use activities of concern in this watershed were urban and mining.

Caleb Fork (Site ID: 01022008)

Caleb Fork Watershed drains 1.8 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There is one permitted active mine site and two hollowfills were located. It received a very poor rating for the MBI (17) and nonsupport habitat score (139). Land use classified as urban has increased from 1994 to 2001 (0% – 6%). Specific conductance (347µs/cm) and ammonia (0.348 mg/L) were elevated at this site. Land-use activities of concern in this watershed were urban and mining.

Caney Fork (Site ID: 01022022)

Caney Fork Watershed drains 24.4 mi.^{2} and is located in Knott County. This watershed was the only watershed in Beaver Creek to obtain a full support rating. However, this watershed should be considered threatened. If current trends continue, this watershed could soon be considered nonsupporting. There are 10 permitted active mine sites and six hollowfills were located. This watershed received a fair rating for the MBI (67), excellent rating for the IBI (77) and a nonsupport habitat score (144). Land use classified as urban has increased from 1994 to 2001 (2% – 8%). Specific conductance was elevated at this site (805µs/cm). Land-use activities of concern in this watershed were mining and urban.

Clear Creek (Site ID: 01022032)

Clear Creek Watershed drains 5.2 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There are three permitted active mine sites and no hollowfills were located. It received a very poor rating for the MBI (20), poor rating for the IBI (32) and a nonsupport habitat score (94). Land use classified as urban has increased from 1994 to 2001 (2% – 10%). Specific conductance was elevated at this site (542 µs/cm). Land-use activities of concern in this watershed were urban and mining.

Dry Creek (Site ID: 01022023)

Dry Creek Watershed drains 4.9 mi.^{2} and is located in Knott County. This watershed received a partial support of aquatic life use. There are no permitted active mine sites and no hollowfills were located. It received a fair rating for the MBI (49) and IBI (54) and a nonsupport habitat score (113). Land use classified as urban has increased from 1994 to 2001 (0% – 7%). Specific conductance was elevated at this site (467µs/cm). Land-use activities of concern in this watershed were urban due to channelization.

Frasure Branch (Site ID: 01022030)

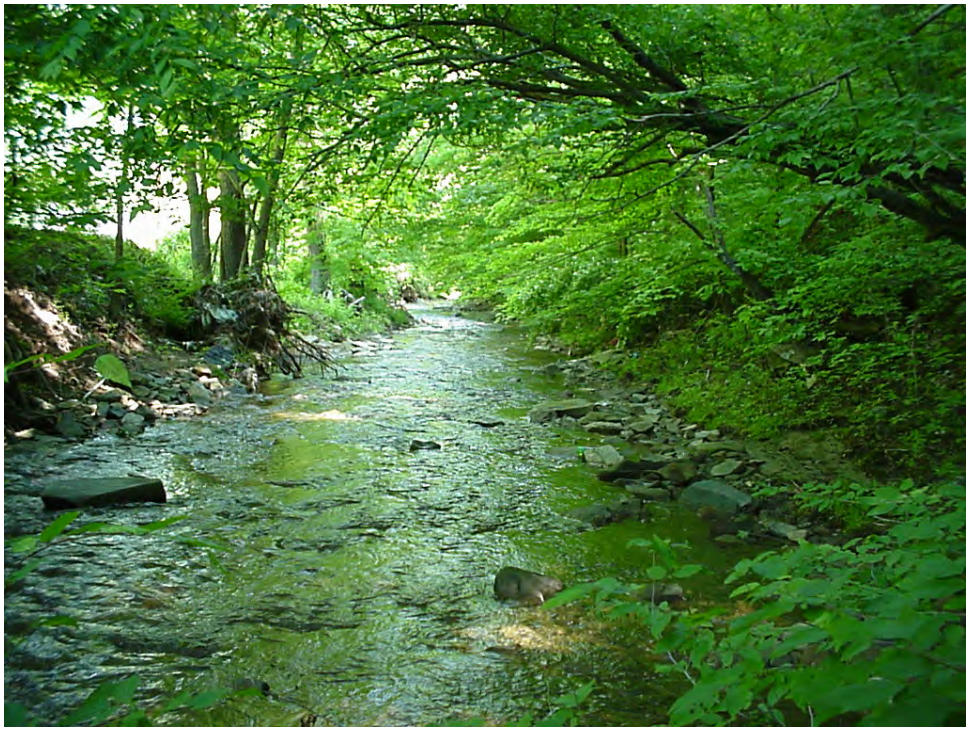
Frasure Branch Watershed drains 11.1 mi.^{2} and is located in Floyd County. This watershed received a partial support of aquatic life use. There are 10 permitted active mine sites and six hollowfills were located. It received a poor rating for the MBI (49), fair rating for the IBI (41) and a nonsupport habitat score (107). Land use classified as urban has increased from 1994 to 2001 (2% – 8%). Specific conductance was elevated at this site (738µs/cm). Land-use activities of concern in this watershed were mining and historic channel alteration.

Goose Creek (Site ID: 01022017)

Goose Creek Watershed drains 1.3 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There are two permitted active mine sites and one hollowfill was located. It received a very poor rating for the MBI (23), fair rating for the IBI (43) and a partial support habitat score (145). Land use classified as urban has increased from 1994 to 2001 (2% – 12%). Land-use activities of concern in this watershed were mining and urban.

Jacks Creek (Site ID: 01022033)

Jacks Creek Watershed drains 4.1 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There are two permitted active mine sites and one hollowfill was located. It received a very poor rating for the MBI (22), poor rating for the IBI (43) and a nonsupport habitat score (126). Land use classified as urban has increased from 1994 to 2001 (2% – 8%). Land-use activities of concern in this watershed were mining and urban.



Johns Creek (Site ID: 01022014)

Johns Creek Watershed drains 0.8 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. Within this watershed there are no permitted active mine sites or hollowfills. It received a poor rating for the MBI (31), fair rating for the IBI (47) and a nonsupport habitat score (139). Land use classified as urban has increased from 1994 to 2001 (0% – 5%). Land-use activities of concern in this watershed were urban.

Jones Fork (Site ID: 01022020)

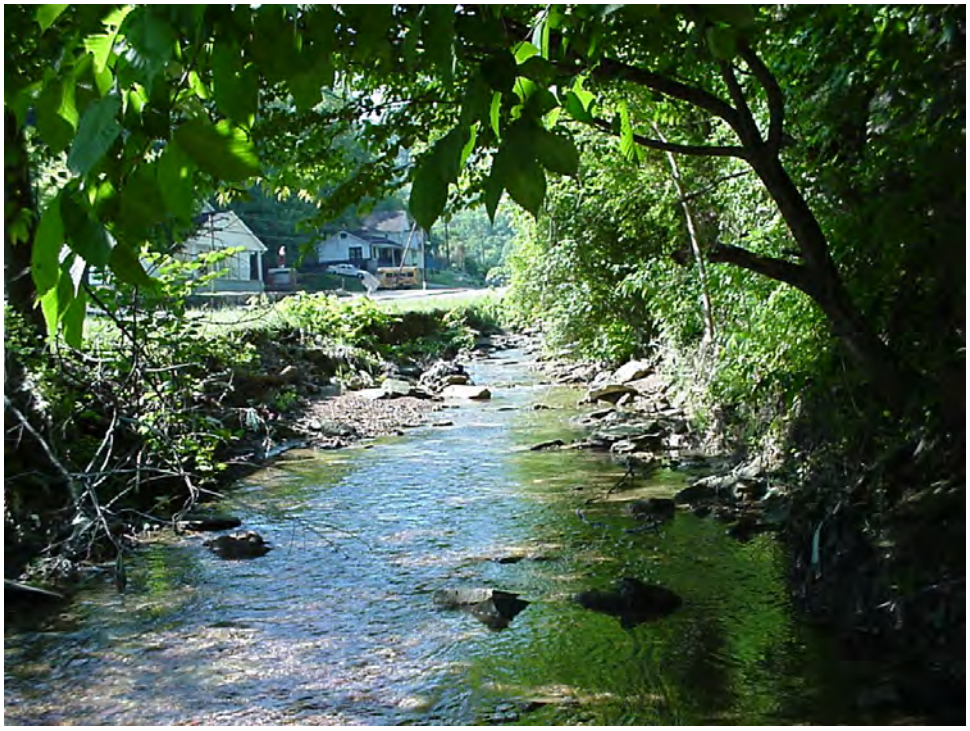
Jones Fork watershed drains 21.6 mi.^{2} and is located in Knott County. This watershed received a partial support of aquatic life use. There are 19 permitted active mine sites and nine hollowfills were located. It received a fair rating for the MBI (60), poor rating for IBI (33) and a nonsupport habitat score (115). Land use classified as urban has increased from 1994 to 2001 (1% – 6%). Specific conductance was elevated at this site (1322 µs/cm). Land-use activities of concern in this watershed were mining.

Left Fork Beaver Creek (Site ID: 01022027)

Left Fork Beaver Creek Watershed drains 61 mi.^{2} and is located in Floyd County. This watershed received a partial support of aquatic life use. There are 33 permitted active mine sites and 13 hollowfills were located. It received a fair rating for the MBI (66), good rating for the IBI (65) and a nonsupport habitat score (95). Land use classified as urban has increased from 1994 to 2001 (2% – 10%). Specific conductance was elevated at this site (539 µs/cm). Land-use activities of concern in this watershed were urban and mining.

Otter Creek (Site ID: 01022009)

Otter Creek Watershed drains 3.3 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There were no permitted active mine sites and no hollowfills. It received a very poor rating for the MBI (7) and a nonsupport habitat score (111). Land use classified as urban has increased from 1994 to 2001 (2% – 11%). Specific conductance was elevated at this site (581 µs/cm). Land-use activities of concern in this watershed were urban due to elevated ammonia concentrations (0.0653 mg/L), sediment deposition and channelization.



Puncheon Branch (Site ID: 01022025)

Puncheon Branch Watershed drains 4.1 mi.^{2} and is located in Knott County. This watershed received a partial support of aquatic life use. There are four permitted active mine sites and five hollowfills were located. It received a fair rating for the MBI (67) and IBI (50) and a nonsupport habitat score (120). Land use classified as urban has increased from 1994 to 2001 (0% – 6%). Specific conductance was elevated at this site (761 µs/cm). Land-use activities of concern in this watershed were urban and mining.

Right Fork Beaver Creek (Site ID: 01022012)

Right Fork Beaver Creek Watershed drains 150.1 mi.^{2} and is located in Floyd and Knott counties. This watershed received a partial support of aquatic life use. There are 85 permitted active mine sites and 36 hollowfills were located. It received a fair rating for the MBI (57) and IBI (57) and a nonsupport habitat score (117). Land use classified as urban has increased from 1994 to 2001 (2% – 8%). Specific conductance was elevated at this site (760 µs/cm). Land-use activities of concern in this watershed were mining and urban.

Rock Fork (Site ID: 01022019)

Rock Fork Watershed drains 6.9 mi.^{2} and is located in Floyd and Knott counties. This watershed received a partial support of aquatic life use. There are three permitted active mine sites and five hollowfills were located. It received a fair rating for the MBI (47) and IBI (47) and a nonsupport habitat score (133). Land use classified as urban has increased from 1994 to 2001 (2% – 13%). Specific conductance was elevated at this site (1121 µs/cm). Land-use activities of concern in this watershed were urban and mining.

Salisbury Branch (Site ID: 01022001)

Salisbury Branch Watershed drains 1.7 mi.^{2} and is located in Knott County. This watershed received a partial support of aquatic life use. There is one permitted active mine site and no hollowfills were located. It received a fair rating for the MBI (55) and IBI (56) and a partial support habitat score (149). Land use classified as urban has increased from 1994 to 2001 (0% – 5%). Specific conductance was not elevated at this site (136 µs/cm). Land-use activities of concern in this watershed were urban.

Saltlick Creek (Site ID: 01022018)

Saltlick Creek Watershed drains 6.8 mi.^{2} and is located in Floyd and Knott counties. This watershed received a partial support of aquatic life use. There are nine permitted active mine sites and no hollowfills were located. Overall, this watershed received a poor rating for the MBI (33), fair rating for the IBI (56) and a nonsupport habitat score (131). Land use classified as urban has increased from 1994 to 2001 (2% – 8%). Land-use activities of concern in this watershed were mining and urban.

Simpson Branch (Site ID: 01022029)

Simpson Branch Watershed drains 1.9 mi.^{2} and is located in Floyd County. This watershed received a partial support of aquatic life use. There are three permitted active mine sites and no hollowfills were located. It received a fair rating for the MBI (52) and IBI (47) and a nonsupport habitat score (139). Land use classified as urban has increased from 1994 to 2001 (0% – 5%). Specific conductance was elevated at this site (305 µs/cm). Land-use activities of concern in this watershed were urban and mining.

Sizemore Branch (Site ID: 01022002)

Sizemore Branch Watershed drains 1.7 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There is one permitted active mine site and no hollowfills were located. It received a poor rating for the MBI (37), fair rating for the IBI (48) and a nonsupport habitat score (133). Land use classified as urban has increased from 1994 to 2001 (5% – 9%). Specific conductance was elevated at this site (401 µs/cm). Land-use activities of concern in this watershed were mining and urban.

Spewing Camp Branch (Site ID: 01022031)

Spewing Camp Branch Watershed drains 2.5 mi.^{2} and is located in Floyd County. There are four permitted active mine sites and one hollowfill was located. Specific conductance (618 µs/cm) and iron concentrations (13.8 mg/L) were elevated at this site. It received a nonsupport of aquatic life use. Land-use activities of concern in this watershed were mining.

Spewing Camp Branch Refuse Reclamation Project - Floyd County- Involves the reclamation of a 60-acre side hill refuse disposal area, widely considered the worst remaining AML site in eastern Kentucky. The project was funded from multiple sources: Forfeited bond, Appalachian Clean Streams Initiative, state AML Funds and Supplemental Reclamation Funds. Final inspection was held 10/13/2004. Reclamation is complete. Total cost approximately $3.4 million (includes reclamation of sites used to generate cover material for the refuse pile) (S. Hohmann personal communication)

Spurlock Creek (Site ID: 01022028)

Spurlock Creek Watershed drains 3.9 mi.^{2} and is located in Floyd County. There are four permitted active mine sites and one hollowfill was located. This site has not been rated for use determination. However, this watershed is likely impaired. Land use classified as urban in 2001 was 11%, partially due to haul roads. Specific conductance (913 µs/cm), iron (6.7 mg/L) and sulfate (150 mg/L) concentrations were elevated at this site. Land-use activities of concern in this watershed were mining.

Steele Creek (Site ID: 01022021)

Steele Creek Watershed drains 3.4 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There are no active mine permitted sites and no hollowfills were located. It received a very poor rating for the MBI (15), fair rating for the IBI (50) and a nonsupport habitat score (121). Land use classified as urban has increased from 1994 to 2001 (2% –9%). Specific conductance (265.5 µs/cm) and Nitrate (0.8 mg/L) were elevated at this site. Land-use activities of concern in this watershed were urban due to sedimentation.

Stephens Branch (Site ID: 01022013)

Stephens Branch Watershed drains 2.2 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There are no permitted active mine sites and two hollowfills were located. It received a very poor rating for the MBI (19), fair rating for the IBI (40) and a nonsupport habitat score (102). Land use classified as urban has increased from 1994 to 2001 (2% – 7%). Aluminum (1.8 mg/L) and Iron (1.4 mg/L) concentrations were elevated at this site. Land-use activities of concern in this watershed were mining and historic channel alteration.

Turkey Creek (Site ID: 01022015)

Turkey Creek Watershed drains 4.7 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There are three permitted active mine sites and three hollowfills were located. It received a poor rating for the MBI (30), fair rating for the IBI (48) and a nonsupport habitat score (101). Land use classified as urban has increased from 1994 to 2001 (3% – 6%). Iron (714 mg/L) and sulfate (216 mg/L) were elevated at this site. Land-use activities of concern in this watershed were mining.

Wilson Creek (Site ID: 01022016)

Wilson Creek Watershed drains 3.1 mi.^{2} and is located in Floyd County. This watershed received a nonsupport of aquatic life use. There are no permitted active mine sites and one hollowfill were located. It received a poor rating for the MBI (25), fair rating for the IBI (46) and a nonsupport habitat score (109). Land use classified as urban has increased from 1994 to 2001 (1% – 6%). Land-use activities of concern in this watershed were urban.

Newcombe Creek Watershed

Nine stations were sampled in the Newcombe Creek Watershed (Table 1, 3, 4, 5 and Figure 2). Overall, two stations obtained full-use designation and one station received a threatened designation. All other stations receive a partial support (n=5) (Figure 6). Land-use analysis indicates a change in the landscape. For instance, an increase occurred in the percent forest in the watershed from 1994 to 2001 (76% – 88%) as well as an increase in percent forest within the riparian zone along Newcombe Creek and its tributaries (57% – 73%). The increase of forest in the watershed can be attributed to a decrease in the land cover accounted to agriculture. Within the Newcombe Creek Watershed, overall percent land cover classified as urban has decreased from 1.7% – 0.3%. This trend in urbanization is also present in the riparian zone (5% – 1%). However, some land cover classified as urban has increased in individual tributaries (see below).

Newcombe Creek (Site ID: 06013011)

Newcombe Creek Watershed drains 15 mi.^{2} and is located in Elliott County. This watershed received a partial support of aquatic life use. There are no permitted active mine sites and 14 hollowfills were located. It received a fair rating for the MBI (58), poor rating for the IBI (38) and a nonsupport habitat score (117). Land use classified as urban has decreased from 1994 to 2001 (2% – 1%). Land-use activities of concern in this watershed were mining.

No Photo

Rocky Branch (Site ID: 06013012)

Rocky Branch Watershed drains 3 mi.^{2} and is located in Elliott County. This watershed received a partial support of aquatic life use. There are no permitted active mine sites and no hollowfill was located. It received a fair rating for the MBI (60), fair rating for the IBI (50) and a partial support habitat score (152). Land use classified as urban has increased from 1994 to 2001 (2% – 8%). Land-use activities of concern in this watershed were urban and resource extraction.

Newcombe Creek UT (Site ID: 06013014)

Newcombe Creek UT Watershed drains 0.3 mi.^{2} and is located in Elliott County. This watershed received a threatened support of aquatic life use. There are no permitted active mine site and no hollowfills were located. Overall, this watershed received a good/fair rating for the MBI (69) and a supporting but threatened habitat score (171). Land use classified as urban has increased from 1994 to 2001 (0% – 2%). Land-use activities of concern in this watershed were resource extraction (petroleum activities).

Laurel Branch (Site ID: 06013021)

Laurel Branch Watershed drains 0.9 mi.^{2} and is located in Elliott County. There are no permitted active mine site and no hollowfill was located. No biological parameters were collected. Land use classified as urban has increased from 1994 to 2001 (2% – 12%).

Laurel Branch (Site ID: 06013022)

Laurel Branch Watershed drains 0.6 mi.^{2} and is located in Elliott County. This watershed received a full support of aquatic life use. There are no permitted active mine site and no hollowfills were located. Overall, this watershed received a good/fair rating for the MBI (70) and a supporting but threatened habitat score (172). Land use classified as urban has increased from 1994 to 2001 (1% – 14%). Land-use activities of concern in this watershed were urban and agriculture.

No photo

Newcombe Creek (Site ID: 06013023)

Newcombe Creek Watershed drains 23.8 mi.^{2} and is located in Elliott County. This watershed received a partial support of aquatic life use. There are no permitted active mine sites and 19 hollowfills were located. Overall, this watershed received a fair rating for the MBI (70), fair rating for the IBI (46) and a nonsupport habitat score (144). Land use classified as urban has increased from 1994 to 2001 (2% – 3%). Land-use activities of concern in this watershed were mining, urban and agriculture.

Newcombe Creek UT (Site ID: 06013024)

Newcombe Creek UT Watershed drains 0.5 mi.^{2} and is located in Elliott County. This watershed received a full support of aquatic life use. There are no permitted active mine sites and five hollowfills were located. Overall, this watershed received a good/fair rating for the MBI (68), fair rating for the IBI (54) and a full-support habitat score (175). Land use classified as urban has remained unchanged from 1994 to 2001 (0%). Land-use activities of concern in this watershed were mining.

Lick Fork (Site ID: 06013025)

Lick Fork Watershed drains 6.8 mi.^{2} and is located in Elliott County. This watershed received a partial support of aquatic life use. There are no permitted active mine sites and 11 hollowfills were located. It received a fair rating for the MBI (63), fair rating for the IBI (51) and a nonsupport habitat score (129). Land use classified as urban has remained unchanged from 1994 to 2001 (2%). Land-use activities of concern in this watershed were mining, urban and agriculture.

Right Fork Newcombe Creek (Site ID: 06013026)

Right Fork Newcombe Creek Watershed drains 6.8 mi.^{2} and is located in Elliott County. This watershed received a partial support of aquatic life use. There are no permitted active mine sites and two hollowfills were located. It received a fair rating for the MBI (51) and a nonsupport habitat score (97). Land use classified as urban has increased from 1994 to 2001 (1% – 2%). Land-use activities of concern in this watershed were mining and agriculture.

Ice Dam Creek Watershed

Three stations were sampled in the Ice Dam Creek Watershed (Table 1, 3, 4, 5 and Figure 2). Overall, all stations received a nonsupport aquatic life use designation (Figure 7). Land-use analysis indicates a change in the landscape. For instance, a decline in the percent forest in the watershed from 1994 to 2001 (55% – 46%), also a decline occurred in percent forest within the riparian zone along Newcombe Creek and its tributaries (37% – 23%). Loss of forest in the watershed can be accounted to urbanization. Within the Newcombe Creek Watershed, overall percent land cover classified as urban has increased from 8% –16%. This watershed is highly urbanized.

Ice Dam Creek (Site ID: 01001001)

Ice Dam Creek Watershed drains 1.7 mi.^{2} and is located in Elliott County. This watershed received a nonsupport of aquatic life use. It received a very poor rating for the MBI (19), fair rating for the IBI (48) and a nonsupport habitat score (121). Land use classified as urban has increased from 1994 to 2001 (8% –16%). Land-use activities of concern in this watershed were urban.

Ice Dam Creek (Site ID: 01001002)

Ice Dam Creek Watershed drains 1.1 mi.^{2} and is located in Boyd County. This watershed received a nonsupport of aquatic life use. It received a poor rating for the MBI (24), fair rating for the IBI (49) and a nonsupport habitat score (119). Land use classified as urban has increased from 1994 to 2001 (5% – 7%). Land-use activities of concern in this watershed were urban.

Paddle Creek (Site ID: 01001003)

Paddle Creek Watershed drains 0.6 mi.^{2} and is located in Boyd County. This watershed received a nonsupport of aquatic life use. It received a poor rating for the MBI (24), good rating for the IBI (59) and a nonsupport habitat score (98). Land use classified as urban has increased from 1994 to 2001 (3% – 13%). Land-use activities of concern in this watershed were urban.

DISCUSSION

Two land uses of concern in the Beaver, Newcombe and Ice Dam Creek watersheds include mining and urban land uses or the combination of mining and urban in the same sub watershed. These two land uses have stressed aquatic communities to the point that the majority of streams in all watersheds are impaired. Pond (2004) indicated that dissolved solids were the primary cause of biological impairment in mining watersheds and that elevated nutrients and organic enrichment were the primary causes of impairment in residential land use in a concurrent study in the eastern coal fields.

Although the classification of urban has been used throughout this report, it should not be considered in the classic use. The terrain in these watersheds is typically steep mountains with the majority of human activity taking place within the valleys. A typical review of land use within eastern Kentucky usually reveals a high percentage of forest and a small distribution of other land uses. This could be somewhat misleading because "useable" land is typically confined to valleys that cover a small area compared to the area covered by mountains. These small "useable" landscapes have created relatively high densities of human activity within valleys. Further investigation into land use classified as urban within the Central Appalachian ecoregion is warranted.

Subwatersheds within the larger watersheds that have low or no residential and no mining should be considered priority areas for protection status. Best management practices should be evaluated and implemented as appropriate. Further investigation into appropriate locations for BMPs should occur within the Beaver, Newcombe and Ice Dam Creek watersheds.

All data has been analyzed, interpreted and aquatic life use determinations included in the *2004 Kentucky Report to Congress on Water Quality* (KDOW 2004). Agency partners, watershed groups and others through the Big Sandy River Basin Team will continue to be encouraged to evaluate opportunities for watershed restoration projects to improve water quality.

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TABLES

Table 1. Site location information for sampling sites in the Big Sandy River Watershed, Kentucky. WS = Watershed, I = Ice Dam, B = Beaver Creek, and N = Newcombe Creek.

Number	WS	SiteID	StreamName	Location	Lat	Long
1	I	01001001	ICE DAM CREEK	Below Paddle Creek	38.39803	-82.59805
2	I	01001002	ICE DAM CREEK	Along Ice Dam Creek Road	38.39715	-82.60240
3	I	01001003	PADDLE CREEK	0.2 km above US 23, ca 1.3 km S of Burke	38.39369	-82.60220
4	B	01022001	SALISBURY BRANCH	0.05 MILES ABOVE RIGHT FORK BEAVER CREEK	37.40672	-82.77637
5	B	01022002	SIZEMORE BRANCH	0.25 MILES ABOVE LEFT FORK BEAVER CREEK	37.47194	-82.75774
6	B	01022008	CALEB FORK	nr. Weeksbury; see RM and lat/long.	37.32683	-82.68780
7	B	01022009	OTTER CREEK	along KY 306	37.35119	-82.71681
8	B	01022010	ARKANSAS CREEK	Along KY 3381, ca 1.8 km E of Martin	37.57071	-82.73301
9	B	01022011	BUCK BRANCH	At KY 122, ca 1.8 km W of Martin	37.57583	-82.77295
10	B	01022012	RIGHT FORK BEAVER CREEK	At Warco Rd., near Warco	37.54575	-82.77479
11	B	01022013	STEPHENS BRANCH	Along KY 1210, ca 1.3 km NNE of Warco	37.55543	-82.78381
12	B	01022014	JOHNS BRANCH	Along Johns Branch Road, ca 0.6 km W of Warco	37.54427	-82.78618
13	B	01022015	TURKEY CREEK	Along KY 777, ca 1.7 km SSE of Langley	37.51737	-82.78551
14	B	01022016	WILSON CREEK	Above KY 2554, ca 1.1 km WSW of Langley	37.52773	-82.80209
15	B	01022017	GOOSE CREEK	Above KY 680, ca 2.1 km SSW of Eastern	37.49981	-82.81615
16	B	01022018	SALTLICK CREEK	Off Old Bosco Road, ca 1.3 WSW of Bosco	37.49465	-82.84912
17	B	01022019	ROCK FORK	Along Rock Fork Road ca 0.3 km above Howard Branch	37.47102	-82.85260
18	B	01022020	JONES FORK	Above KY 550, near Betty	37.45021	-82.84217
19	B	01022021	STEELE CREEK	Ca 0.1 km above KY 7, near Wayland	37.44458	-82.80515
20	B	01022022	CANEY FORK	Below KY 899, near Dema	37.41449	-82.79901
21	B	01022023	DRY CREEK	At first Dry Creek Road crossing, near Topmost	37.35695	-82.78809
22	B	01022024	BILL D BRANCH	Along KY 582, ca 0.3 km SW of Kite	37.31938	-82.80602
23	B	01022025	PUNCHEON BRANCH	Along Puncheon Road, ca 1.9 km SE of Kite	37.30776	-82.79000
24	B	01022026	ARNOLD FORK	0.2 km above KY 1498, ca 4.4 km SE of Kite	37.29721	-82.76430
25	B	01022027	LEFT FORK BEAVER CREEK	Off KY 122 ca 0.2 km below Stonecoal Branch	37.49505	-82.75761
41	B	01022028	SPURLOCK CREEK	At unnamed road off KY 2030, near Printer	37.53112	-82.74226
26	B	01022029	SIMPSON BRANCH	Along Simpson Branch Rd, near Drift	37.47600	-82.74252
27	B	01022030	FRASURE BRANCH	Off KY 680, at McDowell	37.45544	-82.73570
42	B	01022031	SPEWING CAMP BRANCH	At mouth, near Orkney	37.43042	-82.73413
28	B	01022032	CLEAR CREEK	Off KY 979, ca 0.4 km SE of Hi Hat	37.38659	-82.72853
29	B	01022033	JACKS CREEK	Along KY 1492, ca 0.5 km WSW of Jacks Creek	37.36347	-82.73338
30	N	06013011	NEWCOMBE CREEK	FORD OFF KY HIGHWAY 706	38.07330	-83.05530
31	N	06013012	ROCKY BRANCH	FORD W OF BURKE	38.10890	-83.05250
32	N	06013014	NEWCOMBE CREEK UT	UT in Shanty Hollow at Newcombe Road	38.10296	-83.06426
33	N	06013021	LAUREL BRANCH	At KY 706, ca 1.6 km NNW of Burke	38.12066	-83.04581
34	N	06013022	LAUREL BRANCH	Ca 0.8 km above KY 706, ca 1.8 km N of Burke	38.12297	-83.03944
35	N	06013023	NEWCOMBE CREEK	Ca 0.6 km below Rocky Branc, 2.0 km WNW of Burke	38.11126	-83.06271
36	N	06013024	NEWCOMBE CREEK UT	UT in Rice Hollow off Rice Hollow Rd.	38.07459	-83.05489
37	N	06013025	LICK FORK	Off KY 32 behind Isonville Elem	38.05931	-83.04763
38	N	06013026	RT FK NEWCOMBE CREEK	at unnamed private drive off Hwy 706	38.05851	-83.05341

Table 2. Land-use data for sites in the Beaver, Newcombe and Ice Dam Creek Watersheds, Kentucky.

			P_For		P_Urb		P_agt		P_bar	
SiteID	StreamName	Number	2001	1994	2001	1994	2001	1994	2001	1994
01001001	ICE DAM CREEK	1	46	55	16	8	36	36	0	0
01001002	ICE DAM CREEK	2	62	70	7	5	29	24	0	0
01001003	PADDLE CREEK	3	40	44	13	3	45	53	0	0
01022001	SALISBURY BRANCH	4	88	91	5	0	2	9	0	0
01022002	SIZEMORE BRANCH	5	79	82	9	5	4	11	0	2
01022008	CALEB FORK	6	91	88	6	0	0	11	0	0
01022009	OTTER CREEK	7	84	87	11	2	0	10	1	1
01022010	ARKANSAS CREEK	8	75	75	10	2	2	17	0	3
01022011	BUCK BRANCH	9	84	85	8	2	2	12	0	0
01022012	RIGHT FORK BEAVER CREEK	10	79	85	8	2	2	11	1	1
01022013	STEPHENS BRANCH	11	78	81	7	2	2	15	0	0
01022014	JOHNS BRANCH	12	92	94	5	0	2	6	0	0
01022015	TURKEY CREEK	13	76	76	6	3	4	14	0	6
01022016	WILSON CREEK	14	79	85	6	1	4	11	0	3
01022017	GOOSE CREEK	15	73	88	12	2	1	9	1	1
01022018	SALTLICK CREEK	16	84	89	8	2	2	9	0	0
01022019	ROCK FORK	17	76	86	13	2	2	11	1	1
01022020	JONES FORK	18	80	88	6	1	1	9	2	1
01022021	STEELE CREEK	19	74	90	9	2	1	7	0	2
01022022	CANEY FORK	20	78	88	7	2	1	9	1	2
01022023	DRY CREEK	21	86	92	7	0	1	8	0	0
01022024	BILL D BRANCH	22	78	86	10	2	0	10	1	0
01022025	PUNCHEON BRANCH	23	86	91	6	0	0	8	1	0
01022026	ARNOLD FORK	24	85	89	7	1	0	8	2	1
01022027	LEFT FORK BEAVER CREEK	25	83	86	10	2	2	10	1	1
01022028	SPURLOCK CREEK	41	78	.	11	.	1	.	2	.
01022029	SIMPSON BRANCH	26	90	93	5	0	2	5	0	1
01022030	FRASURE BRANCH	27	83	86	8	2	2	9	1	4
01022031	SPEWING CAMP BRANCH	42	85	.	6	.	0	.	2	.
01022032	CLEAR CREEK	28	84	87	10	2	1	11	0	0
01022033	JACKS CREEK	29	85	91	8	2	0	7	0	0
06013011	NEWCOMBE CREEK	30	92	76	1	2	0	22	0	0
06013012	ROCKY BRANCH	31	81	79	8	2	7	18	0	0
06013014	NEWCOMBE CREEK UT	32	24	93	2	0	0	7	0	0
06013021	LAUREL BRANCH	33	85	84	12	2	1	15	0	0
06013022	LAUREL BRANCH	34	85	91	14	1	0	8	0	0
06013023	NEWCOMBE CREEK	35	89	77	3	2	1	21	0	0
06013024	NEWCOMBE CREEK UT	36	97	68	0	0	0	31	0	0
06013025	LICK FORK	37	91	77	2	2	0	22	0	0
06013026	RT FK NEWCOMBE CREEK	38	94	76	1	2	0	22	0	0

Table 3. MBI, IBI and Habitat Scores for sites in the Beaver, Newcombe and Ice Dam Creek Watersheds, Kentucky, 2002.

SiteID	MBI	MBI Score	IBI	IBI Score	Habitat	H SCORE
01001001	19	V_POOR	49	FAIR	121	NS
01001002	24	POOR	48	FAIR	119	NS
01001003	24	POOR	59	GOOD	98	NS
01022001	55	FAIR	56	FAIR	149	PS
01022002	37	POOR	48	FAIR	133	NS
01022008	16	V_POOR	.	.	139	NS
01022009	7	V_POOR	.	.	111	NS
01022010	31	POOR	36	POOR	104	NS
01022011	33	POOR	35	POOR	113	NS
01022012	57	FAIR	57	FAIR	117	NS
01022013	19	V_POOR	40	FAIR	102	NS
01022014	31	POOR	47	FAIR	139	NS
01022015	30	POOR	48	FAIR	101	NS
01022016	25	POOR	46	FAIR	109	NS
01022017	23	V_POOR	43	FAIR	145	PS
01022018	33	POOR	56	FAIR	131	NS
01022019	58	FAIR	47	FAIR	133	NS
01022020	60	FAIR	33	POOR	115	NS
01022021	15	V_POOR	50	FAIR	121	NS
01022022	67	FAIR	77	EXCELLENT	144	NS
01022023	49	FAIR	54	FAIR	113	NS
01022024	40	POOR	43	FAIR	117	NS
01022025	67	FAIR	50	FAIR	120	NS
01022026	37	POOR	19	POOR	131	NS
01022027	66	FAIR	65	GOOD	103	NS
01022028	.	.	.	.	.	.
01022029	52	FAIR	47	FAIR	139	NS
01022030	49	POOR	41	FAIR	107	NS
01022031	.	.	.	.	.	.
01022032	20	V_POOR	32	POOR	94	NS
01022033	22	V_POOR	43	FAIR	126	NS
06013011	58	FAIR	38	POOR	117	NS
06013012	60	FAIR	50	FAIR	152	PS
06013014	69	GOOD_FAIR	.	.	171	SbT
06013021	.	.	.	.	.	.
06013022	70	GOOD_FAIR	.	.	172	SbT
06013023	70	FAIR	46	FAIR	144	NS
06013024	68	GOOD_FAIR	54	FAIR	175	FS
06013025	63	FAIR	51	FAIR	129	NS
06013026	51	FAIR	.	.	97	NS

Table 4. Physicochemical results for sites in the Beaver, Newcombe and Ice Dam Creek Watersheds, Kentucky, 2002. DO expressed as mg/L, Specific Conductance as µs/cm and Temperature as ˚C.

SiteID	DO	% Saturation	pH	Specific Conductance	Temperature
01001001	6.10	57.9	8.7	492.0	13.2
01001002	15.70	150.2	8.3	323.0	12.9
01001003	9.70	83.4	8.0	393.4	7.0
01022001	10.13	99.7	7.4	136.6	13.3
01022002	9.85	99.8	7.7	401.0	14.6
01022008	8.90	94.0	7.8	347.1	16.3
01022009	10.30	94.3	8.0	581.5	10.1
01022010	11.60	132.0	9.0	640.0	20.5
01022011	.	.	.	.	.
01022012	6.24	75.9	7.5	760.0	23.5
01022013	.	.	.	.	.
01022014	.	.	.	.	.
01022015	.	.	8.6	.	.
01022016	.	.	.	.	.
01022017	.	.	8.4	.	.
01022018	.	.	.	.	.
01022019	8.75	104.3	8.1	1121.0	22.7
01022020	6.29	77.5	7.5	1322.0	24.1
01022021	10.30	105.7	7.5	265.5	14.9
01022022	8.80	110.6	7.8	805.0	25.2
01022023	10.13	96.9	8.0	467.4	12.1
01022024	10.60	98.2	7.8	320.4	10.8
01022025	9.50	98.6	8.0	761.9	15.0
01022026	10.11	109.0	8.1	1157.0	16.5
01022027	7.80	95.0	7.6	539.0	24.6
01022028	10.10	92.0	7.3	913.6	9.8
01022029	10.10	104.3	7.4	305.2	15.0
01022030	11.30	140.6	8.2	738.0	25.0
01022031	.	.	6.8	618.3	9.7
01022032	10.40	103.2	8.2	542.9	13.8
01022033	.	.	.	.	.
06013011	6.66	81.5	6.9	565.1	23.9
06013012	10.30	89.3	7.3	112.0	7.4
06013014	.	.	7.9	89.0	11.1
06013021	.	.	8.2	126.0	13.4
06013022	.	.	7.7	820.0	9.3
06013023	6.71	84.0	7.1	426.5	25.0
06013024	1.15	.	8.1	401.0	7.6
06013025	8.05	99.8	7.2	674.7	24.6
06013026	10.30	104.8	7.3	290.0	14.9

Table 5. Chemical results for sites in the Beaver, Newcombe and Ice Dam Creek Watersheds, Kentucky, 2002. All units are expressed as mg/L. Detection limits listed under parameter.

SiteID	Acidity	Alkalinity	Aluminum	Ammonia	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium
	1	5	0.001	0.05	0.002	0.0002	0.001	0.1	0.001	0.001	0.01	0.002	0.05
01001001	1.00	136.0	0.107	0.050	0.002	0.046	0.001	62.9	0.006	0.005	0.193	0.002	18.50
01001002	1.00	141.0	0.166	0.050	0.002	0.050	0.001	69.5	0.001	0.002	0.198	0.002	16.90
01001003	1.86	109.0	0.039	0.050	0.002	50.100	0.001	0.4	0.001	0.001	14.000	0.002	14.00
01022001	1.00	26.8	0.334	0.050	0.002	0.020	0.001	12.0	0.001	0.003	0.316	0.002	5.45
01022002	1.00	84.7	0.101	0.050	0.002	0.034	0.001	33.6	0.001	0.003	0.122	0.002	14.90
01022008	1.00	90.6	0.195	0.348	0.002	0.037	0.001	24.8	0.001	0.002	0.200	0.002	10.70
01022009	1.00	108.0	0.025	0.653	0.002	0.038	0.001	45.7	0.001	0.002	0.095	0.002	20.60
01022010	1.00	84.4	0.169	0.050	0.002	0.035	0.001	47.7	0.001	0.002	0.262	0.002	25.60
01022011	1.17	24.9	0.542	0.068	0.002	0.029	0.001	20.2	0.001	0.001	0.971	0.002	13.50
01022012	8.13	149.0	1.060	0.050	0.002	0.074	0.001	59.6	0.001	0.001	1.350	0.002	24.60
01022013	3.70	27.4	1.820	0.293	0.002	0.030	0.001	31.4	0.001	0.003	1.420	0.002	15.60
01022014	1.00	38.0	0.105	0.050	0.002	0.022	0.001	24.6	0.001	0.001	0.258	0.002	11.10
01022015	1.00	119.0	0.188	0.050	0.002	0.048	0.001	59.0	0.001	0.002	714.000	0.002	34.40
01022016	1.44	74.2	0.051	0.050	0.002	0.034	0.001	46.1	0.001	0.001	0.155	0.002	29.20
01022017	1.00	182.0	0.052	0.050	0.002	0.038	0.001	55.6	0.001	0.001	0.090	0.002	33.60
01022018	2.13	68.7	0.268	0.050	0.002	0.047	0.001	25.1	0.001	0.001	1.540	0.002	9.18
01022019	1.79	243.0	0.023	0.050	0.002	0.064	0.001	55.5	0.001	0.001	0.306	0.002	26.60
01022020	6.43	133.0	0.578	0.050	0.002	0.101	0.001	95.9	0.001	0.001	0.999	0.002	38.60
01022021	1.00	35.6	0.314	0.050	0.002	0.023	0.001	19.5	0.001	0.003	0.257	0.002	9.32
01022022	2.62	123.0	0.151	0.050	0.002	0.067	0.001	65.6	0.001	0.003	0.360	0.002	23.80
01022023	1.00	86.6	0.307	0.050	0.002	0.034	0.001	40.3	0.001	0.001	0.119	0.002	18.80
01022024	1.00	53.5	0.037	0.050	0.002	0.035	0.001	30.2	0.001	0.002	0.066	0.002	12.30
01022025	1.03	120.0	0.331	0.064	0.002	0.059	0.001	60.9	0.001	0.001	0.373	0.002	21.90
01022026	1.00	80.3	0.064	0.050	0.002	0.048	0.001	62.6	0.001	0.002	0.088	0.002	20.00
01022027	5.19	119.0	0.653	0.050	0.002	0.057	0.001	45.3	0.001	0.002	0.855	0.002	16.70

Table 5. Continued

SiteID	Acidity	Alkalinity	Aluminum	Ammonia	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium
	1	5	0.001	0.05	0.002	0.0002	0.001	0.1	0.001	0.001	0.01	0.002	0.05
1022028	4.21	57.5	0.879	0.368	0.002	0.040	0.001	96.4	0.001	0.004	6.730	0.002	32.10
01022029	1.58	52.7	0.188	0.050	0.002	0.188	0.001	27.5	0.001	0.001	0.265	0.002	11.50
01022030	1.00	119.0	0.081	0.050	0.002	0.062	0.001	55.5	0.001	0.001	0.110	0.002	26.20
01022031	5.55	13.7	0.972	0.247	0.002	0.024	0.001	60.8	0.001	0.003	13.800	0.002	27.30
01022032	1.00	101.0	0.086	0.050	0.002	0.033	0.001	41.2	0.001	0.001	0.040	0.002	16.80
01022033	1.00	146.0	0.032	0.050	0.002	0.038	0.001	40.4	0.001	0.004	0.047	0.002	17.00
06013011	7.73	77.4	0.483	0.056	0.002	0.080	0.001	40.9	0.001	0.001	1.700	0.002	19.80
06013012	1.05	15.7	0.257	0.050	0.002	0.017	0.001	9.1	0.001	0.001	0.228	0.002	4.87
06013014	1.00	13.4	0.373	0.050	0.002	0.020	0.001	7.4	0.001	0.001	0.350	0.002	4.41
06013021	1.00	17.8	0.334	0.050	0.002	0.032	0.001	9.8	0.001	0.002	0.568	0.002	4.59
06013022	1.50	13.9	0.654	0.050	0.002	0.026	0.001	6.7	0.001	0.002	0.862	0.002	3.80
06013023	5.81	76.1	0.442	0.050	0.002	0.062	0.001	32.5	0.001	0.002	1.150	0.002	15.80
06013024	1.82	40.9	0.027	0.050	0.002	0.029	0.001	36.8	0.001	0.001	0.131	0.002	29.10
06013025	6.34	95.2	0.039	0.050	0.002	0.082	0.001	50.8	0.001	0.002	0.433	0.002	24.50
06013026	1.92	37.3	0.102	0.050	0.001	0.037	0.000	21.2	0.000	0.001	0.443	0.001	14.70

Table 5. Continued

SiteID	Manganese	Mercury	Nickel	Nitrate	Organic Carbon	Potassium	Selenium	Silver	Sodium	Sulfate	TKN	Total P
	0.002	0.00005	0.002	0.02	0.25	0.05	0.002	0.002	0.01	5	0.05	0.005
01001001	0.098	0.00005	0.002	0.114	3.86	3.94	0.002	0.002	24.0	92.1	0.244	0.005
01001002	0.165	0.00005	0.003	0.150	3.72	3.60	0.002	0.002	19.9	95.8	0.225	0.005
01001003	0.043	0.00005	0.002	1.160	2.77	3.27	0.002	0.000	12.7	78.9	0.059	0.025
01022001	0.036	0.00005	0.003	0.110	2.04	1.79	0.002	0.002	5.4	36.6	0.050	0.011
01022002	0.020	0.00005	0.003	0.153	1.37	3.52	0.002	0.002	19.3	110.0	0.050	0.011
01022008	0.036	0.00005	0.004	0.311	1.46	4.38	0.003	0.002	29.1	83.4	0.422	0.101
01022009	0.058	0.00005	0.002	0.913	1.53	9.07	0.003	0.002	43.3	59.4	0.847	0.231
01022010	0.037	0.00005	0.002	0.212	2.64	3.88	0.002	0.002	13.6	162.0	0.335	0.099
01022011	0.068	0.00005	0.002	0.193	2.11	2.34	0.002	0.002	9.0	97.7	0.271	0.031
01022012	0.185	0.00005	0.002	0.357	2.34	6.73	0.002	0.002	58.7	233.0	0.425	0.026
01022013	0.793	0.00005	0.020	0.665	1.84	2.69	0.002	0.002	11.9	137.0	0.395	0.022
01022014	0.044	0.00005	0.002	0.020	1.87	2.55	0.002	0.002	13.0	90.4	0.149	0.013
01022015	0.084	0.00005	0.002	0.042	2.39	4.73	0.002	0.002	27.4	216.0	0.270	0.028
01022016	0.036	0.00005	0.002	0.276	1.92	4.21	0.003	0.002	11.2	191.0	0.141	0.012
01022017	0.029	0.00005	0.002	0.077	1.86	5.04	0.002	0.002	36.9	164.0	0.144	0.005
01022018	0.192	0.00005	0.002	0.096	1.83	2.91	0.002	0.002	33.1	82.3	0.198	0.018
01022019	0.043	0.00005	0.002	0.209	1.86	8.24	0.002	0.002	151.0	276.0	0.141	0.005
01022020	0.182	0.00005	0.002	0.137	2.29	8.94	0.002	0.002	124.0	478.0	0.365	0.002
01022021	0.056	0.00005	0.003	0.773	2.07	3.57	0.002	0.002	13.7	82.0	0.050	0.019
01022022	0.039	0.00005	0.002	0.075	2.21	6.58	0.002	0.002	60.0	211.0	0.253	0.005
01022023	0.086	0.00005	0.002	0.162	1.02	3.58	0.002	0.002	24.5	55.9	0.050	0.005
01022024	0.005	0.00005	0.002	0.079	1.53	2.52	0.002	0.002	15.1	36.3	0.101	0.005
01022025	0.355	0.00005	0.010	0.377	1.32	5.20	0.002	0.002	68.1	131.0	0.086	0.005
01022026	0.065	0.00005	0.012	0.493	1.06	5.39	0.002	0.002	82.2	167.0	0.050	0.005
01022027	0.082	0.00005	0.002	0.298	2.26	6.12	0.002	0.002	38.5	125.0	0.050	0.012

Table 5. Continued

SiteID	Manganese	Mercury	Nickel	Nitrate	Organic Carbon	Potassium	Selenium	Silver	Sodium	Sulfate	TKN	Total P
	0.002	0.00005	0.002	0.02	0.25	0.05	0.002	0.002	0.01	5	0.05	0.005
01022028	1.690	0.00005	0.039	0.219	1.06	5.85	0.002	0.002	51.8	150.0	0.402	0.005
01022029	0.027	0.00005	0.002	0.414	1.28	3.08	.	0.002	13.2	40.1	0.050	0.015
01022030	0.017	0.00005	0.002	0.315	2.11	6.59	0.002	0.002	48.5	194.0	0.305	0.005
01022031	2.500	0.00005	0.025	0.103	0.85	4.22	0.002	0.002	12.4	131.0	0.275	0.010
01022032	0.007	0.00005	0.002	0.193	1.10	4.68	0.002	0.002	44.3	67.9	0.050	0.005
01022033	0.008	0.00005	0.002	0.121	0.89	5.84	0.002	0.002	53.7	51.1	0.060	0.005
06013011	0.436	0.00005	0.002	0.166	2.20	4.33	0.002	0.002	33.9	81.5	0.389	0.005
06013012	0.049	0.00005	0.002	0.165	1.37	1.79	0.002	0.002	4.4	26.2	0.050	0.026
06013014	0.013	0.00005	0.002	0.216	0.94	1.60	0.002	0.002	2.7	23.1	0.050	0.005
06013021	0.103	0.00005	0.002	0.010	1.93	1.72	0.002	0.002	4.8	22.4	0.151	0.005
06013022	0.068	0.00005	0.002	0.020	0.82	1.58	0.002	0.002	3.8	19.0	0.050	0.005
06013023	0.168	0.00005	0.002	0.108	2.18	3.65	0.002	0.002	25.2	146.0	0.198	0.005
06013024	0.039	0.00005	0.002	0.065	1.22	3.11	0.002	0.002	5.4	174.0	0.050	0.005
06013025	0.190	0.00005	0.002	0.118	1.99	4.63	0.002	0.002	41.7	93.5	0.242	0.005
06013026	0.101	0.00005	0.001	0.853	1.48	2.19	0.001	0.000	10.2	75.5	0.050	0.014

FIGURES

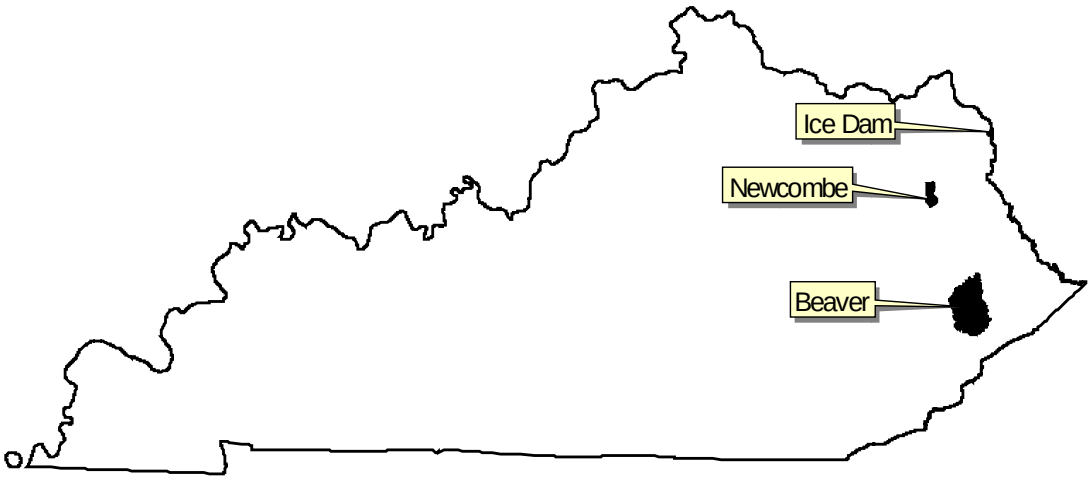

Figure 1. Location of Beaver, Newcombe and Ice Dam Creek Watersheds, Kentucky.

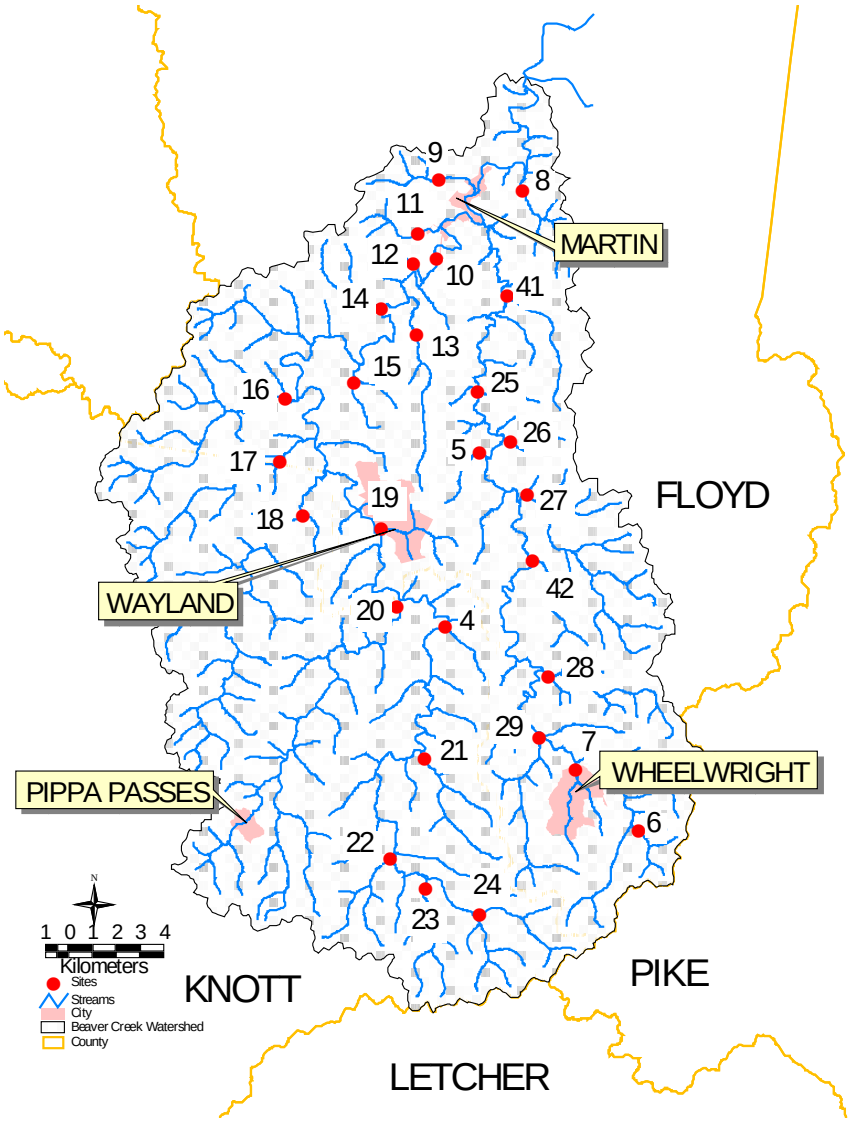

Figure 2. Sample locations within the Beaver Creek Watershed, Floyd and Knott counties, Kentucky, 2001. Refer to Table 1 for site identification.

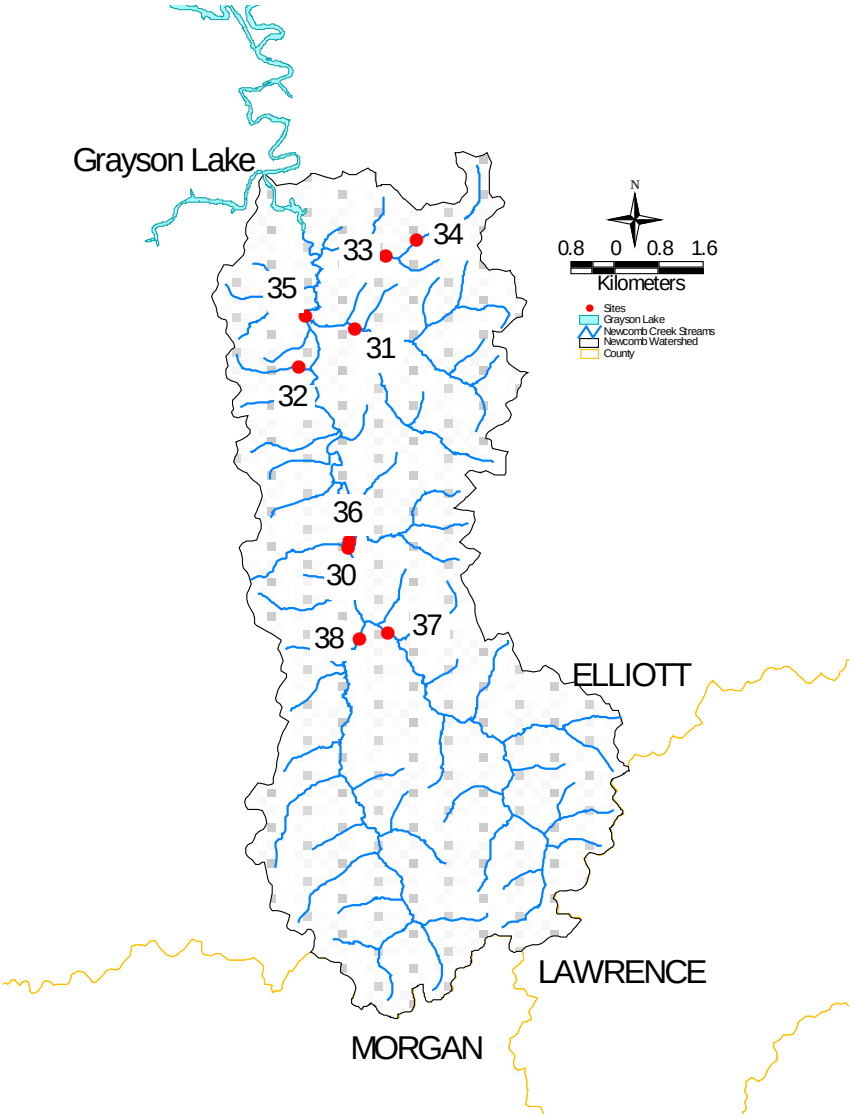

Figure 3. Sample locations within the Newcombe Creek Watershed, Elliott County, Kentucky, 2001. Refer to Table 1 for site identification.

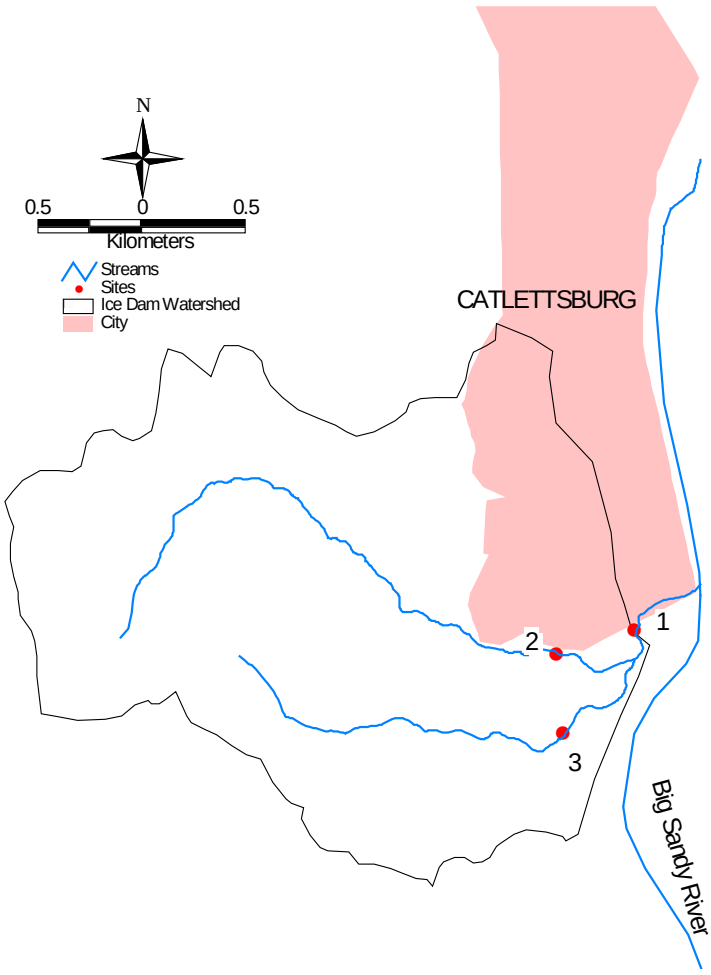

Figure 4. Sample locations within the Ice Dam Creek Watershed, Boyd County, Kentucky, 2001. Refer to Table 1 for site identification.

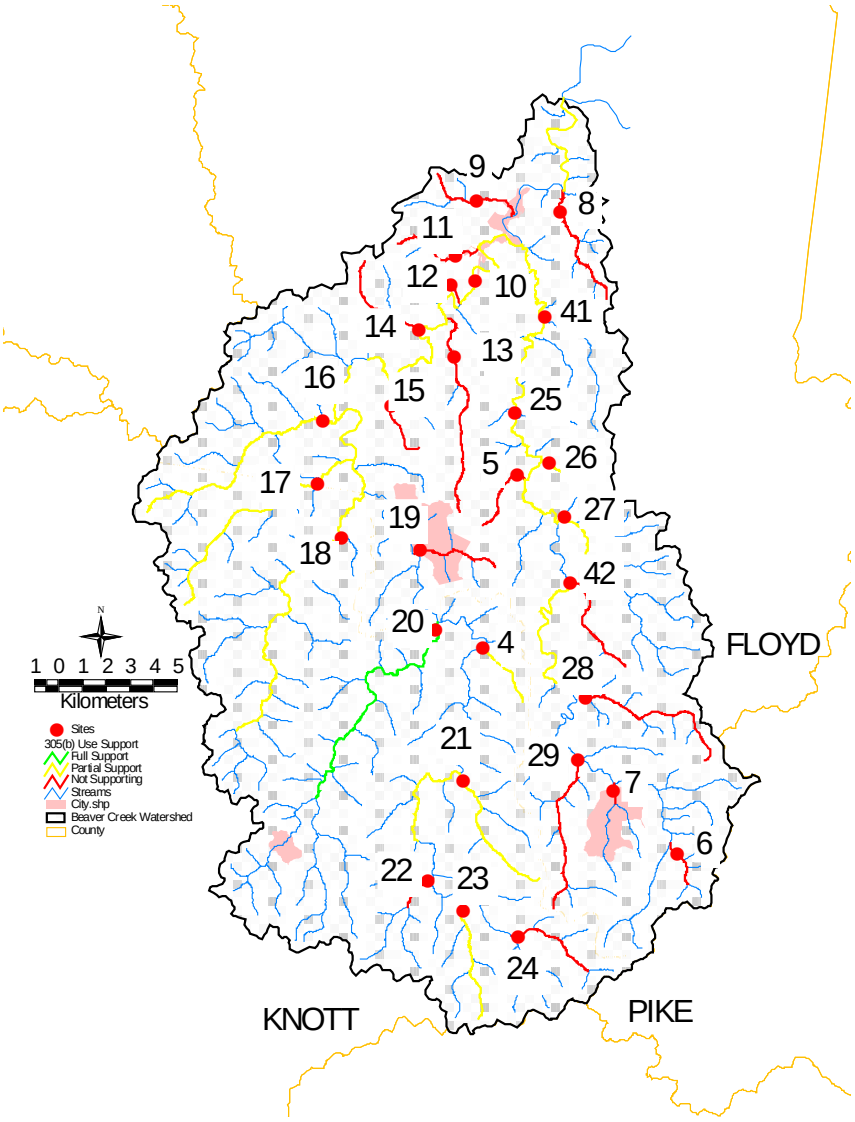

Figure 5. 305(b) use support and sample locations within the Beaver Creek Watershed, Floyd and Knott counties, Kentucky, 2001. Refer to Table 1 for site identification.

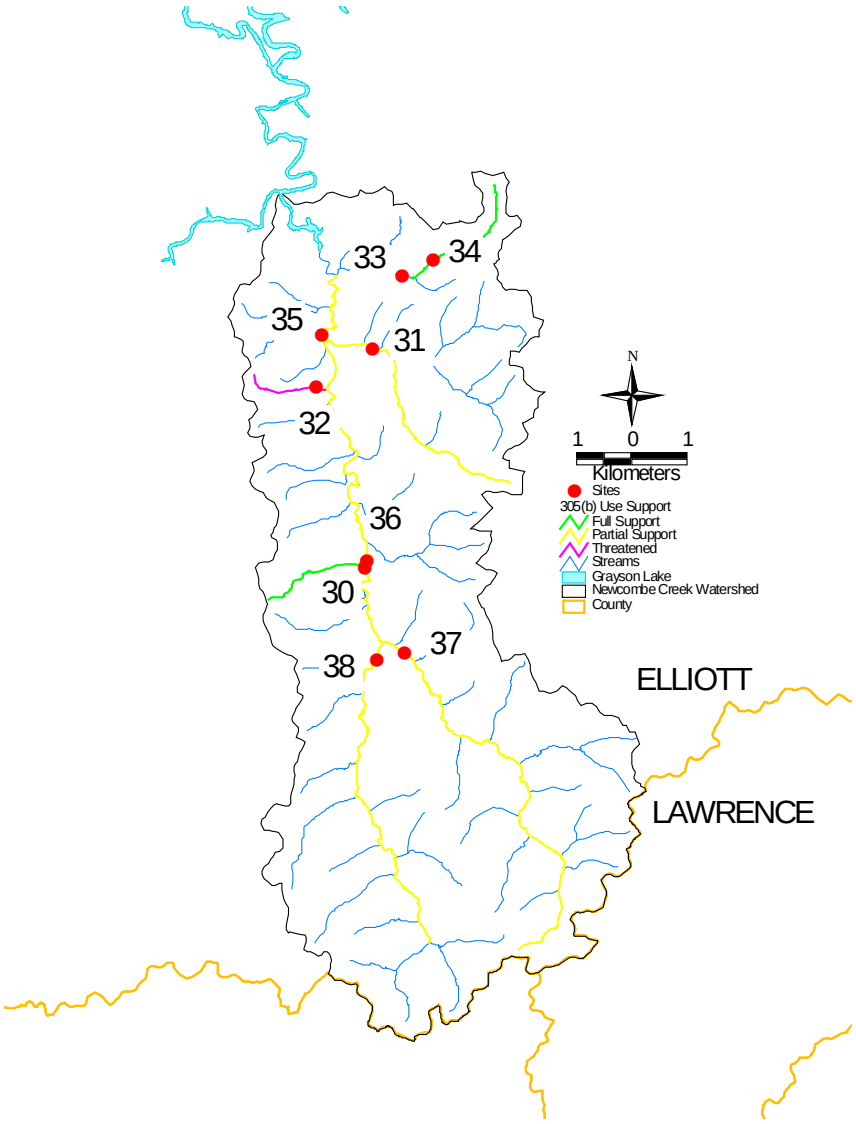

Figure 6. 305(b) use support and sample locations within the Newcombe Creek Watershed, Elliott County, Kentucky, 2001. Refer to Table 1 for site identification.

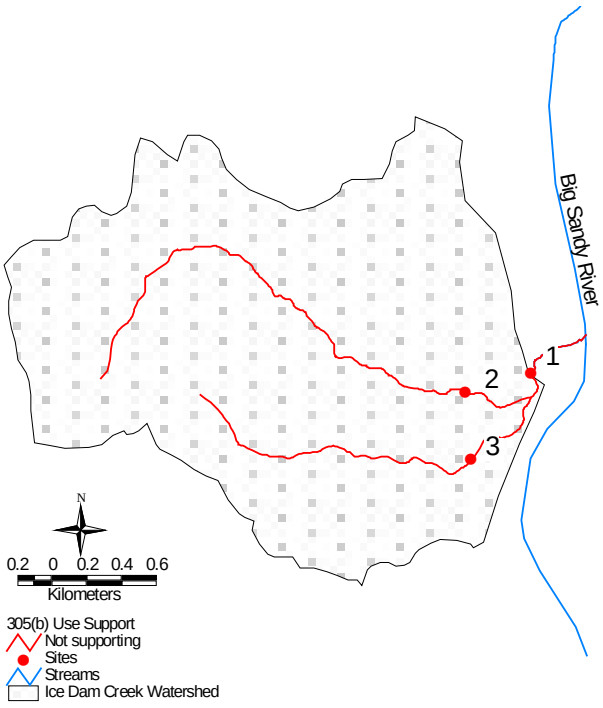

Figure 7. 305(b) use support and sample locations within the Ice Dam Creek Watershed, Boyd County, Kentucky, 2001. Refer to Table 1 for site identification.