10.0 BEST MANAGEMENT PRACTICES (BMPs)

As discussed previously, the models indicate that there are regions within the watershed that require protection. Each of these regions has its own range of issues affecting runoff and water quality. This section will address methods by which these issues may be improved.

Best Management Practices (BMPs) are watershed restoration and management techniques that, if implemented, can improve water quality, reduce runoff and flooding, and protect or restore natural resources. BMPs can include preventative measures to reduce the likelihood of new problems occurring, remedial measures that attempt to solve an existing problem, and maintenance measures that can be either preventative or remedial, depending on the circumstances.

The selection of a BMP or suite of BMPs should be based on the efficacy of each specific BMP to achieve the desired result in a given landscape. The suite of BMPs used in a row crop setting, for example, would be different from the suite of BMPs used in a new urban development, though there would certainly be some overlap.

In this section, a suite of BMPs is matched to landscape characteristics within the watershed. The efficacy of listed BMPs in treating watershed stressors is also summarized.

10.1 BMP Zones

Five discrete zones were identified within the watershed that would benefit from a specialized suite of BMPs: Headwater Pasture, Wooded/Karst Slope, Bottomland/River Valley Floodplain, Transitional Fringe, and Urban Developed (see Figure 9.1-A BMP Zones). Zones were categorized using a combination of GIS data layers and attributes. The data layers used in the zonal data creation consisted of: Cadastrals, Soils, Topography (DEM) and Urban Boundary.

The Upper Pasture Zones were created using poorly drained and somewhat poorly drained soils. The Karst/Central Wooded Zones consist of slopes greater than 30%. The Northern Developed Zones were defined using a combination of data on urban boundary, impervious cover and parcels less than 10 acres. Bottomland Lower Zones contain soils classified as floodplain or stream channel. Transitional Fringe Zones consist of areas that were not classified in the other four classes.

When combining data layers, the layers were prioritized as follows to address data overlap: slope prevailed over soils, and urban prevailed over all other data layers.

Headwater Pasture

General Assessment and Description – The Upper Pasture Zones consist of the upper reaches of North and South Gans Creek, Upper Bonne Femme, Turkey Creek and Bass Creek. Most of this region is east of Route 63, where the topography gently rolls. Most of the land has been cleared for pasture and row crops, though estate-sized lots of 5-10 acres are becoming increasingly prevalent. Soils range from somewhat poorly drained to drained

hydric soils. Wetlands were not observed within this zone, other than narrow bands of wetland vegetation around constructed ponds.

Soil texture within the stream channels and side slopes ranges from highly erosive sand to sandy silt. Nearly all of the channels exhibit some degree of down-cutting. It appears that down-cutting and streambank erosion are most severe and active at locations where the woody riparian buffer has been replaced with pasture grass and grazed. The most stable reaches occur in areas where cattle are excluded and the woody riparian buffer remains intact.

Reaches transitioning from intensive grazing to estate lots are moving toward a more stable equilibrium. While transitional reaches remain down-cut – as they are likely to remain since that is where the culvert inverts are set at road crossings – active erosion of the channel bottom and streambanks appears to be slowing down and may eventually stop with the implementation of BMPs.

Some of the culverts may be improperly sized and contributing to erosion around abutments, with localized flooding upstream.

Most of the groundwater recharge areas for Devil's Ice Box and Hunter's caves occur within this Headwater Pasture Zone; it should be noted that this flow does not go underground until it reaches the Wooded/Karst Slope Zones.

BMPs recommended within this zone should be considered, selected, implemented and enforced within the recharge zones and adjacent buffer areas.

Recommended BMPs – The following BMPs should be considered within this region of the watershed:

- Livestock should be excluded from riparian corridors;
- Riparian woody and prairie buffers should be restored along channels.
- Culverts should be sized and shaped correctly to maintain a natural channel adequately convey stormwater.
- The prevalence of drained hydric soils suggests the historic wetlands have been drained through tiles and ditches. Restoring drained wetlands by disabling tiles and filling ditches would maximize the retention of stormwater runoff, thereby reducing the rate and volume of runoff delivered to the streams.
- The conversion of any high-use open space such as pasture, row crops, or estate lots to natural plant communities such as prairie or native woodland would reduce runoff, increase retention in the uplands, and reduce the rate and volume of water delivered to streams.

Wooded/Karst Slope

General Assessment and Description – The Wooded/Karst Slope Zones occur primarily in the central and southeastern portions of the project area, including the Middle, Lower, and South Branches of Bonne Femme Creek, as well as the most downstream portions of Turkey and Bass Creeks. The topography is steep (greater than 30% slopes), rugged at higher

elevations, and relatively flat within the floodplains below (floodplain habitat is discussed below under Bottomland/River Valley Floodplain). Most of the cover consists of oak hickory woodland, though some of the timber has been cleared for pasture, estate lots, and farmsteads. Upland soils are very well drained, thin, and vulnerable to erosion. Where localized gullies do occur, it appears as if the thin surficial soils are easily eroded, but severe gullying is often arrested once the gully reaches the underlying bedrock or cobble. The steepest slopes in the project area occur within this zone. This zone contains karst features usually manifested in the landscape as losing streams and wooded sinkholes This region is the most sensitive in the watershed in terms of biodiversity and water quality.

Recommended BMPs – The following BMPs should be considered within this region of the watershed:

- Livestock should be excluded from riparian corridors;
- Riparian woody buffers should be restored along channels;
- The most frequently observed form of erosion were rills and gullies caused by concentrated discharges of water from homes, farmsteads, and pastures. These rills and gullies should be repaired and the concentrated discharges dispersed.
- Complete more extensive mapping of localized areas tributary to karst features, including sinkholes and losing streams. These tributary areas should be restored to native woodland and prairie communities where appropriate, and to the greatest extent practical.
- Special care must be taken to minimize soil loss in steep areas during road repair and construction, residential and commercial development, and within areas used for agricultural purposes. Ideally, steep areas should be restored to native plant communities rather than developed.
- Farm fences causing creek obstructions and subsequent erosion should be removed.
- Buffer/expand protected lands and habitat for species of conservation concern (MDC 2005).

Urban/Developed

General Assessment and Description – The Developed Zones occur within the Clear Creek, Gans Creek, Bass Creek and upper reaches of the Lower Little Bonne Femme subwatersheds. Most of the existing and projected development has occurred or will occur within this region, which is at the south edge of the City of Columbia and near Ashland. The topography ranges from relatively steep to gently rolling. Cover consists of residential and commercial development—particularly at the north end of this region—with pasture and timber within the steepest areas of the region. Historically, plant communities within this region would have been similar to plant communities within the Karst/Central Woodland Zones.

Some of the most severely eroded soils in the project area occur within the Urban/Developed Zones. Erosion is exacerbated by heavy development pressure from Columbia to the north and Ashland to the south. Currently, development is spreading into the Transitional Fringe Zone described below.

In general, there were few BMPs, such as detention ponds, observed in this region. However, there were at least two new subdivisions observed that used BMPs with good results. The Bearfield Meadows subdivision used wet-bottomed detention ponds and wetland pretreatment bays to detain and treat runoff prior to discharge into the creek. The receiving creek was in good condition, which we attribute to the use of listed BMPs in this subdivision.

The Highlands subdivision provided the best examples of BMPs observed within the project area. BMPs included the extensive use of detention ponds, grass swales with check dams, outlet protection to disperse concentrated flows, infiltration ponds, and siltation basins. Silt fences around active construction were used throughout the project, but maintenance—and presumably monitoring and enforcement—was poor. Receiving streams were in much better condition than expected, which was also attributed to the use of listed BMPs. It should be noted that many of the observed BMPs were installed by the City of Columbia in the Forum Boulevard right-of-way below the subdivision.

Stream channel characteristics were similar to the Karst/Central Woodland zones. Stream channel bottoms consisted primarily of cobble less than eight inches in diameter and gravel. Channel sideslopes are variable but generally include cobble, silt and sands. Downcutting appeared to be less of an issue than the lateral migration of the stream around woody debris obstructions and large cobble bars. Debris jams were common and likely play a significant role in sideslope erosion.

Recommended BMPs – The following BMPs should be considered within this region of the watershed:

- Localized land planning should occur to protect areas most vulnerable to erosion and sedimentation.
- State of the art BMPs for new development sites including the use of detention ponds, silt fences, minimization of mass grading, inlet protection during construction, and several other BMPs commonly used throughout the country should be adopted. The implementation of these BMPs will be critical as this area continues to develop, and open space is converted to developed land uses.
- Riparian corridors should be buffered with native plant communities.
- It appeared that existing ponds and lakes in developed areas could be retrofitted to detain more water by restricting the outlet, increasing the elevation of the berm/dam, or some combination of the two.
- A channel restoration and maintenance plan should be developed to prioritize creeks for restoration, and regularly remove debris jams causing erosion.

Bottomland/River Valley Floodplain

General Assessment and Description – The Bottomland Lower Zones occur primarily within the floodplains and bottomlands of the Lower Little Bonne Femme, Missouri River, and Lower Bonne Femme subwatersheds. The topography is generally flat. Land uses and cover consist primarily of row crops and pasture in the bottomlands with a few farmsteads in the hills. Historically, most of this region would have consisted of bottomland, open

woodlands.

Waterways within this area have been extensively ditched and channelized. Creek erosion and entrenchment was severe, particularly in the flat bottomlands where row crops and pastures left very little riparian buffer.

Most of the creeks within the bottomlands were severely entrenched and actively eroding. Soils on the sideslopes and creek bottoms were silty. The lowest reaches of creeks within this area were influenced by water level fluctuations in the Missouri River.

Recommended BMPs – The following BMPs should be considered within this region of the watershed:

- Livestock should be excluded from riparian corridors;
- Riparian woody and prairie buffers should be restored along channels.
- Culverts should be sized and shaped correctly to maintain a natural channel in addition to safely conveying flood waters.
- The prevalence of drained hydric soil suggests the historic wetlands have been drained through tiles and ditches. Restoring drained wetlands by disabling tiles and filling ditches would maximize the retention of stormwater runoff, thereby reducing the rate and volume of runoff delivered to the streams.

Transitional Fringe

General Assessment and Description – The Transitional Fringe Zone consists of undeveloped land with slopes less than 30% and non-hydric soils outside of the floodplain. This land is transitional in the landscape – situated between Wooded/Karst Slope, Urban/Developed, and Headwater Pasture – and at many locations, it is land likely to transition into a more intensive use. The topography is moderately rolling. Land cover includes pasture, row crop, and woodland.

Most of the area within this zone occurs in the upper reaches of subwatersheds where there are opportunities to detain and retain water that is now being conveyed to the channels below. Where waterways traverse this zone, the condition of the creek, in general, resembles most closely the neighboring Wooded/Karst Slope Zone or Headwater Pasture Zone.

Recommended BMPs – BMPs recommended for this zone include the same suite of BMPs listed for other zones, with customization appropriate to existing or proposed land uses.

10.2 Implementation Summary and Predicted Benefits

As noted above, Best Management Practices (BMPs) are watershed restoration and management techniques that, if implemented, can improve water quality, reduce runoff and flooding, and protect or restore water resources. The BMPs recommended for each zone of the watershed are summarized in Table 10.2-i, with respect to their placement within the watershed and the attributes they are predicted to improve or protect.

Table 10.2-i. BMP Summary Implementation and Benefit Table

Recommended Best Management Practice	Recommended Implementation Zone within the Watershed	Attributes Protected or Enhanced				
		Water Quality	Biodiversity	Groundwater Recharge/Infiltration	Flood Protection	Wildlife Habitat
Exclusion of livestock from riparian corridors.	*Headwater Pasture, Wooded/Karst Slope, Bottomland/River Valley Floodplain*	√		√	√	
Restoration of riparian buffers along channels.	*All zones*	√	√	√	√	√
Culvert resizing and/or reshaping.	*Headwater Pasture, Bottomland/River Valley Floodplain*				√	
Restore drained wetlands.	*Headwater Pasture, Bottomland/River Valley Floodplain*	√	√	√	√	√
Convert intensively used open space to natural plant communities.	*All zones*	√	√	√	√	√
Repair rills and gullies caused by concentrated discharges of water from homes, farmsteads, and pastures. Provide for dispersion of future discharges.	*Headwater Pasture, Wooded/Karst Slope*	√			√	
Complete more extensive mapping of areas tributary to karst features including sinkholes and losing streams. Restore these areas where appropriate and to the greatest extent practical.	*Wooded/Karst Slope*	√		√		√
Minimize soil loss in steep areas during road repair and construction, residential and commercial development, and within areas used for agricultural purposes.	*Headwater Pasture, Wooded/Karst Slope, Urban/Developed*	√				
Remove farm fences obstructing channels.	*Headwater Pasture, Wooded/Karst Slope*				√	
Buffer and/or expand protected lands and listed species habitat.	*Wooded/Karst Slope*		√			√
Localized land planning should occur to protect areas most vulnerable to erosion and sedimentation.	*Urban/Developed*	√				
Implement the use of decreased road widths, detention ponds, silt fences, minimization of mass grading, and/or inlet protection during construction.	*Urban/Developed*	√		√	√	
Retrofit existing ponds and lakes to detain more water by restricting the outlet, increasing the elevation of the berm/dam, or both.	*Urban/Developed*	√		√	√	
A channel restoration and maintenance plan should be developed to prioritize creeks for restoration and for regular removal of debris jams.	*All zones*	√	√		√	√

10.3 BMP Examples

During site visits, several locations were observed that could benefit from implementation of one or more of the recommended Best Management Practices. This section presents examples of these areas and associated helpful BMPs. The following images detail a specific problem. The accompanying captions identify the problem, provide a recommended solution, and indicate the projected benefits.

Photo 10.3-i Buffer Agricultural Areas from Channels

Photo 10.3-i shows an area with row crops very close to the side of the channel (left side of channel in photo). If a buffer strip were added to these areas, either with woodland or prairie vegetation, it would improve water quality by decreasing overland sediment and nutrient transport, provide for increased biodiversity and wildlife habitat, increase infiltration potential, and provide for some degree of flood protection.

Photo 10.3-ii Buffer Pasture Areas from Channels

Photo 10.3-ii shows an area with pastured regions extending into the channel. If a buffer strip were added to these areas, either with woodland or prairie vegetation, it would improve water quality by decreasing overland sediment and nutrient transport, provide for increased biodiversity and wildlife habitat, increase infiltration potential, and provide for some degree of flood protection.

Photo 10.3-iii Exclusion of Livestock from Riparian Corridors

Photo 10.3-iii is an example of the cattle grazing practices observed during site visits. To minimize nutrient loading and channel disturbance, livestock should be prevented from grazing or crossing channels wherever possible. This would improve water quality and aid in channel stability.

Photo 10.3-iv Channel Debris Removal

The accumulation of debris shown in Photo 10.3-iv can restrict channel conveyance capacity, which will ultimately increase water surface elevations, exacerbate flooding and cause streambank erosion and channel instability. These areas should be monitored and debris should be removed on a regular basis.

Photo 10.3-v Minimizing Road Widths in New Subdivisions

As new developments are constructed in the area, a potential requirement could be reducing the road widths. This would decrease impervious area, resulting in lower runoff volumes because of increased infiltration. In general, motorists also tend to slow down on narrow streets.

Photo 10.3-vi Remove Farm Fences Obstructing Channels

Several channels were observed with fencing directly across a channel, and as in Photo 10.3-vi, some of these fences were equipped with sheet metal to prevent animals from moving under the fences. As high discharges flow out of culverts into these areas, there is potential for erosion of the road embankment and channel banks as water diverts around the obstruction.

Photo 10.3-vii Reshape Culverts

As shown in Photo 10.3-vii, this culvert could be realigned to provide for more natural stream flows. A hanging culvert such as this will impede the passage of fish or amphibians and could also increase erosion potential during high flow events.

Photo 10.3-viii Resize Culverts

This example presents a problem related to that of Photo 10.3-vii where this culvert appears to be undersized, or the stream has possibly reshaped itself since installation. Based on the dimensions of the observed channel, it appears that at high flows the culvert will restrict flows to the point of overtopping the road. A wider span below this road crossing would alleviate this problem.