4.0 Strategies and Tools

The City and County professional staff considered a long list of strategies and tools and used the following reasons for inclusion or rejection of those strategies and tools. This section explains the decision process and background regarding how these strategies and tools were selected.

4.1 Strategy: Modifying Human Susceptibility to Flood Hazards

Flooding impacts may be reduced through information, development policies, regulations, and flood protection measures on individual properties.

4.1.1 Tool: Land Use Policies and Regulations.

Advisable

A wide range of potential land use policies and regulations are available to be adopted that will lessen the likelihood that new or redeveloped buildings would be flooded. The term “higher standard regulations” is used to denote regulations that are more restrictive than the minimum FEMA floodplain regulations requirements.

Some potential higher standard regulations include:

- Prohibit development in the 1% Annual Chance Floodplain.
- Prohibit fill within the 1% Annual Chance Floodplain.
- Increase the required “freeboard” above the current minimum standard of one (1) foot above the base flood elevation.
- Regulate development within the floodplain to the width and depth of the mapped 0.2% Annual Chance Floodplain (commonly referred to as the 500-year floodplain) rather than the FEMA standard of 1% Annual Chance Floodplain.
- Regulate to a community based floodplain model, such as the AMEC Future Conditions 1% Annual Chance Floodplain.
- Require compensatory storage in the floodplain when fill is brought into the floodplain beyond a designated threshold.
- Require new development after a designated date to comply with higher floodplain standards to protect existing developments in the watershed.
- Require development outside and upstream of the urbanized areas to comply with higher floodplain standards to protect existing developments in the urbanized areas of the watershed.
- A host of complementary policies and regulations to some of the ones stated above which are designed to further protect lives and properties during a flood event.

The Land Use Policy & Regulation strategy is readily acceptable to proceed forward within the action plan of the FMP, as it can be an effective measure to protect new developments, additions or redevelopments from flooding by changing current development practices.

4.1.2 Tool: Development Policies - Moratorium.

Not Advisable

Early in the WCWWG discussions, it was proposed to place a moratorium on development in the floodplain of Wildcat Creek until research and ultimate solutions could be created to reduce the flooding impacts from the Creek. In researching the moratorium, it was determined that such a measure would only impact a very small number of vacant properties in the City and might be considered a "taking" if implemented. It was advised by the City of Manhattan Legal Department to not implement such a measure because of these factors.

4.1.3 Tool: Flood Warning Systems.

Advisable

The effects of flooding on lives and personal property can be reduced if enough advanced warning can be given. Advanced warning can empower people who live or work in the floodplain to move themselves and valuable personal property out of harms way. Ideally, early warning systems should be paired with an emergency evacuation plan that has been disseminated throughout the community and in the information and education process.

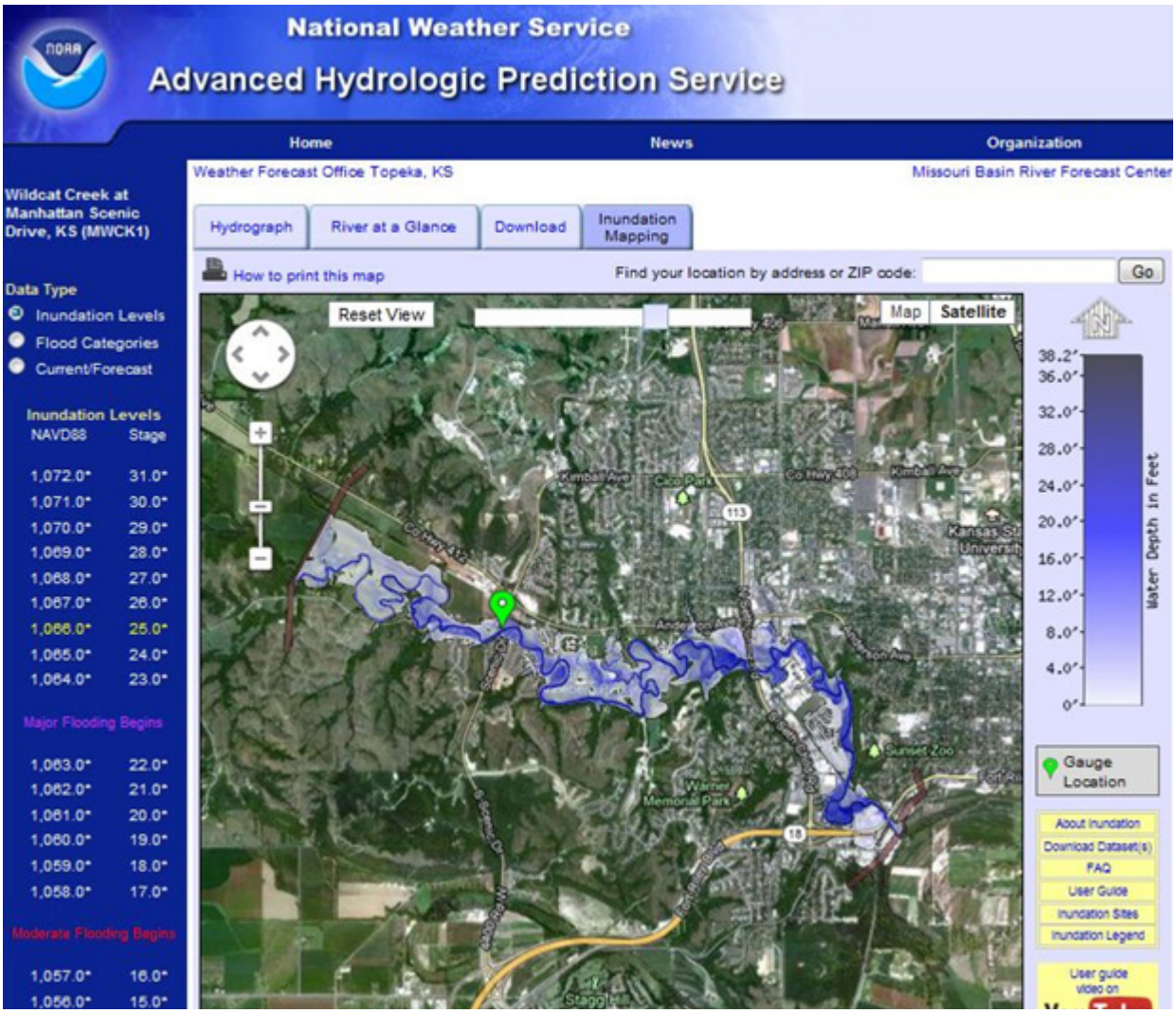

FIGURE 27. THE WILDCAT CREEK IN THE NWS ADVANCED HYDROLOGIC PREDICITION SERVICE.

Riley County and the City of Manhattan have a number of advanced warning measures currently in place. Other measures can be created or expanded upon to induce a more positive effect:

- IRIS Warning System – The Immediate Response Information System (IRIS) is a subscription-based warning system that is free to Riley County residents. The IRIS Warning System is linked to the National Weather Service notifications and will alert subscribers to a wide variety of weather watches and warnings via a number of media types, including phone calls to a land or cellular phone, text messaging or email.

- Bridge Warning Lights – Through the Silver Jacket Pilot Project, warning signs and lights were purchased and installed at the Scenic Drive bridge over Wildcat Creek on the west side of Manhattan. During a flood event, the warning lights are activated on the signs to alert motorists of the flood threat. The warning lights can also provide warning of the flood event to residents living nearby as they travel to or from their homes.

- Gauges & Website – The USACE Silver Jacket Pilot Project, the City of Manhattan, Riley County and the Garrison Command of Fort Riley helped purchase and place three (3) stream gauges along Wildcat Creek (see Figure 29 for location of gauges). These digital stream gauges are linked to the U.S. Geological Survey and National Weather Service websites (see reference section for website address) and provide a real time account of the depth of Wildcat Creek.

  These gauges aid in the prediction of flooding on Wildcat Creek based on rainfall data and the rise of Wildcat Creek. In addition, these maps are clearly organized in a foot-by-foot mapping library that is available on the NWS Advanced Hydrological Prediction Service (AHPS) web-page and is coupled with the NWS weather forecasting. These two (2) tools enable residents and emergency responders the ability to keep a watchful eye on potential flooding on Wildcat Creek and the areas predicted to be impacted by flooding.

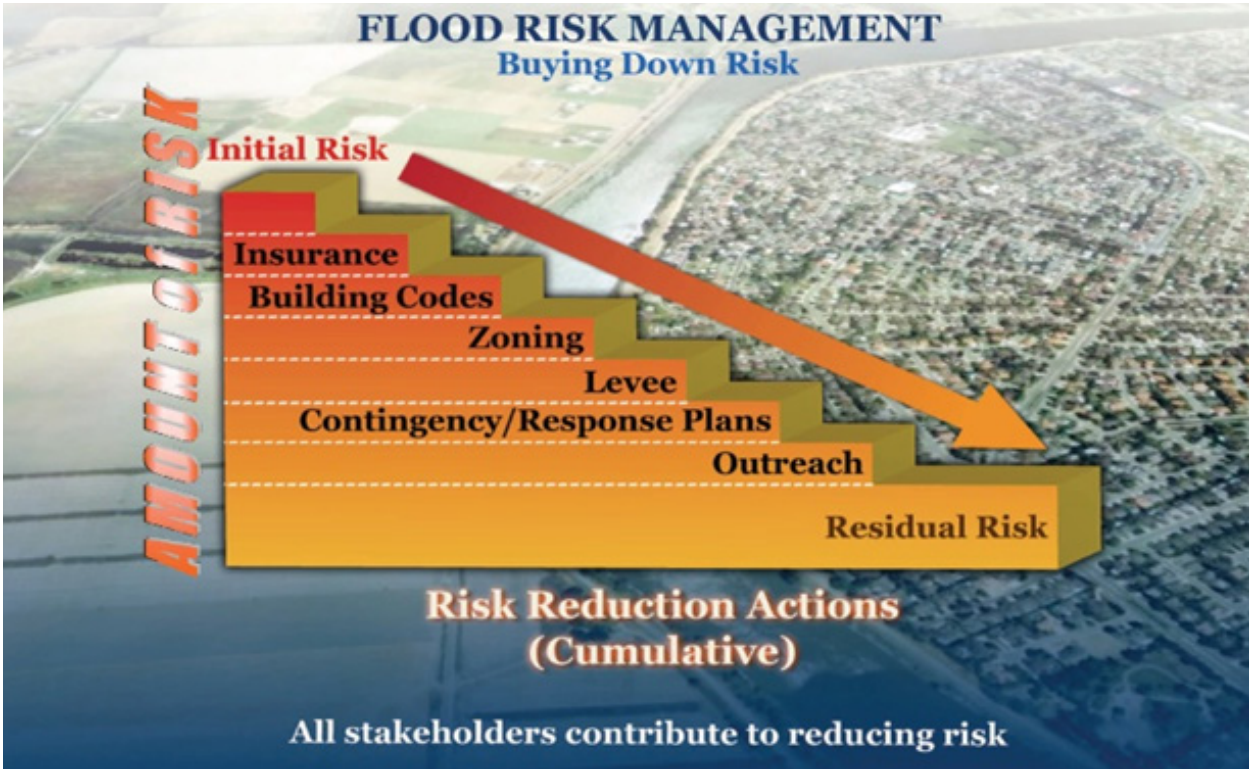

FIGURE 28. EXAMPLE STEPS FOR REDUCING FLOOD RISK TO ACCEPTABLE LEVELS.

- Voice Modulated Warning Sirens – The U.S. Army Corps of Engineers established a voice modulated warning siren system in Manhattan, Riley County and Pottawatomie County as part of a Tuttle Creek Reservoir Dam failure warning system for the Blue River. The City of Manhattan Fire Department would like to replicate that system in the Wildcat Creek watershed within the City limits to provide sound and voice flood warnings and instructions to residents that are outdoors. This system can be tied to the National Weather Service weather notifications system and alert people that are outdoors of a flood and give them instructions on how to evacuate the area. A secondary benefit to the system is that many people will be able to hear the warnings and instructions within their homes and businesses, although most outdoor siren and voice systems are not designed for such a use.

The City of Manhattan and Riley County should continue efforts to increase the number of warning systems to accommodate flood warnings and also look for new and innovative ways to warn those in harms way of a flood or other natural disaster and how to evacuate an effected area.

4.1.4 Tool: Flood Protection of Structures in the Floodplain.

Advisable

There is a wide range of flood protection measures that home and business owners can implement to reduce or eliminate the risk of future flooding. The entire range of flood protection measures should be reviewed and evaluated for properties at risk of flooding.

Non-residential structures, such as businesses or detached garages, can be constructed in a manner to prevent flooding of the interior. In addition to the building materials, special doors and windows and operation procedures are required to seal the building from rising flood waters. City of Manhattan and Riley County regulations currently require that non-residential structures located in designated floodplains that are to be flood-proofed, do so to a minimum of one (1) foot above the base flood elevation (BFE). Residential structures are not permitted to use flood-proofing measures to meet the current floodplain regulations.

Residential structures prone to flooding can use a variety of measures to reduce or eliminate the possibility of flooding. A residential structure can be elevated in place so that it is higher than a certain level of flooding. This will provide a higher level of protection. City of Manhattan and Riley County floodplain regulations require a residential structure to have its lowest enclosed floor a minimum of one (1) foot above the BFE. Home owners with properties prone to flooding may consider raising the home higher than the minimum requirement; however when elevating a home in place, special consideration should be given to how access to the home is provided during a flood event. At least one (1) way of dry access should be provided to a home in case an emergency arises during a flood. One of the most costly impacts from flooding is its effect on a home's electrical, heating and air conditioning systems (HVAC). Having these systems flooded can cost thousands of dollars to clean, repair or replace. A good preventative measure is to relocate these systems above the expected elevation of flood waters. By moving these systems out of a basement and raising the exterior unit of a HVAC system above the expected flood elevation, a home owner can prevent expensive repairs and lessen the impacts from a flood. Flood walls can protect basement window wells or stairs from shallow flooding by preventing waters from entering these openings. Special attention should be given to the design and construction of flood walls to ensure they function properly and don't exacerbate flooding.

Home owners can take other measures to prevent or reduce flood water inundation through back-flow preventers on floor drains, sewer hook-ups and/or foundation drains. These measures can protect against minor or localized flooding and prevent costly cleanups from sanitary sewers backing up during high water in the system, or in cases when the sanitary system fails for other reasons. Home and business owners are encouraged to check with local building code officials and floodplain managers in their jurisdictions before undertaking such flood protection measures as there will most likely be building code and floodplain regulation requirements and permits.

The City of Manhattan and Riley County should be, at a minimum, a repository for information on these types of flood protection options for home and business owners. Local construction contractors should be encouraged to become experts in this topic.

4.1.5 Tool: Process for Relocation or Removal of Structures.

Advisable

One of the most preventative measures to protect a home or business is to relocate it to an area more protected from flooding, such as a high area on the property or to a new piece of land entirely. By moving the structure outside of an area prone to flooding, it can effectively eliminate the impacts of flooding. This measure can be done voluntarily by a property owner or with assistance from local, state and federal governments.

Following a federal flood disaster declaration, mitigation dollars are typically available for mitigation projects, such as purchasing flood prone properties. These federal and state mitigation programs are completely voluntary on the part of the property owner; a local entity **CANNOT** use eminent domain to acquire a property through this project. These mitigation funds are managed by the Kansas State Hazard Mitigation Office and have to meet certain standards, including an acceptable benefit to cost ratio. These programs also require a certain match of local dollars or in-kind contributions. Once a property is purchased through these programs, the local entity must ensure the property is retained by that entity and is maintained as open space in perpetuity.

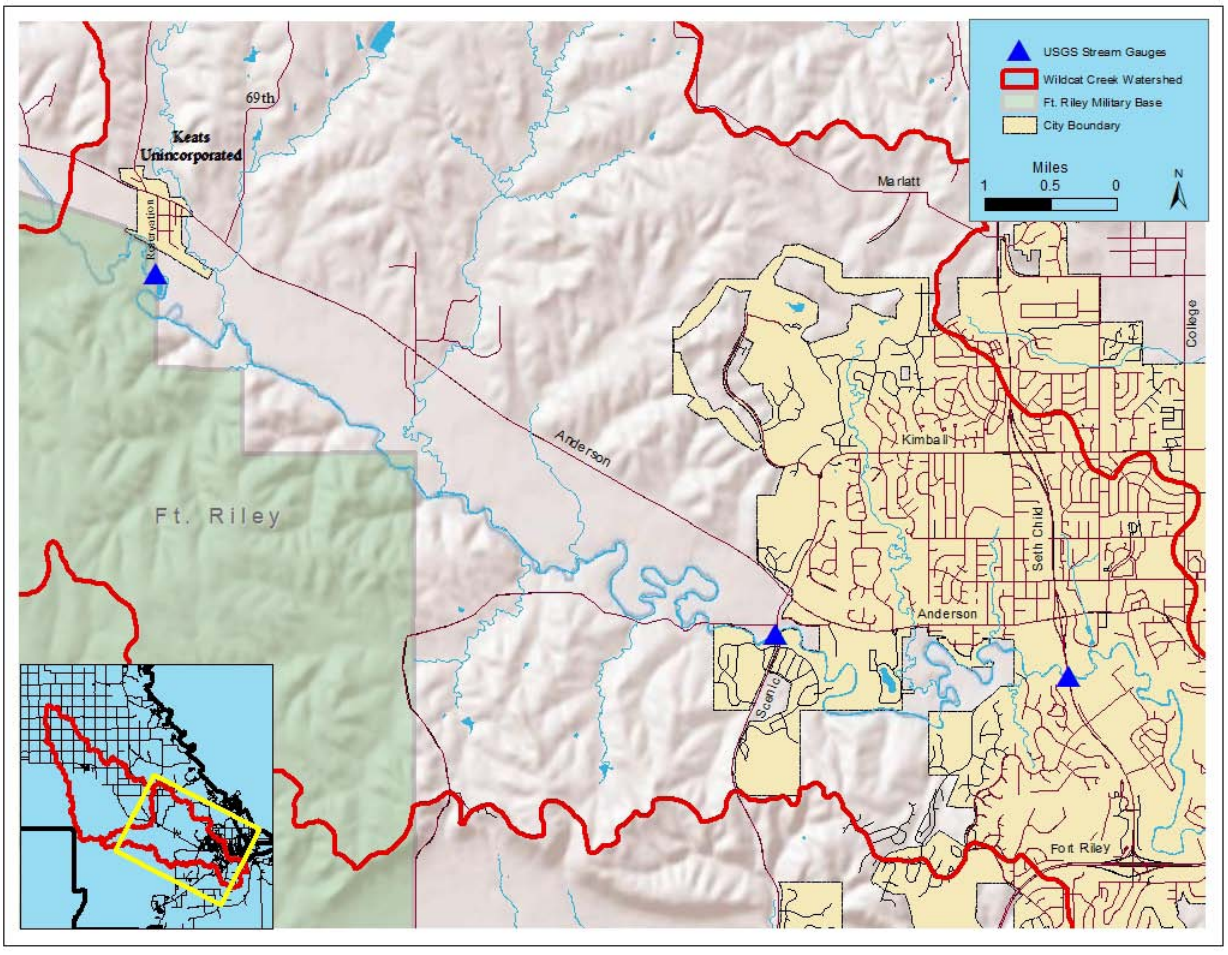

FIGURE 29. LOCATION OF WILDCAT CREEK STREAM GAUGES.

Riley County and the City of Manhattan should evaluate areas of the community where these programs may be worthwhile to move residents and their property out of harms way and develop a comprehensive plan identifying homes and businesses which should be purchased and relocated or removed. These entities should develop comprehensive plans to return the purchased lots back to a natural state or other uses complementary to the floodplain, such as open playing fields (i.e. soccer fields), trails or nature education centers.

4.2 Strategy: Modifying the Impact of Flooding

Local community officials can do a variety of things to modify the impacts flooding has on residents. Education and information on how to avoid floods, the importance of flood insurance and how to recover after a flood event are all elements of this strategy that can help residents of Riley County and the City of Manhattan.

4.2.1 Tool: Information and Education.

Advisable

City and County officials should, through a variety of methods and media, inform the general public and residents within the floodplain of specific flood hazards, how to prevent and/or prepare for a flood event and what to do after a flood event.

Both the City of Manhattan and Riley County maintain current and historic flood insurance studies and Flood Insurance Rate Maps (FIRMs) and applicable local floodplain regulations. The most current FIRMs are available in digital form through geographical information systems (GIS) software. Floodplain development documents are also on file at the public offices. Other data has been and can be further collected by City and County officials, such as localized flooding issues that are not shown on the FIRMs. This list of information topics of the flood risks for specific areas can be relayed to residents. In addition, general flood hazard information should be provided to residents. Public officials should continue to inform residents, real estate agents, lending institutions and developers that such information is available.

A number of local, state and federal agencies, such as the Kansas Division of Water Resources, American Red Cross and FEMA, have prepared detailed pamphlets, books and other informational pieces on how to prevent and prepare for a flood event. Similar information about how to recover from a flood event has been created by these agencies and others. City and County officials should continue to collect, review and maintain a sufficient library of information to assist residents with these topics. In addition to notifying the public about this resource library, the information should be cataloged at public libraries in Riley County.

Information on other topics related to flooding, such as water quality and water conservation, should be collected and made public in similar fashion as the flood hazard and prevention information. This information can be provided at City and County offices and/or the public libraries. A variety of media types can be used to inform residents and other interested parties about these flood related topics. Both Riley County and the City of Manhattan maintain informative websites where this information can be displayed. Newsletters, newspaper advertisements, press releases, notices on utility bills, other government notices, social media and direct mailings should also be used. Both entities should be creative as to how these messages are relayed to the public both broadly and specifically in an effort to have a well informed community on the hazards of flooding in the area.

The City of Manhattan recently applied for and has been accepted to the Community Rating System (CRS), a national program that evaluates a community's floodplain management efforts and rewards those efforts with reductions on National Flood Insurance premiums based on the community's floodplain management performance. A component of the CRS program is public outreach.

FIGURE 30. BRIDGE WARNING LIGHTS ON WILDCAT CREEK.

Credit points can be earned for a comprehensive approach to informing the general public and residents living and working in the floodplain of the potential hazards of flooding in the community. The City of Manhattan should set a goal to create a comprehensive public outreach and educational plan that targets a variety of topics and groups of residents to inform as many people as possible and potentially earn greater reductions in flood insurance premiums through the CRS program.

SPECIAL NOTE: A floodplain management plan (FMP) is the very essence of the Information and Education tool. A primary purpose of the FMP is communicating flood risks, helping to establish public understanding of those flood hazards, and documenting for the community the decision processes used in developing plans, policies and regulations.

4.2.2 Tool: Future Conditions Flood Model.

Advisable

As part of the upcoming Riley County Flood Insurance Study and FIRMs update, the City of Manhattan contracted with AMEC Environment & Infrastructure to develop a flood model based on the Wildcat Creek watershed and Marlatt Ditch watershed being completely built out using the Manhattan Urban Area Comprehensive Plan's Future Land Use Map. This model was completed in the summer of 2012 and is planned to be shown on the FIRMs for reference and potentially for regulatory purposes. The model predicts what the width and depth of flood waters will be for a 1% Annual Chance Flood (commonly referred to as a 100-Year Flood) if currently vacant lands are developed as proposed on the Future Land Use Map. This information is valuable to residents, lenders, developers and public officials by representing what flooding could be in the future (10 – 15 years from now) and how new development and redeveloped areas should be designed to protect against flooding.

4.2.3 Tool: Flood Insurance.

Advisable

Both the City of Manhattan and Riley County are active participants in the National Flood Insurance Program (NFIP) by the Federal Emergency Management Agency (FEMA). Flood insurance is available to all property owners and tenants in participating communities, and in some cases is required for a federally-backed loan to be made. Both entities should continue their participation in the program as it provides the only affordable means of flood insurance for property owners and tenants that are in a mapped floodplain, as well as for those that are not in a mapped floodplain, but want the added protection.

4.2.3.a Tool: Community Rating System.

Advisable

The City of Manhattan has recently been accepted into the Community Rating System (CRS), a national program that evaluates a community's floodplain management efforts and rewards those efforts with reductions on National Flood Insurance premiums based on the community's floodplain management performance. There are four (4) floodplain management categories with nineteen (19) total activities where CRS communities can earn credit points towards flood insurance premium reductions. The Wildcat Creek Floodplain Management Plan, if formally adopted, can earn credits in CRS.

Other credits include higher standard floodplain regulations, public outreach, and floodplain document libraries. Several manuals on this are listed in the References section of this FMP, including the manual, Example Plans and Coordinator's Manual (FEMA).

4.2.4 Tool: Tax Adjustments.

Dependent on Location and Situation

One strategy to promote and provide open space along streams and within floodplains is to provide tax incentives to property owners who provide this dedicated open space. The purpose of open space is to provide an area along a stream that is free and clear of man-made obstructions so that flood waters can flow unobstructed as nature intended in these areas. A tax incentive program could provide a reduction of the property tax in exchange for the dedicated open area through conservation and drainage easements.

The majority of land along Wildcat Creek is privately owned, so this strategy tool may be effective. More research on this tool needs to be done to determine if there would be a substantial benefit to both the property owner and the community and what mechanisms need to be put into place to make an open space tax incentive program successful.

4.2.5 Tool: Emergency Relief.

Advisable

Following the latest flood events along Wildcat Creek and the wealth of research and information collected by the City, County, Kansas State University, State, and Federal agencies and community groups, emergency responders have been able to devise specific response and evacuation plans for flood events on Wildcat Creek. The United States Geological Survey (USGS) stream gauges and National Weather Service flood models should be invaluable in the event of a flood by providing advance warning that will allow emergency responders to act in a more timely and decisive fashion. As part of a Presidential Disaster Declaration, emergency relief funds and hazard mitigation grants are typically available to address property owner's needs after an event and to reduce or remove the impacts of hazards, such as purchasing property through FEMA's property acquisition hazard mitigation assistance program.

To participate in these Federal grant programs, the County's Multi-jurisdictional Hazard Mitigation Plan must be up to date and formally adopted. Riley County's Emergency Management Department is the entity in charge of the plan, with help from the City of Manhattan Fire Service, Riley County Emergency Medical Services, Riley County Police Department and other local and state agencies. This plan should be, at a minimum, updated as required to ensure these grants are available.

4.2.6 Tool: Post-Flood Recovery Processes.

Advisable

Unfortunately, the City of Manhattan and Riley County have been well versed in their roles and requirements in post-flood events along Wildcat Creek in recent years. Both the Manhattan building codes and the Manhattan and Riley County Floodplain Regulations require that homes and businesses impacted by flood waters be inspected to ensure they are habitable and meet all regulations and standards.

The City of Manhattan and Riley County will continue to inspect damaged homes after future flood events to ensure they comply with all regulations. In addition, both entities should, at a minimum, become a repository of post-flood disaster information on flood safety, clean up and mitigation options for home and business owners and encourage local businesses to become experts in these topics.

4.3 Strategy: Preserving and Restoring Floodplains' Environmental Quality

Generally Advisable

Floodways and floodplains function best when they are left in their natural state to move storm water out of an area, reduce erosion, and control sedimentation and water quality. Typical development patterns in the City, County, and across the country have been to manipulate floodplains to accommodate development. Where physically and financially possible, options should be reviewed to preserve natural floodplains and restore disturbed floodplain to its natural state.

4.3.1 Tool: Wetlands Protection and Restoration.

Dependent on Location

Wetlands play an important role in reducing sediment and other pollutants from entering a stream channel and can reduce flood waters in low intensity storms. The City and County have a number of known and mapped wetlands within the City limits and there are several within the Wildcat Creek watershed. Federal and State regulations dictate the protection, restoration and creation of wetlands. The continued protection of established wetlands in the City and Riley County is a priority of both entities.

Where feasible, the restoration of wetlands should be considered in mitigation measures along Wildcat Creek and its tributaries.

4.3.2 Tool: Erosion and Sediment Control.

Advisable

Sediment Control: The City of Manhattan and Riley County are required to follow the Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES), Phase II program to prevent polluted storm water runoff from entering U.S. water bodies. As part of NPDES, Phase II, the City and County require Notice of Intent Permits for construction projects that will disturb an acre or more of ground. The City also has adopted best management practices (BMPs) for construction projects to prevent sedimentation from construction sites from reaching the stormwater system and staffs a full-time employee to enforce the BMP construction requirements (City of Manhattan, 2012).

Riley County has recently adopted riparian buffer regulations that require specific buffer zones based on the order ranking of the stream (Riley County, 2011). Other agencies, such as the Riley County Conservation District, provide educational and technical support and possible funding sources to preserve natural resources in Riley County. The City has also adopted policies and procedures for post-construction BMPs, which through structural and non-structural measures, are intended to provide for long-term water quality improvement for individual lots and/or entire subdivisions (City of Manhattan, 2012).

Erosion Control: Erosion control is an ongoing problem on Wildcat Creek and its tributaries. The majority of the issues are on private property, where the City and County have limited abilities to assist with the correction of severe erosion. In instances where the City and County can participate to prevent or repair eroded stream banks, assistance should be given. This assistance can be in the form of sponsoring state and federal grants and projects. For instance, following the recent flooding events on Wildcat Creek, significant erosion of the stream bank has occurred near Garden Way. This erosion has threatened some apartment buildings in the area. With the assistance of property owners and the Natural Resources Conservation Service, a project was proposed to properly restore and stabilize the bank and protect the existing buildings. Unfortunately, this project was never implemented due to a variety of reasons.

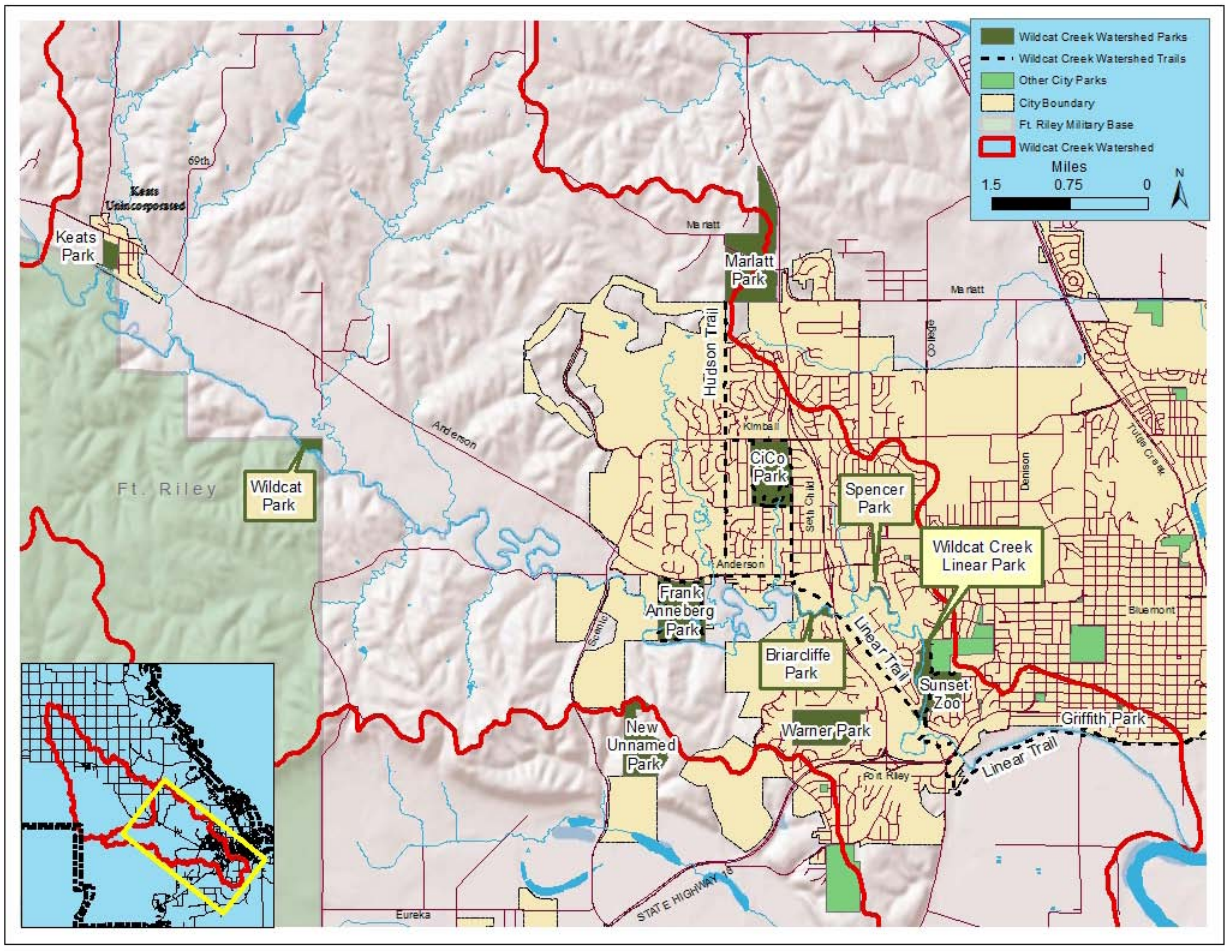

FIGURE 31. COMMUNITY PARK LOCATIONS.

For several reasons, significant erosion has also occurred along the CiCo Tributary. The City contracted with Olsson Associates to study the issues and develop solutions to stabilize the stream bank and to a lesser extent control flooding along the tributary. The study has been completed and a proposal has been designed over two phases to meet the objectives of the City and the property owners in the area. The final proposal includes stream stabilization projects along the stream south of Dickens Avenue and upstream detention basins in CiCo Park. The project is currently awaiting a funding source (Olsson Associates, 2012). The City and County should continue to participate in these types of programs and projects to protect existing homes and businesses. Riley County's riparian buffer regulations and the City's post-construction BMPs will also assist in preventing or slowing erosion problems.

4.3.3 Tool: Water Quality Enhancement.

Advisable

As described above in 4.3.2 Erosion and Sediment Control, the City, County and other agencies have plans, policies and regulations in place to begin addressing water quality issues. These items include pre- and post-construction BMPs and riparian buffer regulations. However, more can and should be done where feasible. A variety of local groups and organizations can be partnered with, to address both water quality issues and other environmental concerns along Wildcat Creek and in other parts of the City and County. These groups include classes and organizations at Kansas State University and the Wildcat Creek Watershed Council.

Collaboration projects, such as rain barrel giveaways and sales, which were recently done at Sunset Zoo, City Park Pavilion, Kansas State University Earth Day, 4-H Discovery Days at Kansas State University, and the Riley County Garden Show, can be accomplished. Professors and students at Kansas State University can assist government entities in developing educational programs and assist private property owners with technical assistance to address water quality concerns. More collaboration and cooperative endeavors should be explored to tackle these needs.

FIGURE 32. WILDCAT CREEK FLOOD STRUCTURE.

4.3.4 Tool: Enhancement of Recreation and Educational Opportunities.

Advisable

A variety of recreation amenities exist along Wildcat Creek, including the Linear Trail and Frank Anneberg Park within the City, and Keats Park in the County (see Figure 35). Currently, there is no direct connection via a recreation trail between these amenities. To date, no specific master plan has been created to study and expand on this concept, however an opportunity exists.

In the mid-1970's creek bottom land that is south of present day Washington Square, was dedicated to the City to extend a Wildcat Linear Trail. A portion of Wildcat Linear Trail exists west of Sunset Zoo - this appears to be the start of a concept to connect these recreation amenities together by extending and expanding the Linear Trail. This concept could be extended beyond the City limits to include Wildcat Park and Keats Park in Riley County, making this a regional park and trail network along Wildcat Creek.

The Manhattan Urban Area Comprehensive Plan, which was jointly developed and adopted by the City and Riley County in 2003, includes applicable policies in Chapter 5 – Natural Resources and Environment that promote the creation of trails and connected open space areas along riparian stream corridors including Wildcat Creek.

In addition to the expansion of recreation in the watershed, a regional trail and park network, if done correctly, could also be used to preserve more open space in the floodplains, which will assist in alleviating flooding downstream and improve erosion and water quality. This concept could also include an educational component to describe a variety of functions and topics related to natural and cultural resources found in the Wildcat Creek watershed. Much of the land along the creek is privately owned. A joint venture between the City and County will most likely be needed to study the preferred route, purchase easements and property. A funding source will need to be establish to make this trail network a reality.

4.3.5 Tool: Preservation of Cultural Resources.

Advisable

The Wildcat Creek watershed holds a plethora of cultural resources. Artifacts from prehistoric nomadic tribes, American Indian tribes, the establishment of Fort Riley Military Reservation, and early settlers can be found in the watershed. The watershed also contains an excellent example of today's agrarian lifestyle characteristic of the Flint Hills. The City of Manhattan and Manhattan Historic Resources Board, in conjunction with the State Historic Preservation Office, Riley County Historical Society and the History Department at Kansas State University have done both a Phase I and Phase II archaeological resource study for the area within the boundaries of the Manhattan Urban Area Comprehensive Plan, including much of the Wildcat Creek watershed.

FIGURE 33. PHOTO OF SILT FENCE.

Because of pressure from urban growth, a large portion of the Wildcat Creek watershed was the focus of pedestrian surveys during the phase II project, which meant that, when available, researchers systematically walked and surveyed targeted areas in the watershed for potential archaeological artifacts and sites to be identified for future studies. As structural projects are proposed that are related to this Floodplain Management Plan, these cultural resources must be considered and protected when discovered.

4.4 Strategy: Modifying Floodwaters

Where appropriate, storm waters may be modified to mitigate impact on private and public property. This can be in the form of man-made structures to slow runoff, and block or redirect flood waters. These strategies tend to be more costly, when compared to other strategies, due to the cost of land acquisition, design and construction of the facilities and on-going maintenance. Likewise, these strategies can never ensure that the risk of flooding is eliminated. Dams, levees and detention basins can be designed improperly and fail, have a finite lifespan and, due to an intense storm event in the "wrong" location in the watershed may be ineffective in preventing flooding. Careful consideration must be made regarding the feasibility, value, maintenance costs and reliability of each of these strategies.

4.4.1 Tool: Stormwater Detention and Retention Basins.

Advisable

On March 1, 2009, an update to the City of Manhattan's Design and Construction Standard Specifications and Policies was adopted that made changes to the Stormwater Detention Requirements. The updated requirements are summarized as follows:

> The stormwater detention requirement has changed for the post development condition on new subdivisions and infill projects that are 0.5 acres or larger. Previously the Stormwater Management Master Plan (SWMMP) established maximum allowable release rates on page 19 for the 2 year, 10 year and 100 year storm events on a per acreage basis. The new criteria for both new subdivisions and infill developments shall provide stormwater detention on site and the post-development condition shall have stormwater release rates equal to or less than the pre-developed condition. Developers should continue to have licensed professional engineers prepare drainage studies on all new developments and infill projects to determine the impact and mitigating methods to keep post developed conditions for the 2 year, 10 year, and 100 year storm equal to or less than the pre-developed condition.

This requirement has been implemented in new developments and redevelopment areas where it is appropriate, such as the upper reaches of a watershed.

National Flood Insurance Program

Nothing Could Dampen the Joy of Home Ownership . . .

FEMA

FIGURE 34. FEMA FLOOD INSURANCE BROCHURE.

A detention structure would typically be inappropriate near a stream and/or in the floodplain. Examples of recent detention basins are those found in the Grand Mere Development in the Little Kitten Creek watershed and the Westport Commons development at the intersection of Claflin Road and Browning Avenue in the Virginia-Nevada Tributary. These new basins have significantly reduced the rate of runoff from these developments and the surrounding areas to the point that they have lessened the base flood elevation and shrunk the mapped floodplain boundaries below these basins when comparing the preliminary flood study to the current flood study for Riley County. In addition to requiring detention basins where they are appropriate, the City of Manhattan has also implemented the practice of requiring restrictive covenants on the property to identify who will own and maintain the basins and what measures will be taken by the City in the event that a detention basin is not maintained. These measures can include the City doing the required maintenance of the detention basin and assessing the property for the cost of the work. This policy should be continued within the City. A similar policy is encouraged to be adopted in rural Riley County to reduce the rate of runoff from new developments that could flow into Wildcat Creek and affect properties downstream, including the urban areas of Manhattan.

4.4.1.a Tool: Additional Stormwater Policies

An additional or supplemental policy could be to require fee-in-lieu payments, or off-site improvements for new developments or redevelopment areas that are not appropriate for on site detention. Detention basins are best used in the middle to upper reaches of a watershed where they can slow the rate of runoff from an area before it reaches a stream.

If designed properly, these basins should lessen the impacts of a flood by reducing the amount of peak flows in a flood. A detention basin located in a floodplain or close to the receiving body in the watershed is typically not appropriate because it can hold back flood waters and release the water at a time when flood waters from upstream reach the area. This can worsen a flood event by "stacking" the water released from a detention basin onto the peak flood waters, making the flood event deeper, longer lasting and more significant.

By requiring a fee-in-lieu payment for development in areas not appropriate for stormwater detention or retention basins, the developer would pay the City and/or County the equivalent of what it would cost to construct the basin. The funds generated in this manner could then be used to construct new basins and other stormwater improvements within the community or a specific watershed or improve existing stormwater infrastructure.

4.4.2 Tool: Levees, Floodwalls, and Landforms.

Dependent on Location

A levee, floodwall or other landforms could be constructed along Wildcat Creek to protect private property from flood waters. A few of these structures exist on Wildcat Creek at the Deer Run Addition, Pebblebrook Apartment Complex, and the Stone Pointe Apartments. The majority of property along Wildcat Creek is privately owned, so the public sector currently does not have the ability to construct a major levee system in this area. In addition to this restriction, constructing these kinds of structures takes a considerable amount of funding, engineering, land and construction expertise to ensure that a failure of this kind of protective structure would not occur during a flood event. These requirements may make the improvements cost prohibitive. If private property owners would like to undertake such a structure to mitigate flood waters along Wildcat Creek, all local, state and federal regulations and permit requirements must be followed. The structure should be designed appropriately and constructed accurately to prevent damage to adjacent and downstream property owners and failure during a flood event. It should be noted that structural solutions are not always the best tool to address reduction of flood risk and there can be unforeseen and unintended consequences that cost more in the long run.

4.4.3 Tool: Channel Alterations, Diversions, and Bypasses.

Not Advisable

Ideally, floodplains should be maintained without any channel alterations to mitigate the effects of flood waters. Only in extreme cases are channel alterations or diversions used to protect a community. This type of mitigation measure is extremely costly, a massive public undertaking and only done in circumstances where the surrounding terrain would make this a possibility. **Altering the channel of Wildcat Creek is not advisable.** In limited situations, improvements or alterations to the channel may be appropriate when associated with stream bank stabilizations and restorations, such as the work that has been done along the creek in Washington Square, near Pecan Circle and the proposed restoration project near Garden Way.

4.4.4 Tool: Pump Stations.

Not Advisable

Pump stations are stormwater sewer system improvements that are generally found on the land side of a levee or floodwall that are used to pump ponding stormwater up and over the flood protective structure during flood stage events, when storm water would not be otherwise released into the stream. **Pump stations are not an adequate improvement to the stormwater sewer system to mitigate flooding on Wildcat Creek** for the following reasons:

1. There are no levees along Wildcat Creek. The old Rock Island Rail Road track bed, now the Linear Trail, functions as a levee, but was not designed as such and does not meet current preventative standards. A few walls that act as floodwalls have been constructed on private property along the creek, but it is indeterminable if they were designed to function as such.

2. The flood characteristics are extremely “flashy”, with flood waters recently rising and receding within 8 hours. Pump stations are ideally used when flood waters are present for several days or weeks on a levee or floodwall and other means of draining stormwater on the land side of the protective structure cannot occur.