# 2009 Salt Lake Countywide Water Quality Stewardship Plan

# ADDENDUM
# STREAM FUNCTION INDEX
## Cottonwood Heights City Report

Water Quality Stewardship Plan

SALT LAKE COUNTY

# 2009
# SALT LAKE COUNTYWIDE
# WATER QUALITY STEWARDSHIP PLAN

# ADDENDUM
# STREAM FUNCTION INDEX REPORT

# Cottonwood Heights City Report


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SALT LAKE COUNTY

WATER QUALITY STEWARDSHIP PLAN

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## 1.0 INTRODUCTION

Armed with the widely supported 2009 Salt Lake Countywide Water Quality Stewardship Plan (WaQSP), regulatory and municipal authorities in Salt Lake County seek to work collaboratively to monitor and improve watershed and stream health. After examining the current conditions, numerous water quality and watershed improvement recommendations were made in the 2009 WaQSP. However, written recommendations and well laid plans are only as good as the implementation efforts that result. With the completion of the WaQSP, Salt Lake County and its partners now enter the most challenging and rewarding phase of watershed management—implementation. A key challenge in the implementation phase is to measure the success and/or failure of implementation efforts. Therefore, to inform future planning decisions, and to assure a successful, iterative, planning and implementation process, Salt Lake County developed a monitoring tool for the WaQSP known as the Stream Function Index (SFI). The SFI was developed in 2006 with the assistance of several environmental consulting firms. The primary consultant on this effort was Cirrus Ecological, based in Logan, UT.

It is anticipated that SFI data will be collected along with each update of the WaQSP that will occur every six years. It is also anticipated that reports, such as this one, will be written for each municipal government at that same frequency. Successful implementation of WaQSP recommendations should lead to improved SFI scores. However, if BMPs do not lead to improved SFI scores, they will be re-examined for effectiveness in the local environment.

Little Cottonwood Creek in Cottonwood Heights City

## 1.1 COMPONENTS OF THE STREAM FUNCTION INDEX (SFI) AND ECOSYSTEM HEALTH INDEX (EHI)

Streams and rivers, although single components of the larger watershed, may serve as indicators of overall watershed health. To maximize resources and time, Salt Lake County decided to focus on monitoring stream and river corridors to indicate overall watershed function. However, a broader examination of watershed function may be accomplished in the future with increased funds and staff. For the purposes of this document, data collected in stream and river corridors are used to indicate watershed function.

To monitor stream and river health, the SFI measures physical, chemical, biological, and social functions of stream and river corridors in Salt Lake County. The four watershed functions that are examined in the SFI include: habitat (aquatic and terrestrial), hydraulics (flood conveyance and stream stability), water quality and social (recreation and aesthetics). Metrics used to determine scores for each of the four watershed functions are included in Table 1. Recreation and aesthetics monitoring is included in the SFI to indicate the degree to which stream and river corridors provide appropriate, or resource compatible, recreation and aesthetic opportunities. However, recreational facilities may, if incompatible with the resource, detrimentally effect stream ecology.

In order to examine ecological health independent of social function, Salt Lake County created an Ecological Health Index (EHI). The EHI is a sub-component of the SFI that includes habitat, hydraulics, and water quality evaluations. The EHI may be compared with the SFI to determine possible effects of social (i.e. recreational and aesthetic) functions on stream ecology.

See the “Stream Function Index Main Report” Appendices for the complete SFI Methodology Report.

## 1.2 DATA COLLECTION

The majority of 2009 SFI numbers were based on data gathered between 2007 and 2008. However, water quality data spans a greater time period (2001 to 2008). In future SFI updates, it is anticipated that water quality data collected between updates will be used to assess stream

## Salt Lake County—Stream Function Index (SFI)
Cottonwood Heights City

| Metric | Sub-Group | Functional Group | Ecosystem Health Index | Stream Function Index |
|---|---|---|---|---|
| Pool/Riffle ratio | Stream Channel | Habitat | EHI | SFI |
| Water Depth | | | | |
| Fish Passage | | | | |
| Habitat Structures | | | | |
| Flow Diversion | | | | |
| Riparian Width | Riparian Corridor | | | |
| Riparian Density | | | | |
| | | | | |
| Floodplain Development | Flood Conveyance | Hydraulics | | |
| Floodplain Connectivity | | | | |
| Bank Stability | Stream Stability | | | |
| Hydraulic Alteration | | | | |
| | | | | |
| 303(d) list | Regulatory | Water Quality | | |
| Macroinvertebrate | Aquatic | | | |
| Total P | Monitoring | | | |
| Temperature | | | | |
| TDS | | | | |
| DO | | | | |
| *E. coli* | | | | |
| | | | | |
| Management | Aesthetics | Social | | |
| Visual Aesthetics | | | | |
| Location | Amenities (Nodes) | | | |
| Accessibility (ADA Approved) | | | | |
| Restrooms | | | | |
| Resource Compatibility (Nodes) | | | | |
| Trail Corridor | Amenities (Trails) | | | |
| Connectivity | | | | |
| Resource Compatibility (Trails) | | | | |

**Table 1. Stream Function Index Metrics Flow Chart**

health. Although previous stream stability and fish habitat assessments were conducted on a few streams and the Jordan River in the mid 1980's, the 2009 SFI represents the first comprehensive assessment of all major waterways in Salt Lake County. Therefore, this dataset is considered a baseline.

The SFI is intended to give watershed and stream managers an overview of current stream conditions. However, as improvement projects are identified, more detailed studies may be required to fully assess the condition of the stream.

Young trout in Little Cottonwood Creek in Cottonwood Heights City where irrigation return flows and springs provide some habitat after spring runoff.

## 2.0 COTTONWOOD HEIGHTS CITY—INFORMATION

City of Cottonwood Heights, located in the east-central portion of Salt Lake County, is a relatively new city (incorporated in 2005) and is home to approximately 36,016 residents. Contained within the City boundaries are sections of Big and Little Cottonwood Creeks. Additionally, portions of Lower Big and Little Cottonwood Creek sub-watersheds are also found within the City boundaries. This report summarizes the health of the stream sections within the City of Cottonwood Heights and provides guidance for future water quality improvement and watershed preservation efforts. The City of Cottonwood Heights will also receive a copy of the 2009 WaQSP Addendum Stream Function Index Main Report, and will receive electronic files of the report and Geographic Information System (GIS) shapefiles depicting information collected as part of the SFI.

Big Cottonwood Creek below the water treatment plant near the canyon mouth.

### 2.1 WATER QUALITY STRESSORS IN COTTONWOOD HEIGHTS CITY

Although the SFI is a measure of stream corridor health, it is imperative that water quality and watershed health be approached comprehensively. Therefore, this section is provided to review water quality stressors identified in the 2009 WaQSP for the sub-watersheds in Cottonwood Heights City.

As part of the 2009 WaQSP, a computer-based GIS analysis was conducted in each of the 27 sub-watersheds in Salt Lake County to determine existing and potential future water quality stressors. In Chapter 5 of the WaQSP document, these water quality stressors are outlined and Best Management Practices (BMPs) recommended to address potential concerns.

Below is a review of the stressors and recommendations identified for sub-watersheds within Cottonwood Heights City.

Water quality stressors that were identified in the Lower Big Cottonwood Creek Sub-Watershed include:

- Floodplain encroachment
- Stream flow diversions
- Lack of corridor preservation
- Lack of developed recreation opportunities
- Unstable banks
- Stream channel modification

Water Quality stressors that were identified in Lower Little Cottonwood Creek Sub-Watershed include:

- Lack of developed recreation opportunities
- Stream flow diversions
- Floodplain encroachment
- Lack of stream corridor preservation

| | | |
|---|---|---|
| **Cottonwood Heights City** | | 6,008 Acres |
| **Sub -Watersheds** | Lower Big Cottonwood Creek | 3,482 Acres |
| | Lower Little Cottonwood Creek | 2,278 Acres |
| **Streams** | Big Cottonwood Creek | 12,034 Feet |
| | Little Cottonwood Creek | 18,556 Feet |

**Table 2. Cottonwood Heights City Watershed Areas and Stream Lengths**

Management Practices that were recommended to address these potential water quality stressors include:

- Bioengineered bank stabilization
- Grade control structures
- Channel restoration/enhancement
- Streambank revegetation
- Diversion structures modification
- Canal water diversion
- Leadership in Energy and Environmental Design criteria
- Minimum flow protection
- Water rights acquisition
- Identify community recreation needs and opportunities
- Wetlands restoration/enhancement
- Manufactured treatment systems
- Participate in new and/or existing planning efforts
- Floodplain re-establishment
- Trash racks
- Land acquisition for preservation
- Volunteer programs
- Recreational facilities that are accessible and resource compatible.

Big Cottonwood Creek in Cottonwood Heights is typically dry after spring runoff due upstream diversion for its high quality water used for culinary water source.

## 3.0 STREAM FUNCTION INDEX (SFI)

Similar to the WaQSP effort to identify water quality/watershed stressors, four watershed functions were examined for each stream: water quality, habitat, hydraulics, and social/aesthetics services. In order to assess the ability of streams to provide these four functions, Salt Lake County developed what is called the Stream Function Index (SFI). The SFI is a rapid assessment protocol that assesses stream habitat, hydraulics, water quality and social factors. Based on established methodology, the SFI measures 27 metrics to determine overall stream health. These metrics are categorized by watershed function (water quality, habitat, hydraulics, social/aesthetic) and can therefore be examined individually or by functional group.

The SFI is a tool to help identify the results of water quality stressors along main stream channels and the Jordan River. These areas are candidates for enhancement projects. The SFI provides the framework for a more detailed baseline and monitoring techniques that may be used on those projects. The first complete dataset was collected during the 2007 and 2008 field seasons and is considered the baseline. The SFI will be repeated every 6 years in conjunction with the Water Quality Stewardship Plan Update.

## 4.0 WATERSHED FUNCTION GROUPS

This section summarizes scores for the four watershed functions countywide and reviews data and scores within Cottonwood Heights City boundaries. Additional information on SFI methodology can be found in the SFI Main Report.

### 4.1 WATER QUALITY FUNCTIONAL GROUP SCORE

The SFI water quality functional group is comprised of seven metrics or measures: 303(d) list status, macroinvertebrates, Total Phosphorus, Temperature, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), and Coliform (*E. Coli*). Based on 2009 SFI scores, the streams with the best water quality are concentrated in the upper regions of both the Wasatch and Oquirrh streams, with the notable exception of upper Little Cottonwood Creek (currently listed as water quality impaired by the State Division of Water Quality) for zinc. Additionally, lower Emigration Creek and Red Butte Creek received high rankings for water quality. Notably, these scores are based entirely on data contained in the Environmental Protection Agency's STORET database. Although this data represents a large portion of water quality data collected in Salt Lake County, it does not represent all data. However, it was decided that the SFI would rely on STORET data to assure consistent

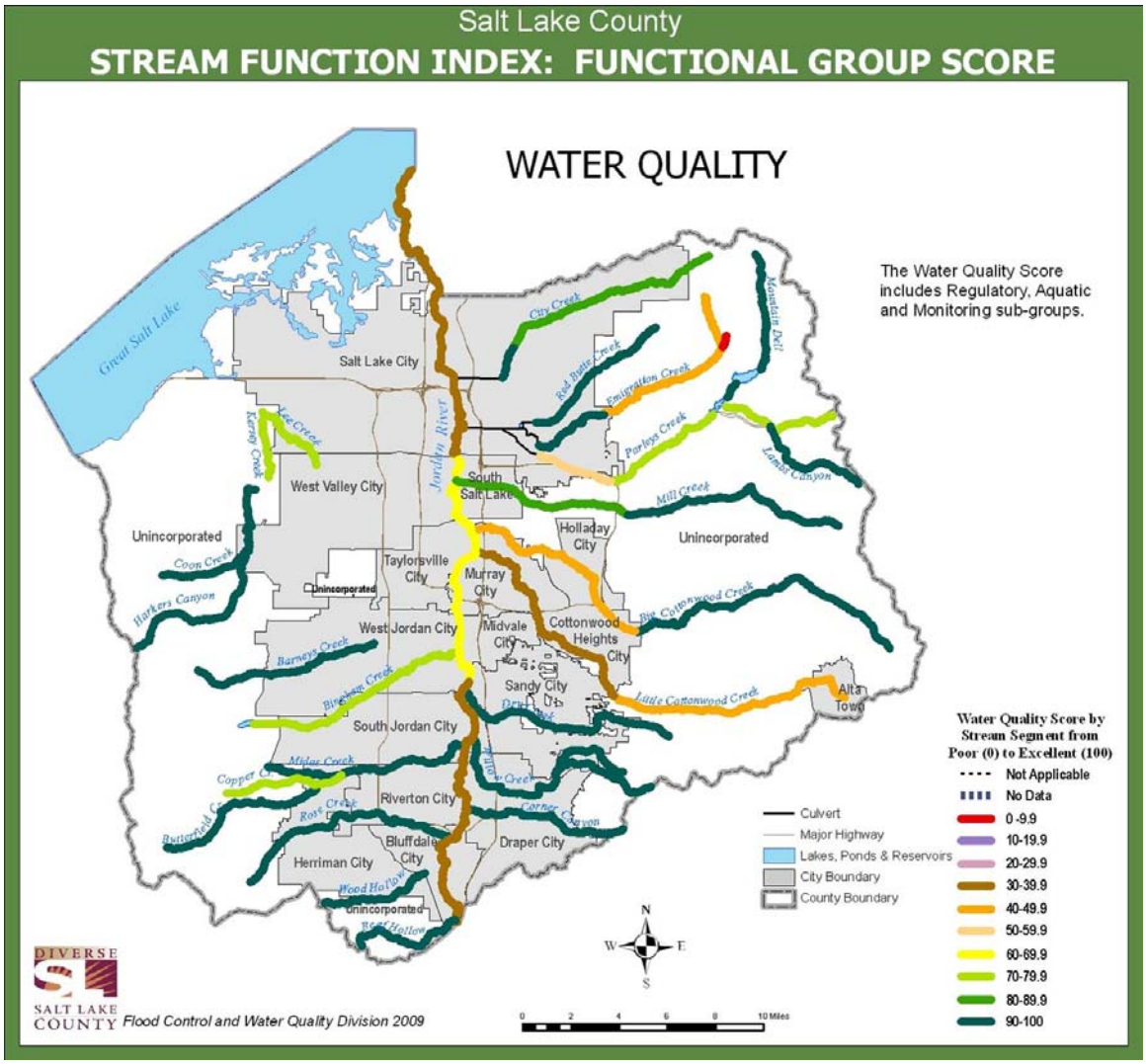


**Figure 1. Water Quality Functional Group Scores Countywide**

methodologies and that certified water quality assurance (QA) and water quality control (QC) measures were taken.

In addition to noting areas of high, or good, water quality, it is important to note areas of low, or poor water quality. As can be seen from the Countywide data presented in Figure 1, segments with low water quality values include: upper and lower Jordan River, lower and upper Little Cottonwood Creek, lower Big Cottonwood Creek, and upper Emigration Creek. All of these reaches scored as meeting water quality standards in <50% of samples taken. Many of these water quality concerns are currently being addressed through the State Division of Water Quality's (DWQ) Total Maximum Daily Load program.

Water quality concerns in the City of Cottonwood Heights occur in both Big and Little Cottonwood Creeks. Pollutants of concern include Total Dissolved Solids (TDS) and temperature for both of these streams. To address these concerns, it is recommended that the City of Cottonwood Heights actively participate in discussions regarding water right exchanges with the State Division of Water Rights (DWRi), Division of Water Quality (DWQ), Salt Lake City, and Salt Lake County to address these concerns .

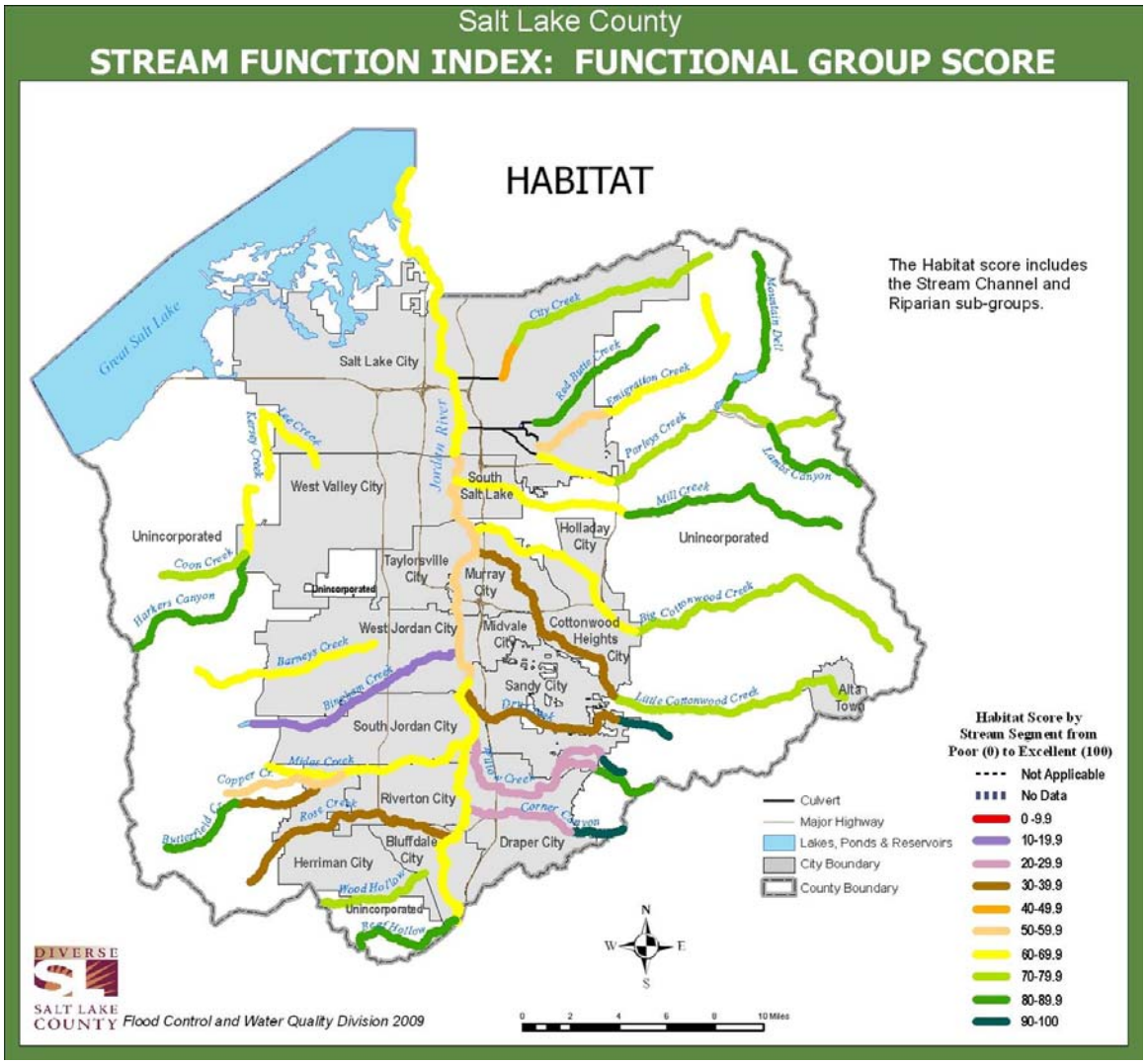


**Figure 2. Habitat Functional Group Scores Countywide**

## 4.2 HABITAT FUNCTIONAL GROUP SCORE

In the SFI, the habitat function was characterized by: pool/riffle ratio, fish passage, habitat structure, flow diversion, riparian width, and riparian density. Of note, stream channel habitat metrics were only assessed for streams that have been identified, by the State Division of Wildlife Resources (DWR) as supporting fish habitat. Flow diversion and riparian metrics were assessed for all streams.

Similar to the Water Quality Functional Group Score, the streams with the best, or highest scoring, habitat function are concentrated in the upper regions of both the Wasatch and Oquirrh mountains. However, in contrast to water quality, not all sections of upper Oquirrh Mountain streams rank high for habitat. Of note, Copper Creek and Rose Creek both scored <60% for overall habitat function. Other areas of particular habitat concern include lower Big and Little Cottonwood Creeks and the section of Butterfield Creek upstream from its confluence with Midas Creek.

As can be seen from Figure 2, the City of Cottonwood Heights contains sections of Big (60 to 69.9) and Little Cottonwood (30 to 39.9) Creeks that received relatively poor ratings for habitat function. Both streams received low scores for flow diversion; however, the other metrics were variable between streams. Recommendations to improve habitat function will be further explored in the following sections that examine specific habitat concerns.

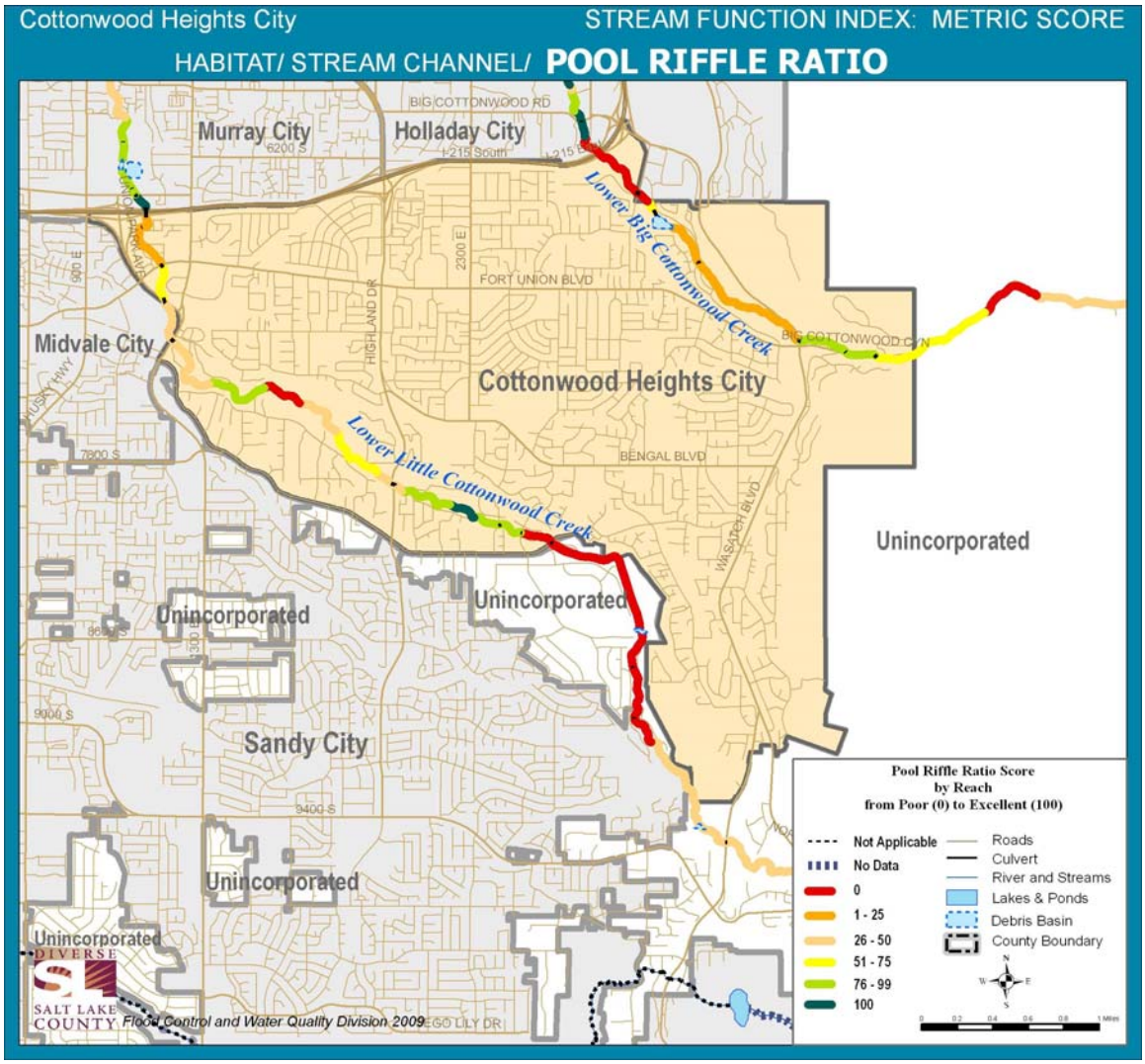


**Figure 3. Habitat Function—Pool/Riffle Ratio in Cottonwood Heights City**

### 4.2.1 Pool/Riffle Ratio in Cottonwood Heights City

An important component of stream habitat function is the ratio between pools and riffles. For the SFI, the number of pools and riffles were counted for each stream reach. Pools were defined as mid-channel areas with low velocity that were at least 1 foot deep. Riffles were defined as mid-channel shallow turbulent areas of high velocity. The number of pools was compared to the expected number for the given stream type (see SFI Main Report for an explanation of stream type.) Subsequently, the pool/riffle ratio was determined. A score of "Not Applicable" (N/A) indicates that the stream does not support a fishery.

As can be seen in Figure 3, sections of both Little and Big Cottonwood Creeks through the City of Cottonwood Heights contain areas that scored extremely low for pool/riffle ratio (0). Additionally, a large section of Big Cottonwood Creek through the City of Cottonwood Heights scored between 1 and 25 for this metric.

To address pool/riffle ratio concerns, it is recommended that the City of Cottonwood Heights work with both Midvale City and the County to identify opportunities for stream restoration and enhancement efforts.

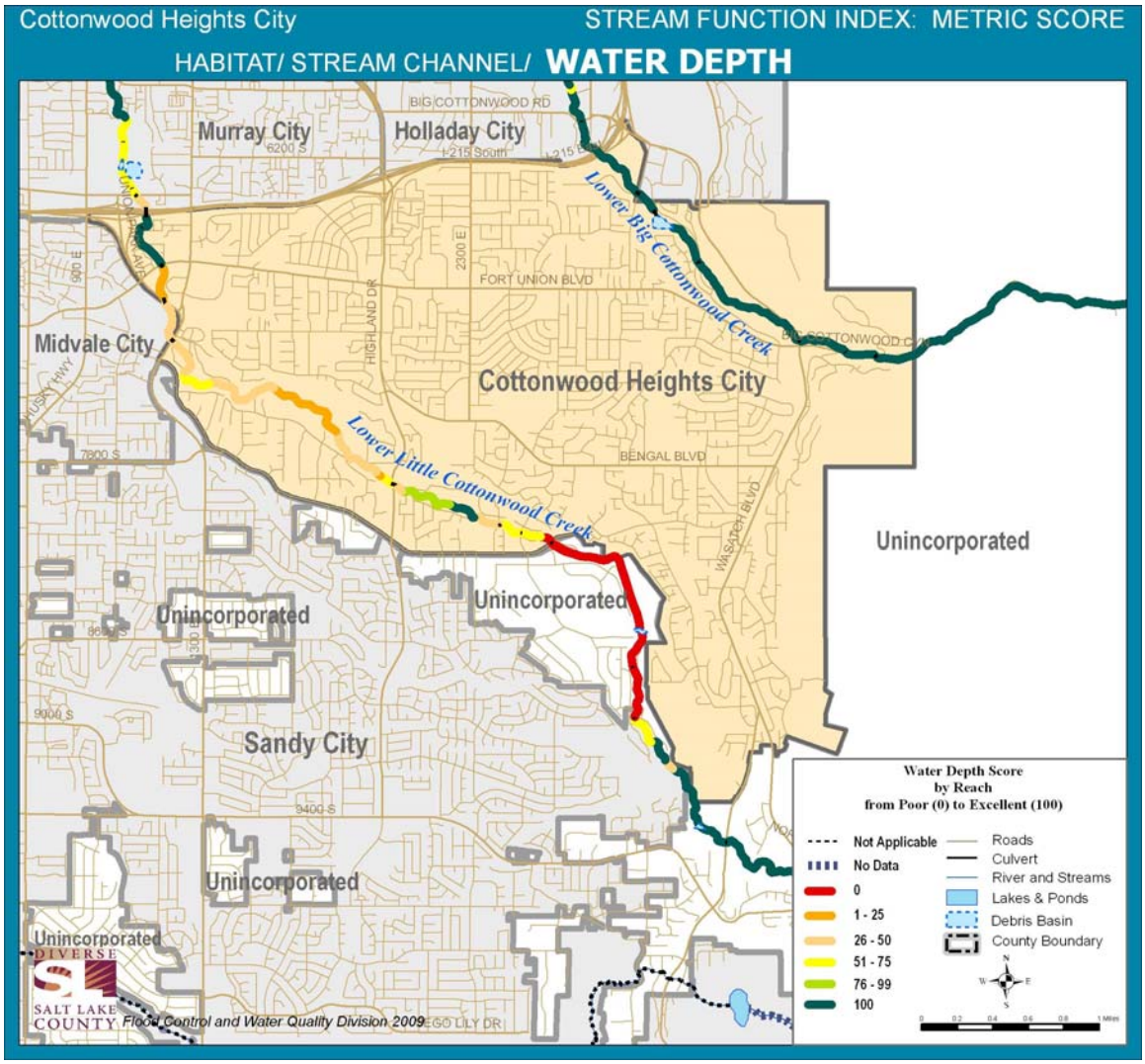


**Figure 4. Habitat Function—Water Depth in Cottonwood Heights City**

### 4.2.2 Water Depth in Cottonwood Heights City

In Salt Lake County, many streams have experienced altered or reduced stream flow or may naturally have minimal stream flow. In order to assess the extent to which streams have sufficient water depth to support aquatic habitat, Salt Lake County staff measured stream depth at representative locations within each stream reach during late summer low flow. Targets for this metric were set based on minimum depth requirements for trout and native sucker species established by the Utah Division of Wildlife Resources (DWR).

As can be seen in Figure 4, the section of Big Cottonwood Creek through the City of Cottonwood Heights scored well for this metric (100). However, based on field observations over a period of years, this, this score is not typical, Normally, this section of Big Cottonwood Creek is dry in late summer. Little Cottonwood Creek through Cottonwood Heights scored much lower (between 1 and 51).

In order to improve water depth in Little Cottonwood Creek, it is recommended that the City of Cottonwood Heights work closely with the State Division of Water Rights (DWRi), Salt Lake City, Salt Lake County, and other water rights holders to identify opportunities to increase flow through this section of Little Cottonwood Creek. Additionally, stream restoration/enhancement projects may alter the stream geometry and consequently improve water depth.

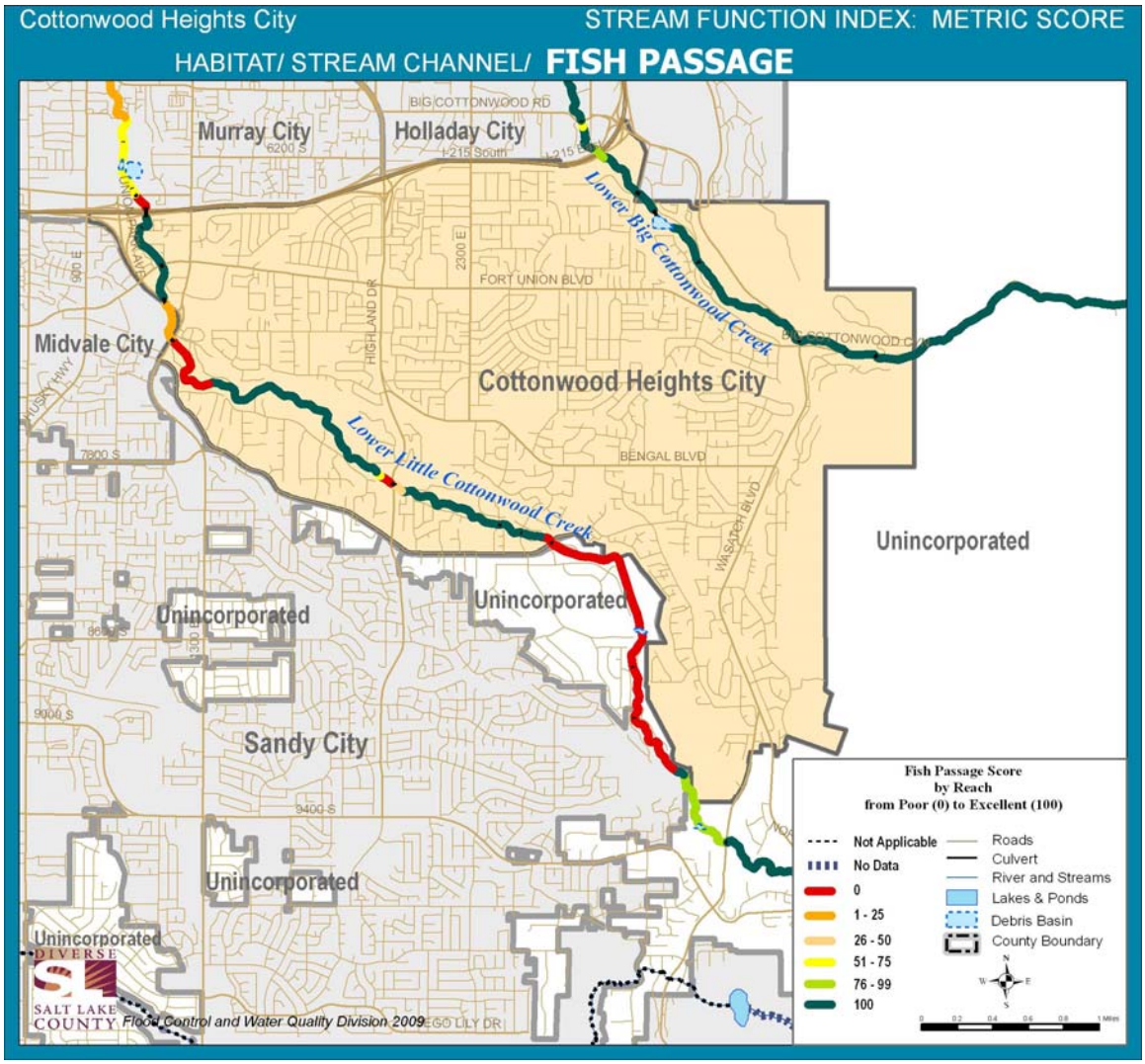


**Figure 5. Habitat Function—Fish Passage in Cottonwood Heights City**

### 4.2.3 Fish Passage in Cottonwood Heights City

For the purposes of the SFI, fish passage was scored based on the distance between barriers to fish passage. Barriers were tallied for each stream reach and analyzed for overall function during late summer low flow. Barrier criteria included height of barrier, depth of plunge pool, water depth, and beaver dam density. The optimum value for this metric was to have at least 1/4 of a mile between barriers.

As can be seen from Figure 5, the sections of Big and Little Cottonwood Creeks that run through Cottonwood Heights scored very high for fish passage (100). Of note, however, are several sections of Little Cottonwood Creek that scored between 0 and 25.

To address fish passage concerns in these areas, it is recommended that the City of Cottonwood Heights partner with State and local agencies to identify opportunities to retrofit existing barriers to accommodate passage. Additionally, it is recommended that the City of Cottonwood Heights work closely with developers and other regulatory agencies to assure that any new instream structures accommodate fish passage.

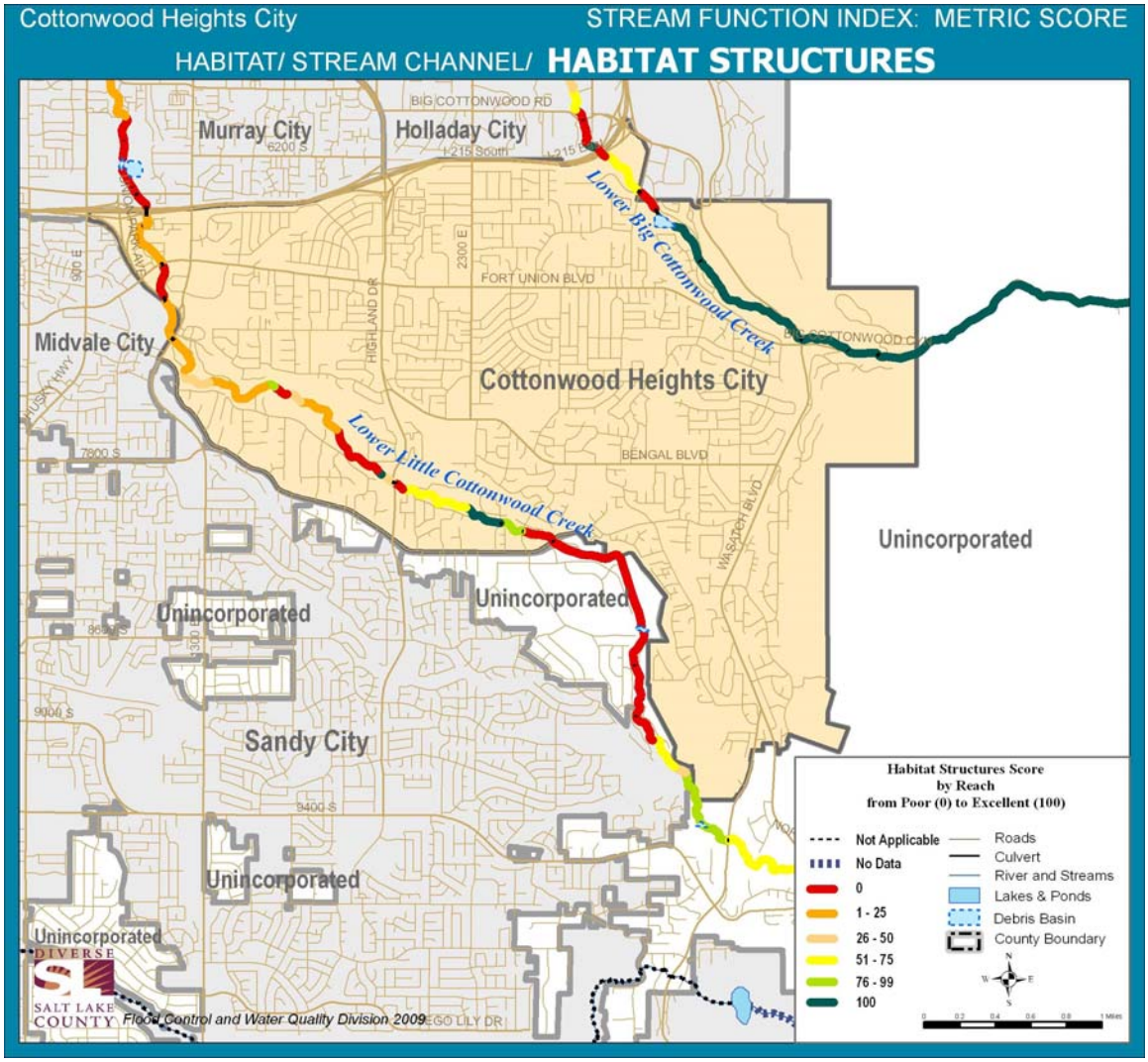


**Figure 6. Habitat Function—Habitat Structures in Cottonwood Heights City**

### 4.2.4 Habitat Structure in Cottonwood Heights City

For the purposes of the SFI, habitat structures are defined as instream natural, or man-made, objects that provide cover, resting, and feeding resources for fish species. To measure the function of habitat structures, the number of embedded logs, rootwads, boulders, undercut banks, beaver dams, and man-made structures were tallied for each reach. Targets were set based on the number of habitat structures anticipated to occur in specific stream types.

As can be seen from Figure 6, the majority of Big Cottonwood Creek scored very high (100) for this metric. There was one small section of Big Cottonwood that scored extremely low (0). The majority of little Cottonwood Creek, on the other hand, scored low (between 0-25).

Recommended actions to improve habitat structure resources in the City of Cottonwood Heights include: participating in discussions regarding opportunities to accommodate flood control, water rights, recreation, and habitat needs and seek opportunities to improve this metric. As with many metrics, habitat structures are essential to stream function, but need to be balanced with other stream functions.

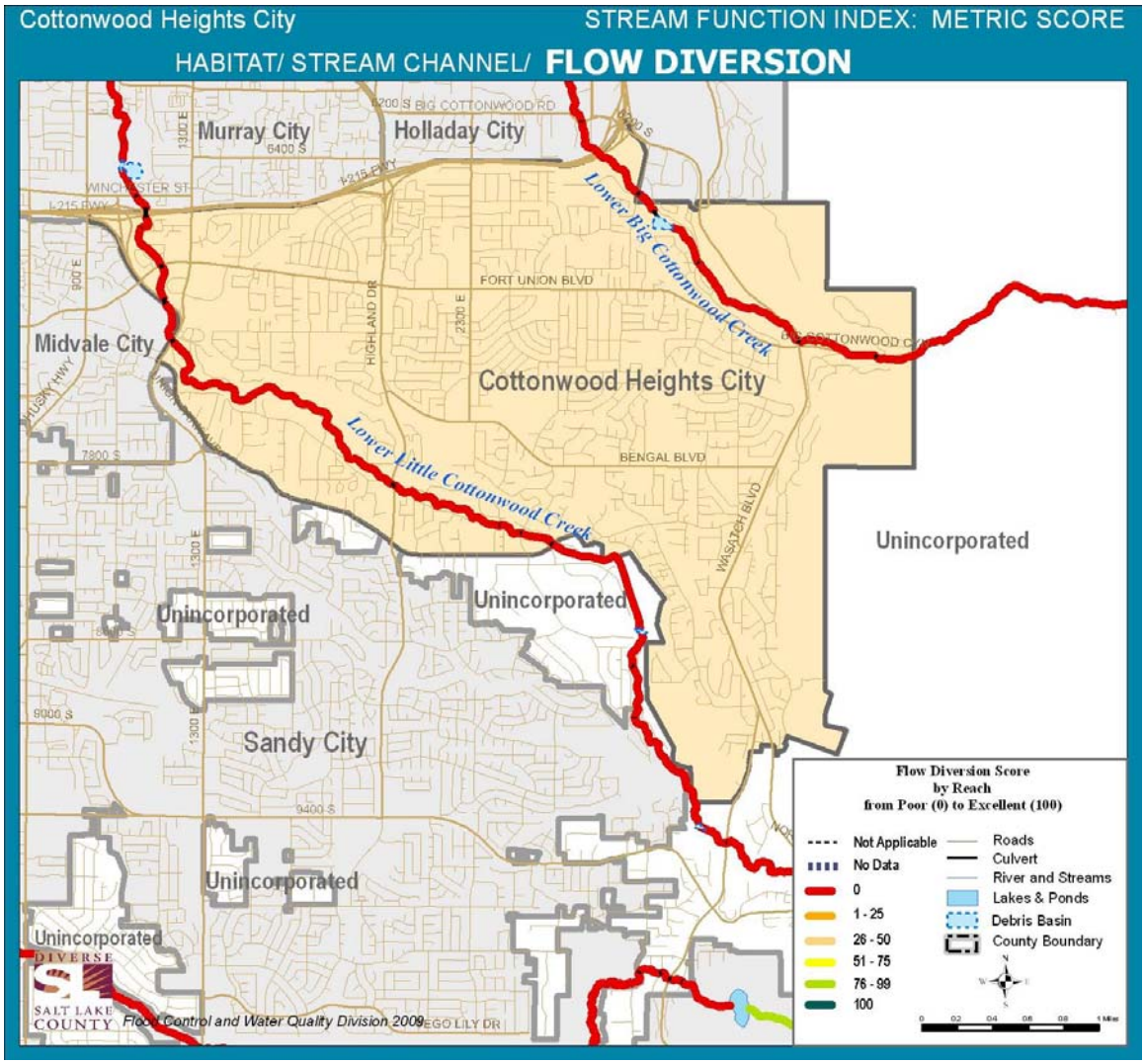


**Figure 7. Habitat Function—Flow Diversion in Cottonwood Heights City**

### 4.2.5 Flow Diversion in Cottonwood Heights City

In the arid environment of Salt Lake County, many streams have been greatly impacted due to altered surface and groundwater flows. To include potential effects on habitat in the SFI, Salt Lake County developed a flow diversion metric. The flow diversion metric measured the degree to which natural surface stream flows have been reduced or interrupted. This metric includes both the amount of time over a year and the length of stream that is maintaining natural flows. The target for this metric was set at 100%, i.e. a natural flow for 100% of the year.

As can be seen in Figure 7, Big and Little Cottonwood Creeks that run through the City of Cottonwood Heights both scored 0 for this metric.

To maintain water depth in Big Cottonwood Creek and to enhance water depth in Little Cottonwood Creek, it is recommended, that the City of Cottonwood Heights participate in discussions with the State Engineer's office, Salt Lake City, and Salt Lake County to identify opportunities for flow augmentation. Additionally, it is recommended that the City of Cottonwood Heights actively monitor any new water diversion applications for these streams.

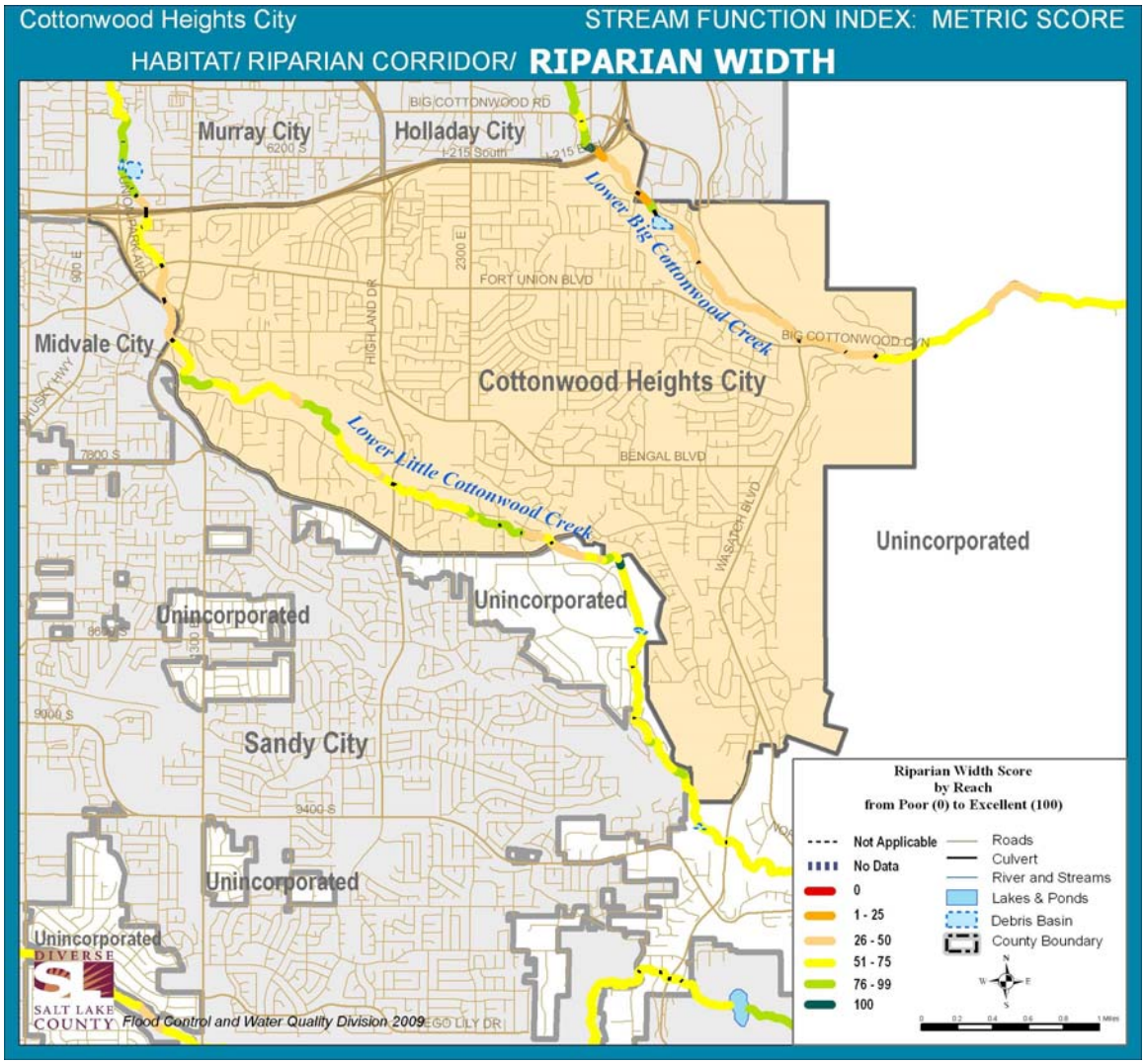


**Figure 8. Habitat Function—Riparian Width in Cottonwood Heights City**

### 4.2.6 Riparian Width in Cottonwood Heights City

The SFI also examined habitat beyond the stream channel with Riparian habitat metrics. The first metric examined was the width of riparian corridors. For the purposes of the SFI, riparian width was measured as the continuous and contiguous areas of uninterrupted vegetation growth along streams. The target riparian width was established by Salt Lake County to be 100 feet, i.e. ideally, all streams/river in the County would be bordered on both sides by 100 feet of uninterrupted vegetative growth. The actual amount of riparian vegetation was then compared with the target.

As can be seen in Figure 8, the majority of Big and Little Cottonwood Creeks scored between 26 and 75 for riparian width. Generally, Big Cottonwood Creek scored lower for this metric than Little Cottonwood; however, opportunities for improvement exist on both creeks.

To improve riparian habitat function of the streams Cottonwood Heights, it is recommended that: the City of Cottonwood Heights pass a land use ordinance to limit development within 100 feet of streams and river (this may also be included in development codes), and again work with other authorities to promote vegetative growth along the streams and river. Although much of these areas is already developed, such a land use ordinance would prevent further inappropriate development and provide opportunities for improved stream compatibility with re-development projects.

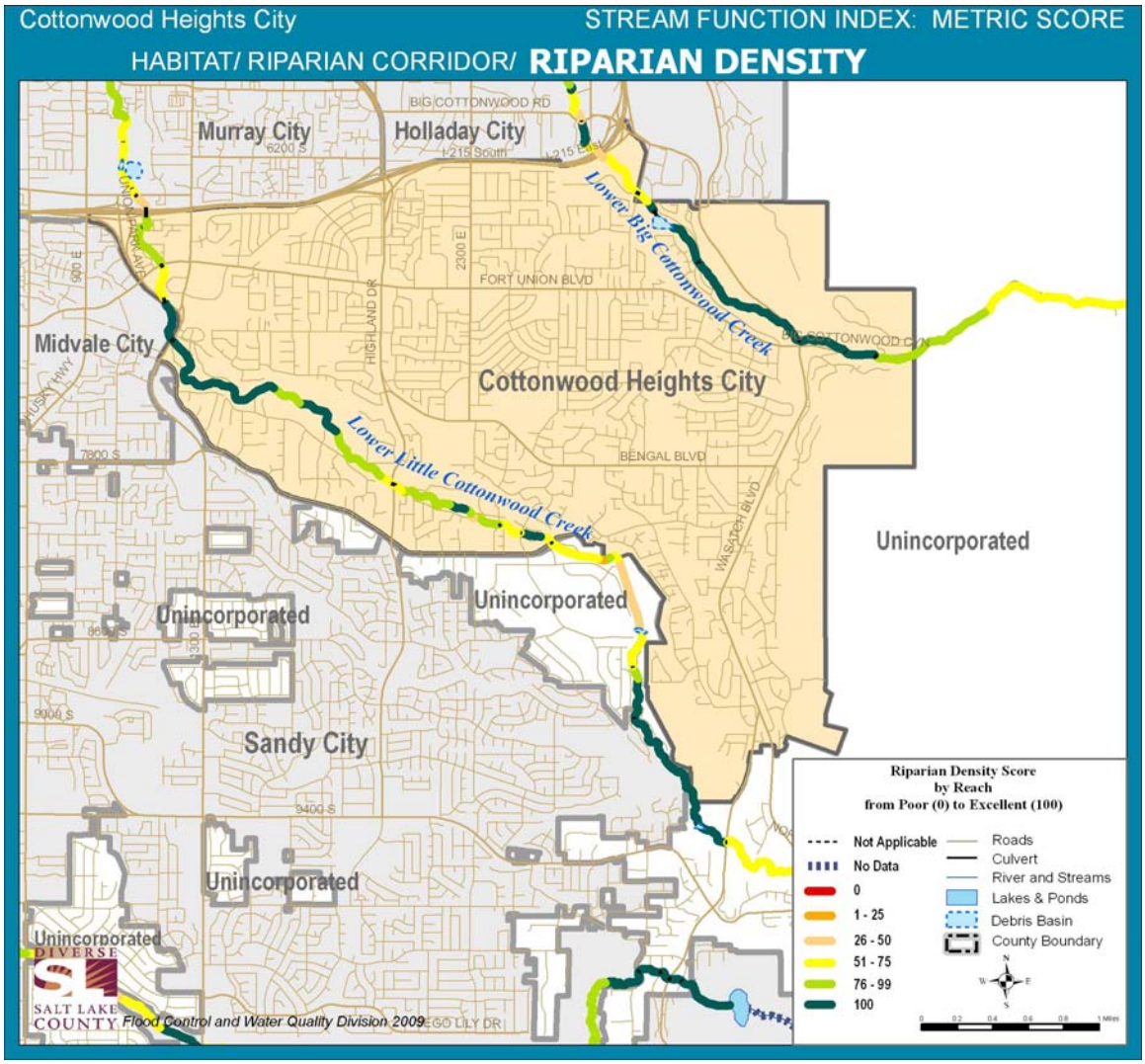


**Figure 9. Habitat Function—Riparian Density in Cottonwood Heights City**

### 4.2.7 Riparian Density in Cottonwood Heights City

In addition to riparian width, the density of riparian vegetation is a strong indicator of overall stream health. This metric scores the percent coverage of the canopy, middle story, and understory to determine overall riparian density. As opposed to examining species, this metric assumes that the highest functioning riparian areas will have at least 80% coverage at all levels of the canopy.

As can be seen in Figure 9, the sections Big and Little Cottonwood Creeks within the City of Cottonwood Heights boundary generally scored between 51 and 100 for this metric—indicating that in general existing riparian communities have good vegetative coverage.

For areas scoring below 76, it is recommended that the City of Cottonwood Heights work with local landowners as well as other State and local authorities to identify areas that may be candidates for re-vegetation projects or management practices that will enhance riparian vegetative community growth. In addition to working with local landowners and other authorities, it is recommended that the City of Cottonwood Heights actively seek management practices that will encourage growth of riparian vegetation.

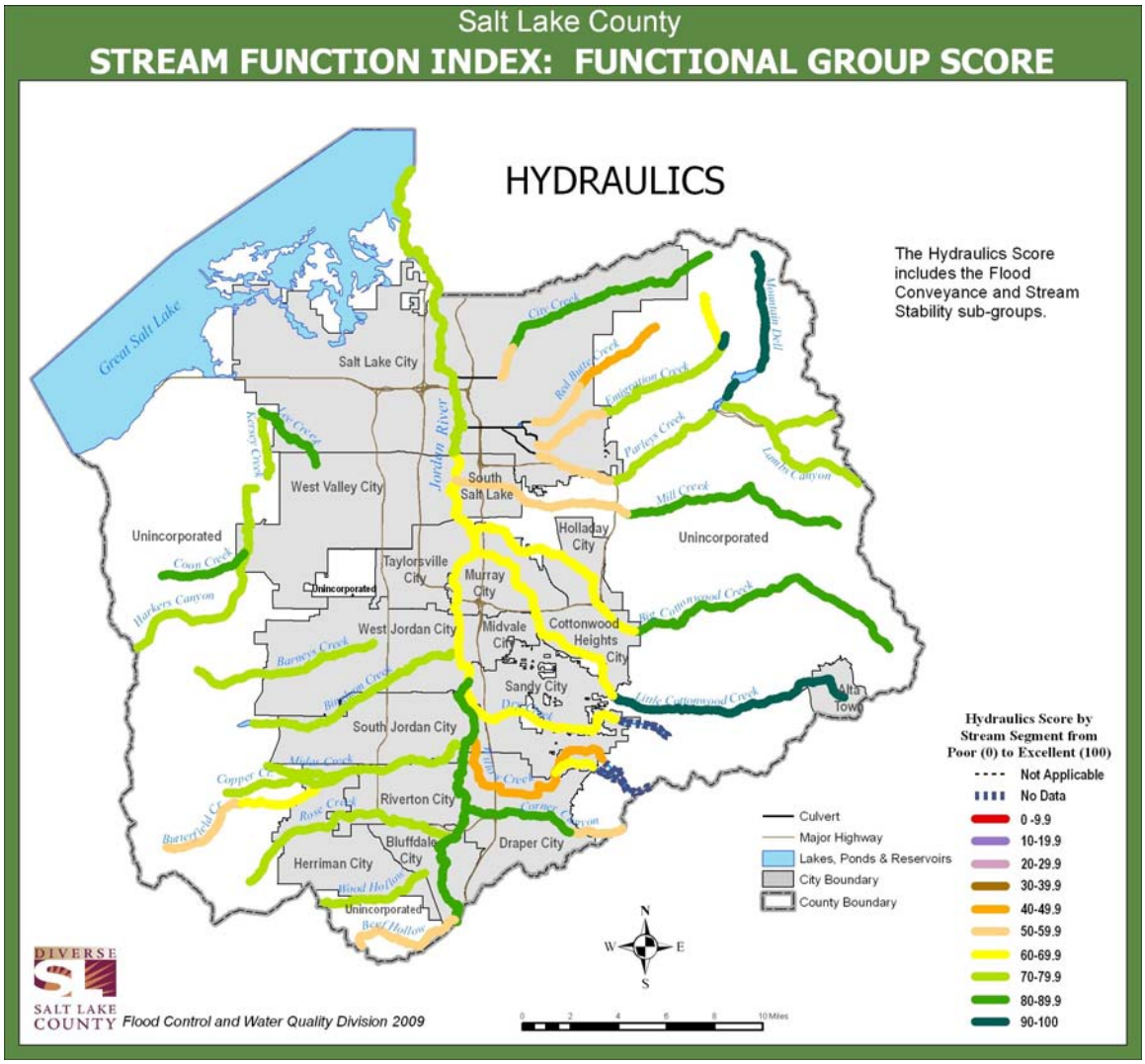


**Figure 10. Hydraulics Functional Group Scores Countywide**

## 4.3 HYDRAULICS FUNCTIONAL GROUP SCORE

The third watershed function examined for the purposes of the SFI was hydraulics function. This functional group is comprised of four metrics: floodplain development, floodplain connectivity, bank stability and hydraulic alteration.

As can be seen in Figure 10, the majority of streams in Salt Lake County scored > 50 for the hydraulics function; however, an appropriate target for this functional group is closer to 75. Countywide, the streams with low hydraulics function scores were concentrated in the lower sections of the Wasatch Mountain streams. Namely, City Creek, Red Butte Creek, Emigration Creek, and Parley's Creek showed low hydraulics function. This may be due to the highly developed nature of these streams and the extensive culverts on each of them.

The sections of Little and Big Cottonwood Creeks within the City of Cottonwood Heights scored moderately high for hydraulics function (between 60 and 69.9). Although these scores are moderately high, some opportunities for improvement may exist. Therefore, the following information is provided to review hydraulics function metrics to assist in the identification of opportunities.

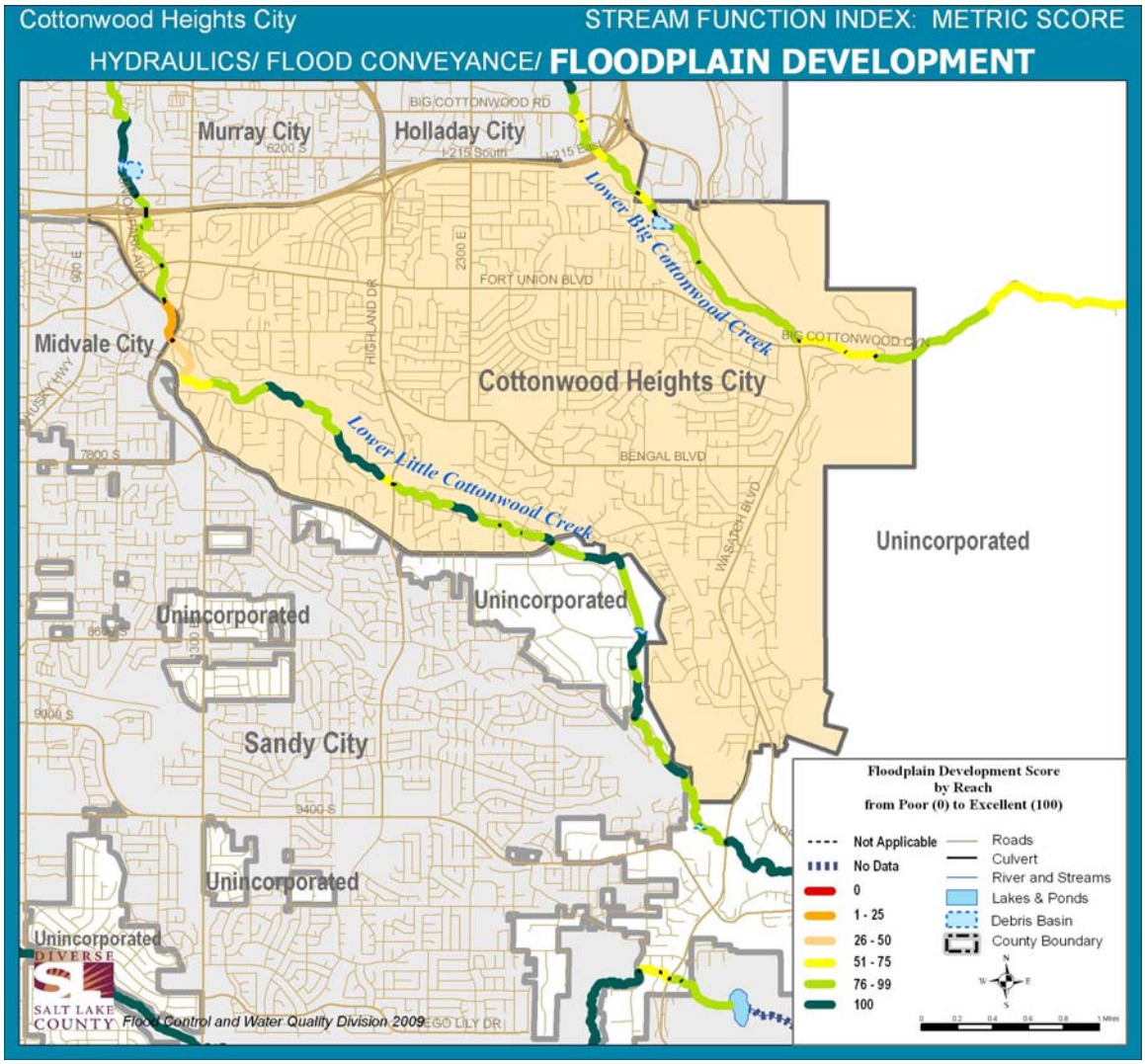


**Figure 11. Hydraulics Function—Floodplain Development in Cottonwood Heights City**

### 4.3.1 Floodplain Development in Cottonwood Heights City

The floodplain development metric evaluates the percent of impervious surface within the 100 year floodplain as defined by the FEMA Flood Insurance Program. For the purposes of the SFI, the target was that 100% of the floodplain be pervious, or free from development that would limit groundwater infiltration.

As can be seen in Figure 11, the majority of the section of Little Cottonwood Creek through the City of Cottonwood Heights scored high with several sections meeting the target. Overall, Big Cottonwood scored lower, with areas scoring between 51-99. The lack of impervious surfaces along sections of Little Cottonwood Creek presents a great opportunity for Cottonwood Heights to preserve hydraulic function.

To keep inappropriate development out of both Little and Big Cottonwood Creek corridors, it is recommended that the City of Cottonwood Heights adopt land use ordinances, or incorporate into the Cities development code, regulations that will limit impervious surface area along streams within City boundaries. In areas that are already developed, such as Little Cottonwood Creek, it may take decades or longer until redevelopment occurs to see improvements in this metric score.

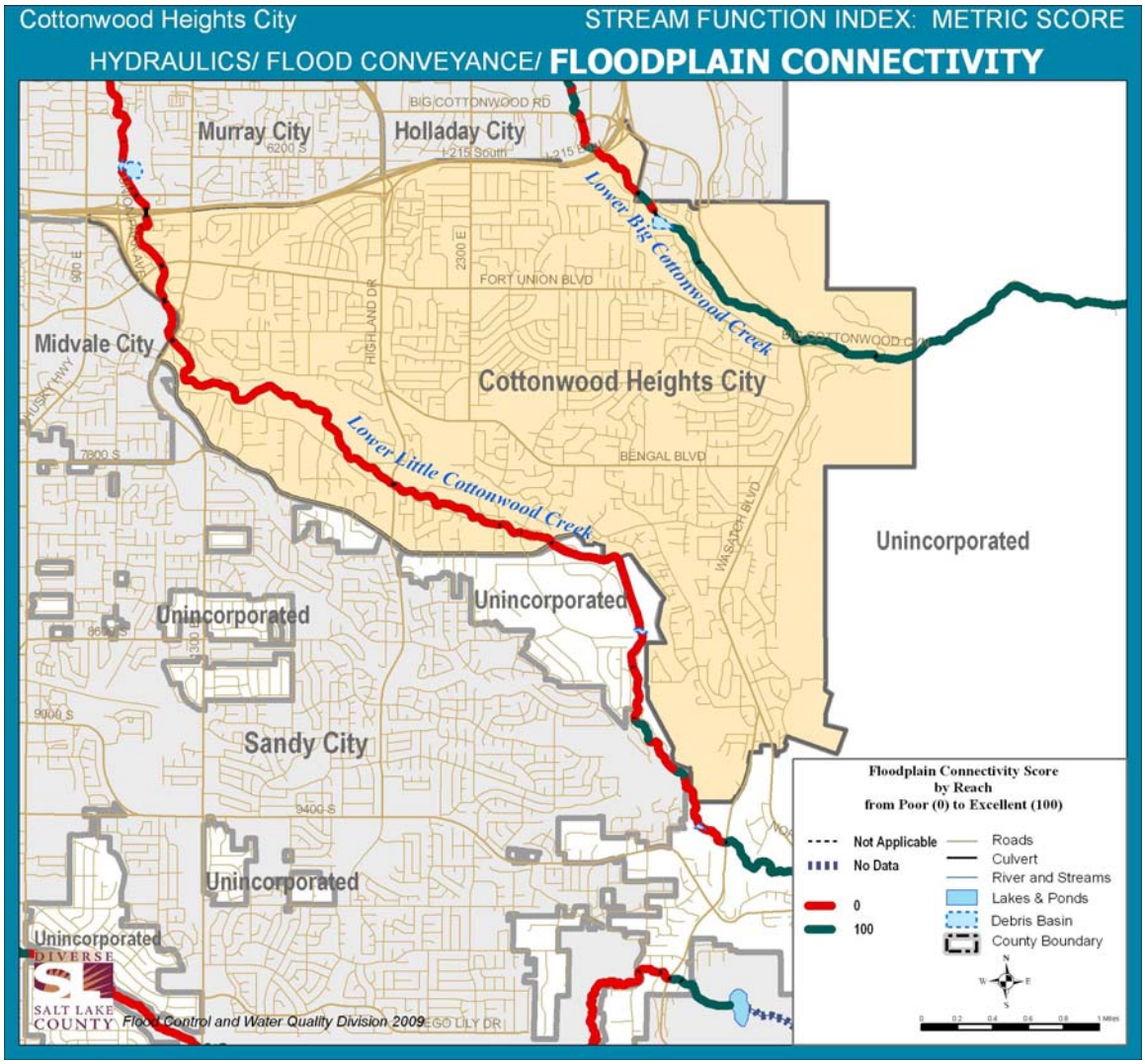


**Figure 12. Hydraulics Function—Floodplain Connectivity in Cottonwood Heights City**

### 4.3.2 Floodplain Connectivity in Cottonwood Heights City

The floodplain connectivity metric is essentially a measure of stream entrenchment (or eroded streambed). Entrenchment disconnects the stream from its historic floodplain, lowers the water table, and increases the intensity of flood events. For the purposes of the SFI, floodplain connectivity was measured and scored against targets established by stream type (see SFI Main Report.) Any score falling within the appropriate entrenchment range for a stream type was given a score of 100. If the entrenchment ratio was outside the appropriate range, the reach was given a score of 0.

As can be seen in Figure 12, the section of Little Cottonwood Creek through the City of Cottonwood Heights scored low for this metric (0); whereas, the majority of Big Cottonwood Creek scored high (100). Notably, this is similar to the floodplain development scores for these creeks.

To address concerns observed along Little Cottonwood, and to protect Big Cottonwood Creek, it is again recommended that the City of Cottonwood Heights partner with other authorities to conduct stream/river restoration efforts that may reconnect the stream with its historic floodplain. Salt Lake County has successfully used an emergent bench design for similar sections of the Jordan River (see Figure 18 on page 22).

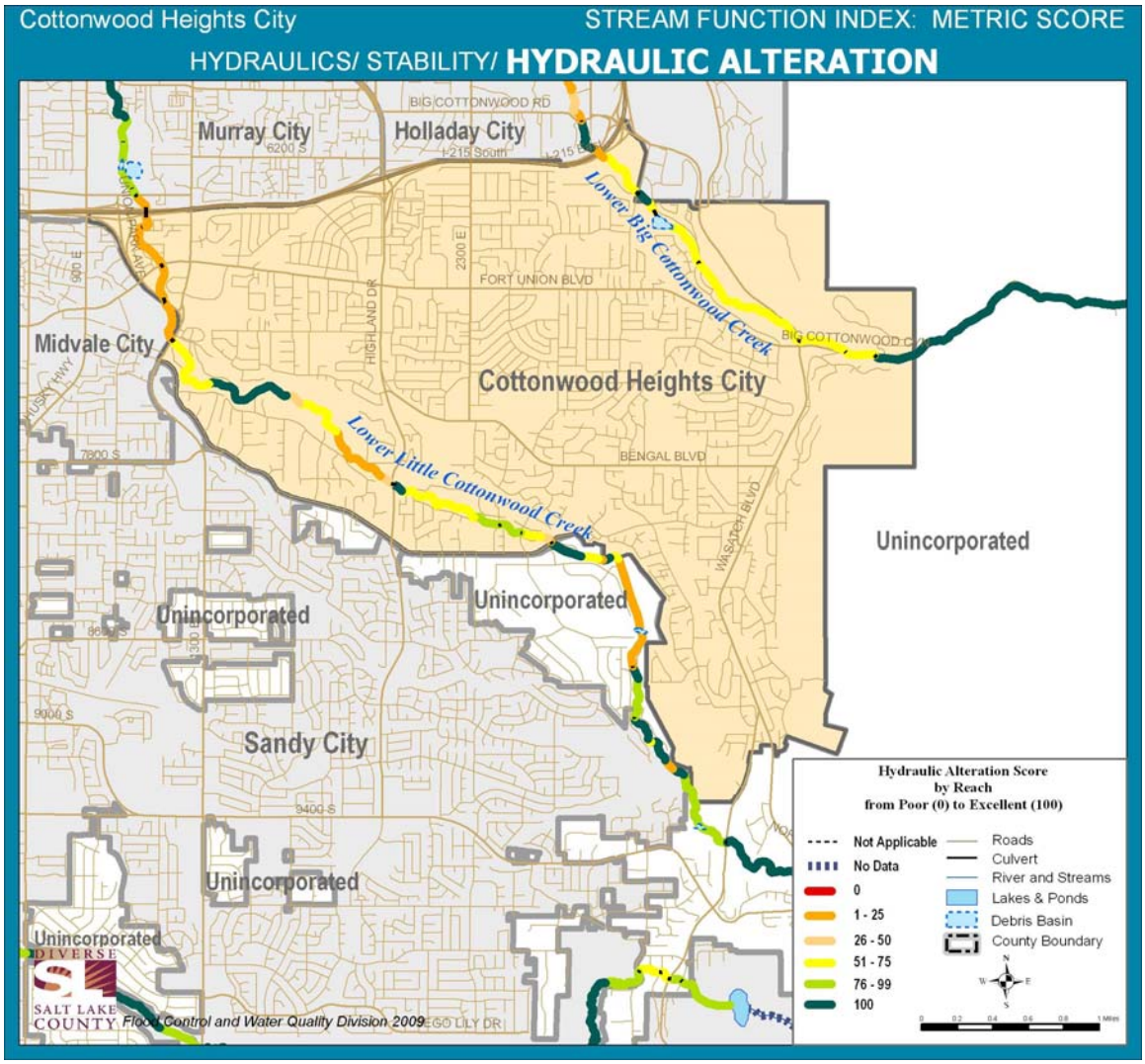


**Figure 13. Hydraulics Function—Hydraulic Alteration in Cottonwood Heights City**

### 4.3.3 Hydraulic Alteration in Cottonwood Heights City

Although bank stability is key to the hydraulics function of an urban stream, artificial bank configurations that reduce riparian and floodplain areas and the types of artificial materials used may cause stability and habitat problems. For the SFI, hydraulic alteration was evaluated as the percent of culverts and man-made bank stabilization structures and built with materials such as concrete riprap or gabion baskets within a reach. The percent was based on visual observation by field personnel and computer-aided mapping of culverts.

As can be seen in Figure 13, the section of Big Cottonwood Creek within the City of Cottonwood Heights had hydraulic alteration scores primarily between 51 and 75. Little Cottonwood Creek scores varied more (ranging between 1 and 100).

To mitigate problems that may result from hydraulic alteration, it is recommended that the City of Cottonwood Heights work with Salt Lake County's Flood Control Division to identify opportunities for improvement of existing stability structures. Stability structures in poor condition may be updated with new methods and materials to appear and function more natural.

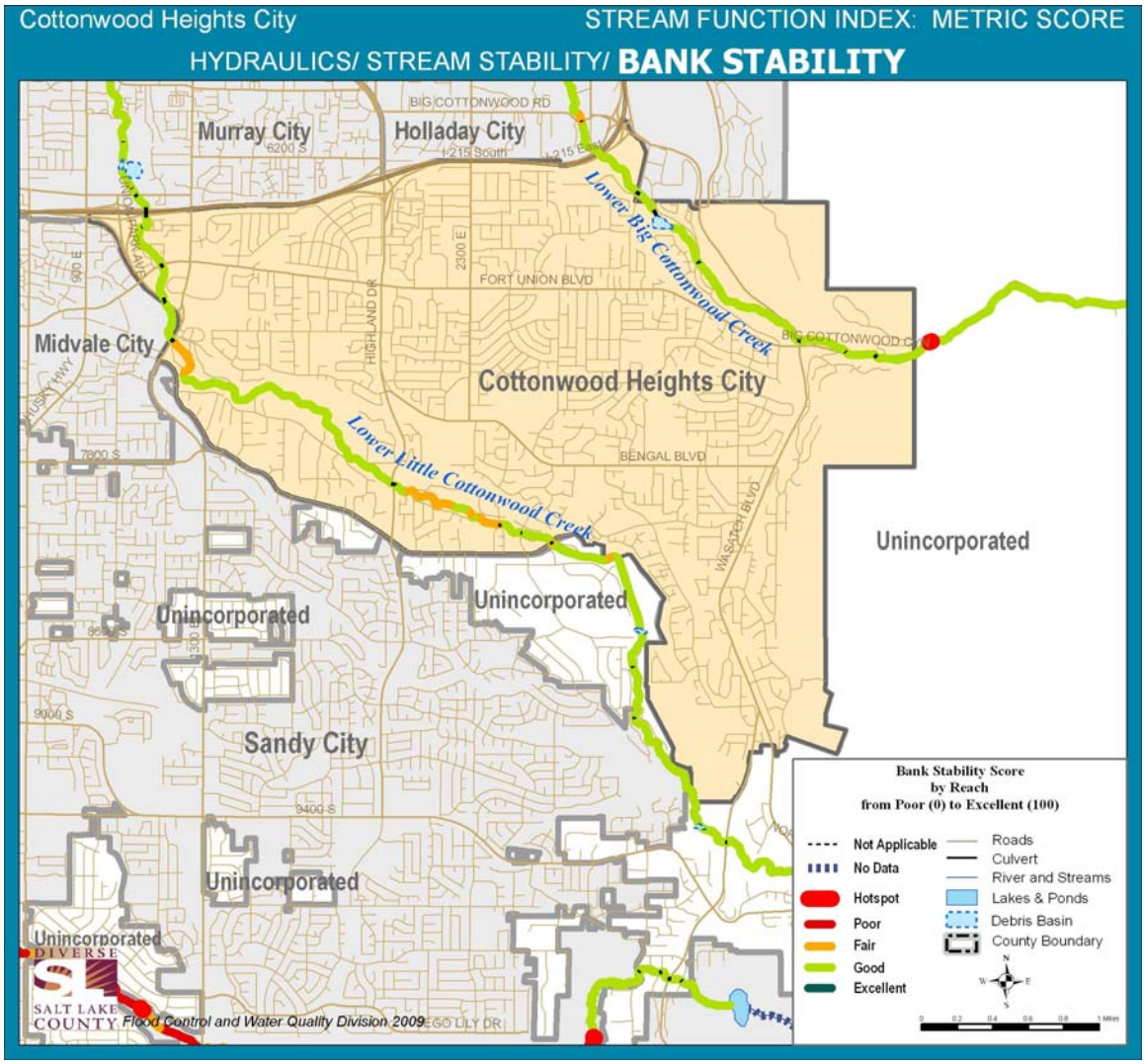


**Figure 14. Hydraulics Function—Bank Stability in Cottonwood Heights City**

### 4.3.4 Bank Stability in Cottonwood Heights City

In addition to measuring the condition and frequency of man-made stability structures in Salt Lake County's streams and river, an established bank stability method was also employed to characterize overall stream stability.

The Pfankuch Stream Stability Evaluation protocol—developed for the U.S. Forest Service—was slightly modified for use on the urban streams of Salt Lake County. Although the Pfankuch rating is only one of the metrics contained in the SFI, it, in itself, examines 18 stream characteristics. This metric therefore contains abundant information that may be used in stream restoration and enhancement projects. "Hot spots", or actively eroding sites, were also identified and mapped. Although the presence of a hot spot did not contribute directly to the score, they give an indication of where to perhaps prioritize bank stabilization projects.

As can be seen in Figure 14, the majority of Big Cottonwood Creek within the City of Cottonwood Heights' boundaries scored "Good" on the Pfankuch stability scale. Although a score of "Excellent" would be ideal, a "Good" score is considered acceptable. Several reaches of Little Cottonwood Creek scored "Fair" for stability and should be examined for restoration opportunities.

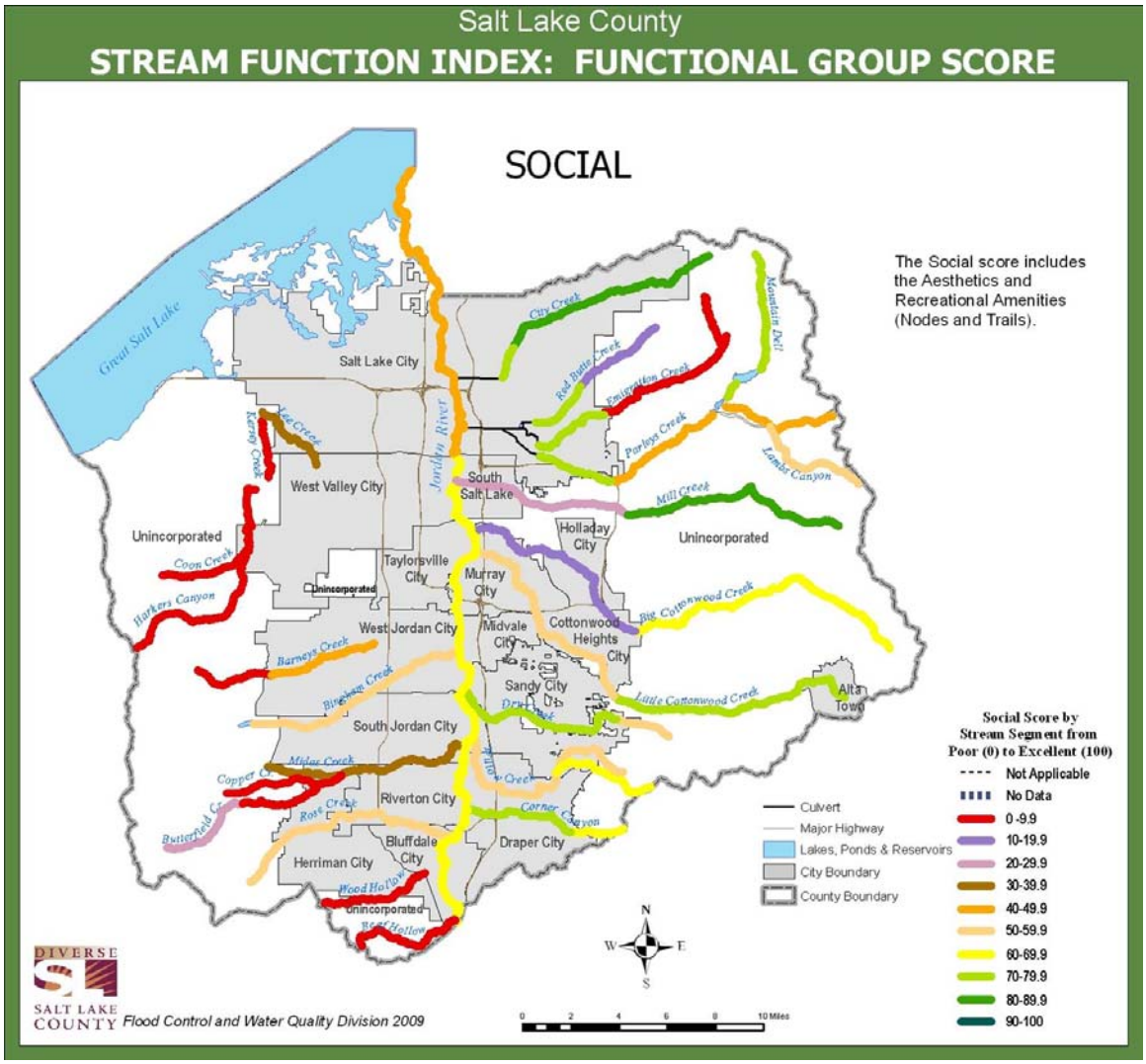


**Figure 15. Social Functional Group Scores Countywide**

## 4.4 SOCIAL FUNCTIONAL GROUP SCORE

Social watershed function was measured by examining recreational facilities: management, aesthetics, location, Americans with Disabilities Act (ADA) compatibility, restroom facilities, trail connectivity, and resource compatibility.

Social function is probably the most difficult function to measure because there is a broad range of preferences by recreationists for different types of facilities. Therefore, the SFI focused on assessing the availability of all types of recreation facilities along the waterways, the minimum requirements for a positive user experience, and impact that the use of those facilities may have on the stream ecosystem. Although recreation may have detrimental impacts on stream and river corridors, it is the opinion of Salt Lake County staff that the best way to promote stewardship of local resources is to provide appropriate facilities and access.

As can be seen in Figure 15, the sections of Big and Little Cottonwood Creeks through the City of Cottonwood Heights had relatively low scores for social function (between 10 and 59.9). This is likely due to the large amount of private land along these stream corridors.

To enhance public access to Big and Little Cottonwood Creeks, and to encourage stewardship, it is recommended that the City of Cottonwood Heights work with local land owners and nonprofit organizations to identify potential partnerships for increased recreational access and/ or fee title purchase of private lands.

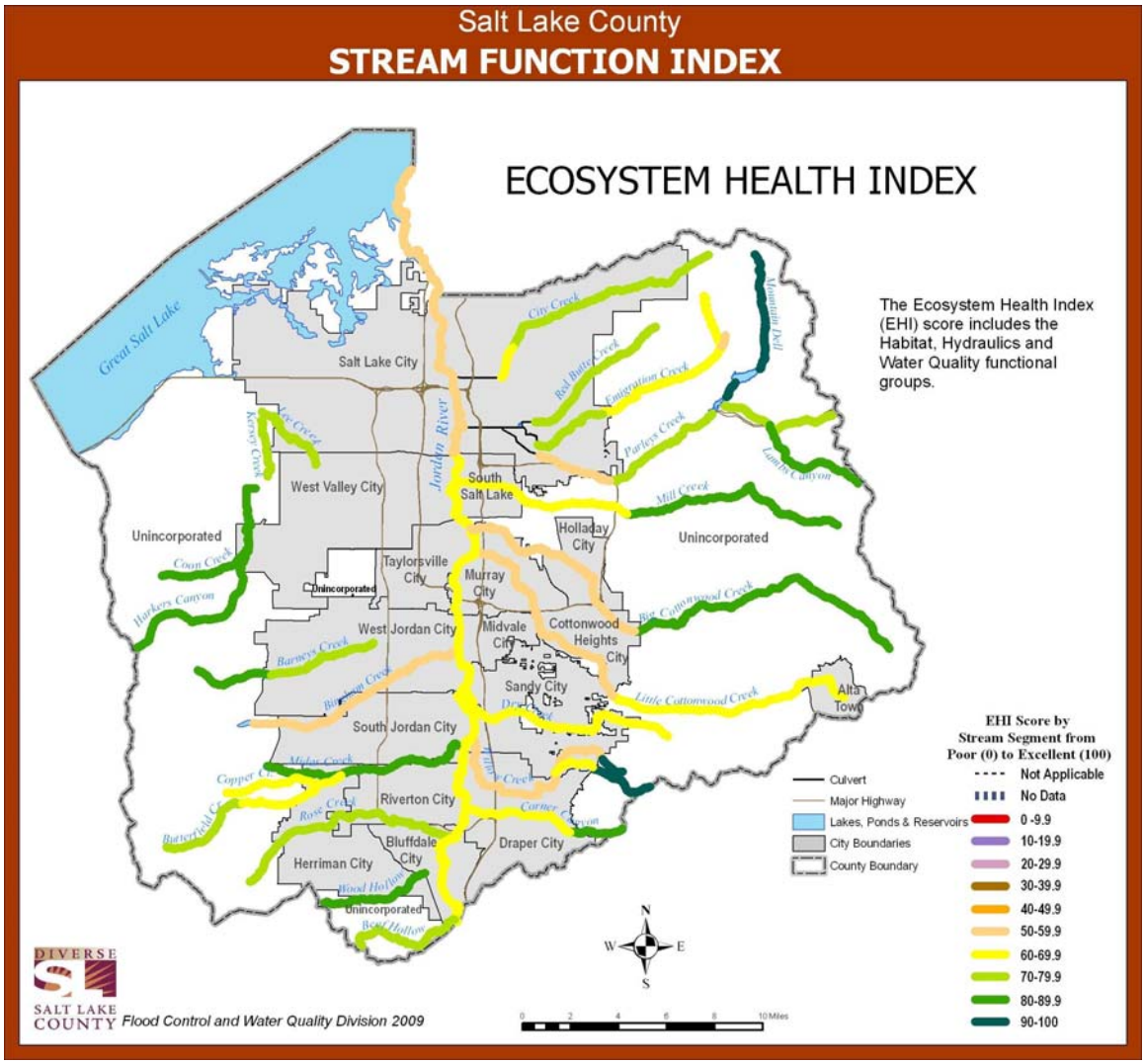


**Figure 16. Ecosystem Health Index (EHI) Final Score 2009**

## 5.0 ECOSYSTEM HEALTH INDEX (EHI) - COTTONWOOD HEIGHTS CITY

In order to determine the physical, chemical, and biological health of streams in Salt Lake County, the County has developed an Ecosystem Health Index (EHI) score. This score is meant to reflect the ecological health of the stream. Although the County's position is to promote responsible and appropriate recreational access along the stream corridors, it is also understood that recreational activities may counteract ecological function. Therefore, it is important to examine the combined EHI score outside of the overall Stream Function Index (SFI) score which includes the Social Function.

As can be seen in Figure 16, sections of Big and Little Cottonwood Creeks within the City of Cottonwood Heights boundary scored between 50 and 59.9. Numerous management practices may be employed to raise these scores; however, the lowest scoring metrics appear to be in the water quality functional group as well as hydraulics metrics.

To address these concerns, it is recommended that the City of Cottonwood Heights partner with adjacent cities and other agencies to identify opportunities to improve instream flows and address water quality concerns. Additionally, it is recommended that the City of Cottonwood Heights establish zoning ordinances and/or regulations that will limit development along their streams.

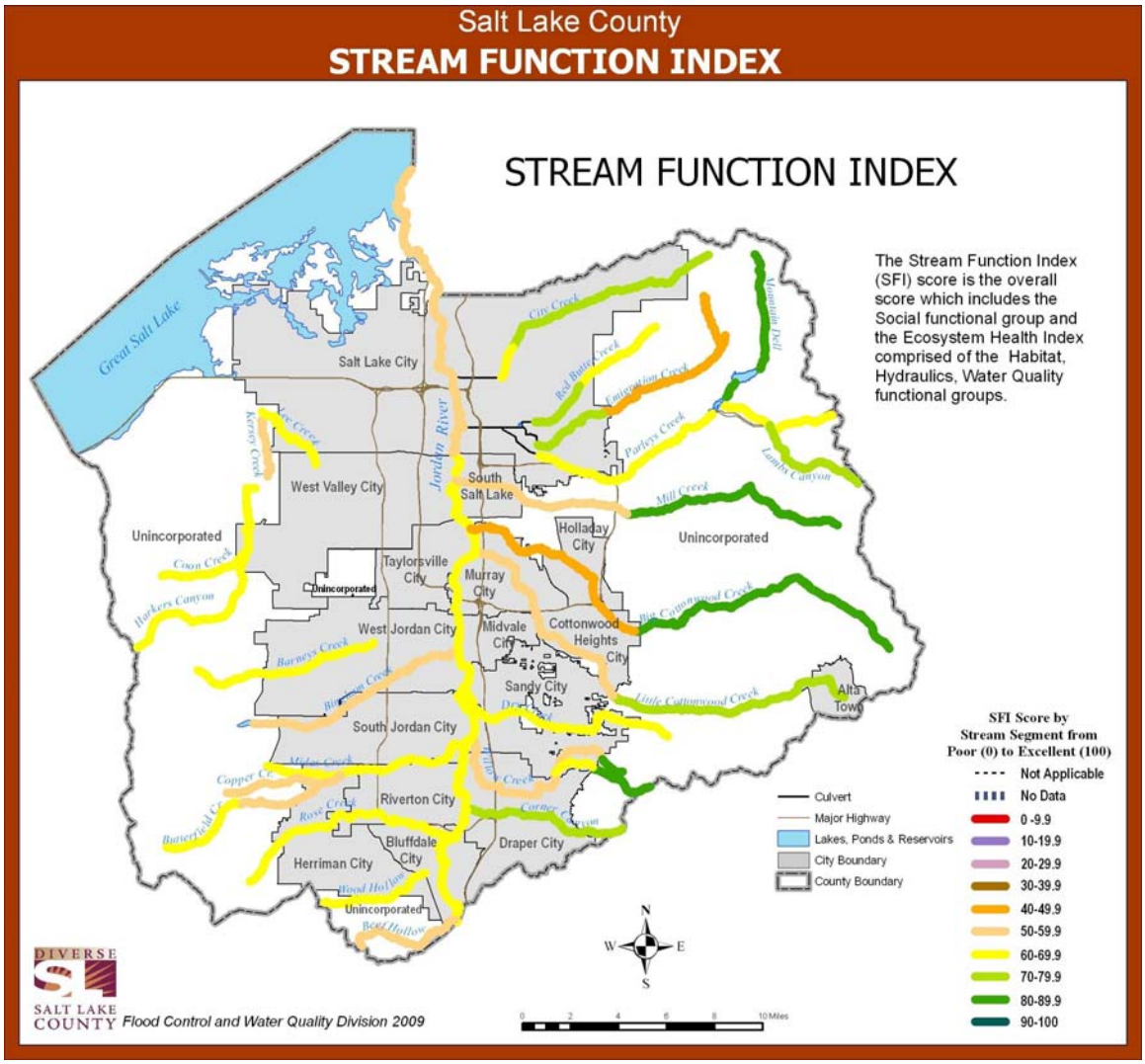


**Figure 17. Stream Function Index (SFI) Final Score 2009**

## 6.0 STREAM FUNCTION INDEX (SFI) - COTTONWOOD HEIGHTS CITY

To include social/recreational functions in the overall SFI score, Salt Lake County combined the EHI with social scores.

As can be seen in Figure 17, sections of Big and Little Cottonwood Creeks through the City of Cottonwood Heights scored between 40 and 59.9 for overall stream function—including social function. Therefore, many opportunities exist to improve stream function in both creeks. By partnering with other municipal governments, residents, and State and local authorities to implement recommendations contained in this document, the City of Cottonwood Heights may drastically improve both the health of these streams as well as the quality of life for its residents.

## 7.0 IMPLEMENTATION

Because many of the recommendations included in this document suggest stream/river restoration efforts, this section is written to provide some general guidelines/suggestions with such projects.

### 7.1 SITE IDENTIFICATION

Salt Lake County encourages local cities to consult the data collected as part of the SFI effort to identify appropriate restoration sites. In addition to the GIS data that each city will be provided, Salt Lake County staff are available for consultation and assistance with grant application efforts.

### 7.2 PLAN DEVELOPMENT

Salt Lake County has used an "Emergent Bench" design for restoration projects along the Jordan River (Figure 18). This design is appropriate for reaches with large easements/access. If easements are not available, other designs may need to be developed. Currently, Salt Lake County is working to develop ideas for entrenched, urban reaches.

### 7.3 FUNDING

As with most municipal functions, a major hurdle to stream/river restoration projects is funding. Some municipalities have elected to use stormwater utility fees or bond efforts to fund such projects. However, the majority of projects that have been completed in Salt Lake County have relied heavily on Federal grants. Fortunately, numerous Federal grants are available to support stream restoration efforts. However, the cost of site identification and plan development usually fall to the sponsoring agency.

Although application deadlines and typical amounts awarded vary greatly, there are some common characteristics of successful grant applications:

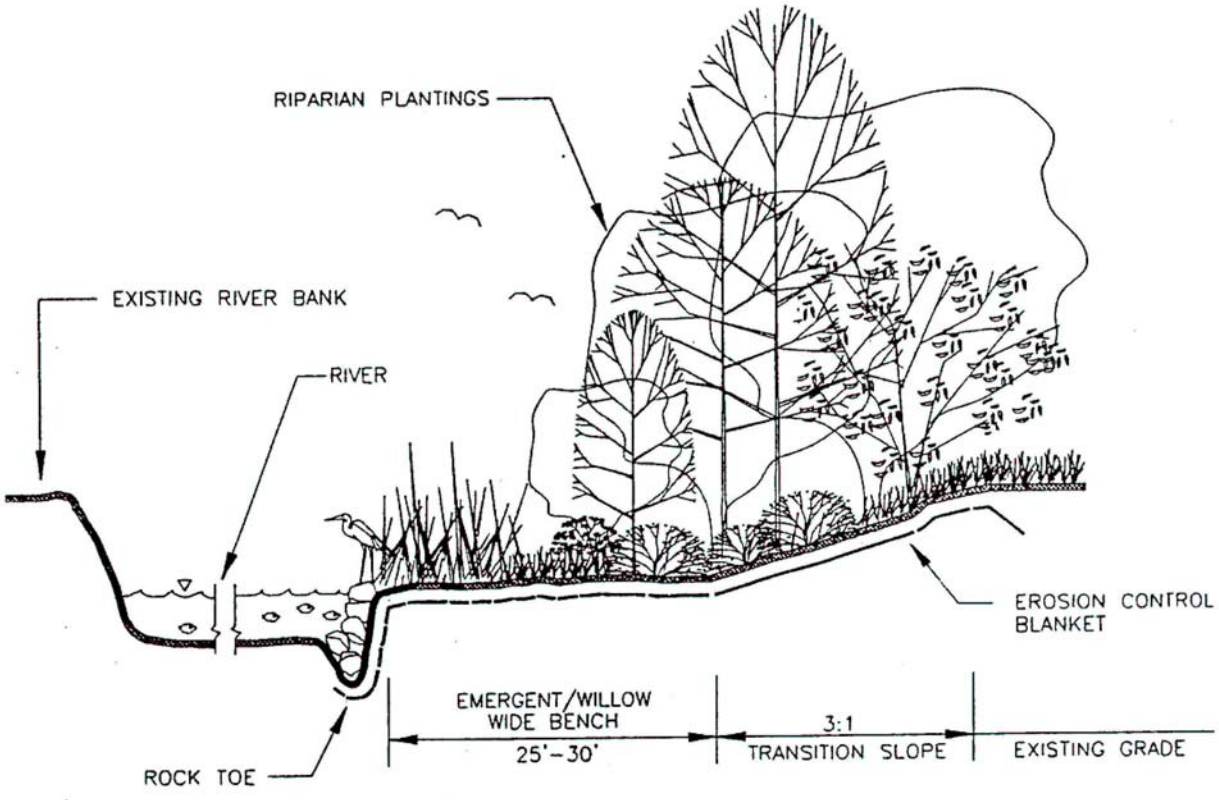


**Figure 18. Diagram of Emergent Bench design used along the Jordan River**

- A clear, precise work plan
- Demonstrated involvement of many partners
- Inclusion of a monitoring effort
- Strong financial match

A list of some grants that may be appropriate are provided in Table 3, Grants for Stream and River Restoration Projects.

## 7.4 PLAN IMPLEMENTATION

With robust planning, established partnerships, and sufficient funding, stream and river restoration efforts may be highly successful. However, some pitfalls do exist. Things to be aware of during a stream restoration effort:

- Flow diversions may occur unexpectedly. Please assure that all permits (namely stream alteration and flood control permits) have been acquired and appropriate entities notified to avoid the unexpected destruction of restoration work.

- Order your plant and rock material early as many of these materials are in high demand.

- Notify the public. Although stream and river restoration efforts are a great benefit to the local stream health, the process of restoration may at times appear destructive. Post notices explaining the project in order to prevent public misunderstanding.

- Allow enough time. As with most projects, stream and river restoration projects may take longer than expected. Be sure to plan for unexpected delays in your scheduling.

- We're not the only ones that love trees. In many of the restoration efforts that Salt Lake County has overseen, beaver activity has been highly destructive. Be sure to consult local experts to prevent the destruction of your newly planted trees.

## 7.5 POST-CONSTRUCTION

One of the most important components of a successful stream or river restoration project is the long-term maintenance of the restoration site. Especially in the arid Salt Lake Valley, be sure to plan for irrigation of planted vegetation and weed control to assure that the monies spent on the restoration project are used to their fullest extent; budgeting for a two-year vegetation establishment period is ideal.

Example of before (above) and after (right) river restoration project completed in 2009 using Emergent Bench model along the Jordan River. This site in Riverton will be irrigated for 2 years to establish vegetation.

| GRANT | SPONSOR | ELIGIBLE | TYPES OF PROJECTS | MATCH | $ RANGE | DEADLINE | MORE INFORMATION |
|---|---|---|---|---|---|---|---|
| Targeted Watershed Grant | Environmental Protection Agency (EPA) | States, local governments, public and private nonprofit institutions/ organizations, federally recognized Indian tribal governments, U.S. territories or possessions, and interstate agencies. | **Eligible Activities**<br>Activities that will result in the protection, and restoration of a watershed that incorporates a watershed-based approach, and meets the prescribed criteria.<br>**Ineligible**<br>- Development of TMDLs<br>- Phase II Stormwater Projects<br>- Construction of buildings or major structures<br>- Purchase of equipment of machinery<br>NOTE: Watershed nominations must be submitted by either a Governor or a Tribal Leader. | 25% Non-federal match | 2005 Grants ranged from $600,000 to $850,00 | Typically October through November | http://www.epa.gov/twg |
| Environmental Education Grants | Environmental Protection Agency (EPA) | Local education agency, state education or environmental agency, college, or university, not-for-profit organization as described in section 501(C)(3) of the Internal Revenue Code, noncommercial educational broadcasting entity, tribal education agency (which includes school and community colleges controlled by an Indian tribe, band, or nation) | Environmental education projects that enhance the public's awareness, knowledge, and skills to help people make informed decisions that affect environmental quality. | 25% Non-federal match | Applications may be up to $50,000; however, typical awards are between $15,000 and $20,000 | Typically in December | http://www.epa.gov/ enviroed/grants.html |
| Aquatic Ecosystem Restoration (Section 206 of WRDA) | | Nonprofit Groups, Conservation District, Water and Wastewater Utilities, Local Government, State/ Territorial Agency | | 35% Non-federal match | Typical awards are ~$300,000 | None - these allocations are through Section 206 of the WRDA | www.usace.army.mil/ cw/ |
| Conservation Security Program | Note: Upper Weber has received this | The agricultural operation must be privately owned land or Tribal land, the majority of which must be located within a selected priority watershed. The applicant must be in compliance with highly erodible and wetland compliance provisions, have an active interest in the agricultural operation, and have control of the land for the life of the contract. The applicant must share in the risk of producing any crop or livestock and be entitled to a share in the crop or livestock marketed from the | Financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. | None required | Not available; however, in FY 2007 this program was awarded $259 Million | 1. The CSP sign-up will be offered in selected priority watersheds across the Nation.<br>2. Producers completed a self-assessment to determine eligibility.<br>3. Eligible producers within these watersheds submit an application.<br>4. Base on the application, description of conservation activities, and a follow up interview, the Natural Resources Conservation Service | www.nrcs.usda.gov/ programs/csp |

**Table 3. Grants for Stream and River Restoration Projects**

| GRANT | SPONSOR | ELIGIBLE | TYPES OF PROJECTS | MATCH | $ RANGE | DEADLINE | MORE INFORMATION |
|---|---|---|---|---|---|---|---|
| Conservation Security Program - Continued | | operation. There are certain tier eligibility and contract requirements, as well:<br>-For Tier I, the producer must have addressed soil quality and water quality for eligible land uses on part of the agricultural operation prior to application.<br>-For Tier II, the producer must have addressed soil quality and water quality for eligible land uses on the entire agricultural operation prior to application and agree to address one additional resource concern by the end of the contract period.<br>-For Tier III, the producer must have addressed all resource concerns to a resource management system level for all eligible land uses on the entire agricultural operation and adequately treat riparian zones before application into the program. | | | | (NRCS) will determine which program tier and enrollment category are available for the applicant. | |
| Environmental Quality Incentives Program (EQIP) | | Business, Community/Watershed Group, Nonprofit Groups, Educational Institution, Private Landowner, Water and Wastewater Utilities, State/ Territorial Agency, Tribal Agency, Agricultural producers who face serious threats to soil, water, and related natural resources, or who need assistance with complying with Federal and State environmental laws. A participant may be an owner, landlord, operator, or tenant of eligible agricultural lands. Limited resource producers, small-scale producers, producers of minority groups, Federally recognized Indian tribal governments, Alaska natives, and Pacific Islanders are encouraged to apply. | These contracts provide incentive payments and cost-shares to implement conservation practices. Persons who are engaged in livestock or agricultural production on eligible land may participate in the EQIP program. | Typically 25 to 50% | Limited to $10,000 per person per year and to $50,000 over the length of the contract.<br>Not available in FY 2007 this program was awarded $739 Million | | http:// www.nrcs.usda.gov/ programs/equip |
| Five-Star Restoration Program | | Business, Community/Watershed Group, Nonprofit Groups, Educational Institution, Private Landowner, Conservation District, Water and Wastewater Utilities, Local Government, State/Territorial Agency, Tribal Agency | | Typical projects include at least five diverse partners. Most partnerships contribute more than $40,000 for every $10,000 Five Star grant. | Typically range between $5,000 and $20,000 | Typically in February or March | http://www.epa.gov/ owow/wetlands/ restore/5star/ index.html |

**Table 3. Grants for Stream and River Restoration Projects (continued)**

| GRANT | SPONSOR | ELIGIBLE | TYPES OF PROJECTS | MATCH | $ RANGE | DEADLINE | MORE INFORMATION |
|---|---|---|---|---|---|---|---|
| Land and Water Conservation Fund (Outdoor Recreation, Acquisition, Development and Planning Grants) | National Park Service (NPS) | Local Government, State/ Territorial Agency, Tribal Agency | | | Typically range between $1,000 and $3 million - median is $150,000 | | http://wwwnps.gov/nrc/programs/lwcf/ |
| Natural Resources Conservation Service: Conservation on Private Lands | National Fish and Wildlife Foundation (NFWS) | Community/Watershed Group, Nonprofit Groups, Educational Institution, Conservation District, Local Government, State/ Territorial Agency, Tribal Agency, Federal Agency | Grants are awarded to projects that: (1) address priority actions promoting fish and wildlife conservation and the habitats on which they depend; (2) work proactively to involve other conservation and community interests; (3) leverage available funding; and (4) evaluate project outcomes. | NFWF funds must be matched on at least a 1:1 basis, although 2:1 is encouraged, and higher ratios are more competitive. | Typically range between $10,000 and 150,000 - median is $60,000 | Varies each year. | http://www.nfwf.org/AM/Template.cfm?Section=Home |
| Nonpoint Source Implementation Grants (319 Programs) | Environmental Protection Agency (EPA) through the Utah Division of Water Quality | Business, Community/ Watershed Group, Nonprofit Groups, Educational Institution, Conservation District, Local Government, State/Territorial Agency, Tribal Agency, Federal Agency | Restoration, Information & Education, Planning, TMDL implementation | States required to provide 40% non-Federal match for whole grant. Recipients within state typically required to provide 40% match for each project, but this may be negotiable with a given state. | Varies | | Mike Reichert; Utah Division of Water Quality (DWQ) |
| North American Wetlands Conservation Act Grants Program | United States Fish and Wildlife Service (USFWS) | Business, Nonprofit Groups, Private Landowner, Local Government, State/Territorial Agency, Federal Agency | Long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats. | Cost-share partners must match grant funds 1:1 with U.S. non-federal dollars | Funding amounts vary; however in 2007 this program was awarded 39.4 Million | Typically in early spring (March) | http://www.fws.gove/birdhabitat/Grants/NAWC/index.shtm |
| Not-for-Profit Acid Mine Drainage Reclamation | U.S. Department of the Interior Office of Surface Mining, Division of Reclamation Support | Community/Watershed Group, Nonprofit Groups, Conservation District | Support the efforts of local not-for-profit organizations, especially watershed groups, to complete construction projects designed to clean streams impacted by Acid Mine Drainage | Partners are encouraged to make monetary contributions or provide in-kind services; however, a specific match is not specified. | Typically range between $25,000 and $150,000 - median is $50,000 | Applications will be accepted until all available funds have been awarded | http://www.osmre.gov/osmaml.htm |

**Table 3. Grants for Stream and River Restoration Projects (continued)**

| GRANT | SPONSOR | ELIGIBLE | TYPES OF PROJECTS | MATCH | $ RANGE | DEADLINE | MORE INFORMATION |
|---|---|---|---|---|---|---|---|
| Partners for Fish and Wildlife Program | U.S. Department of the Interior, U.S. Fish and Wildlife Service Branch of Habitat Restoration, Division of Fish and Wildlife Management and Habitat Restoration | Business, Community/ Watershed Group, Nonprofit Groups, Educational Institution, Private Landowner, Conservation District, Local Government, Tribal Agency | The partners for Fish and Wildlife Program provides technical and financial assistance to private landowners to restore fish and wildlife habitats on their lands. | Typically an applicant contributes 50% of the total project cost through matching funds or in-kind services but this amount is negotiable. | Typically range between $300 and $25,000 - median is $25,000 | Funds available year -round | http://ecos.fws.gov/ partners/ viewContent.do? viewPage=home |
| Urban and Community Forestry Challenge Cost -Share Grants | USDA Forest Service | Business, Community/ Watershed Group, Nonprofit Groups, Educational Institution, Conservation District, Water and Wastewater Utilities, Local Government, State/Territorial Agency, Tribal Agency | The program works to achieve a number of goals, including (1) effectively communicating information about the social, economic, and ecological values of urban and community forests; (2) involving diverse resource professionals in urban and community forestry issues; and (3) supporting a holistic view of urban and community forestry. In particular, the program supports an ecosystem approach to managing urban forests for their benefits to air quality, stormwater runoff, wildlife and fish habitat, and other related ecosystem concerns. | All grant funds must be matched at least equally (dollar for dollar) with non-federal source funds. | Typically range between $3,000 and $250,000 - median is $125,000 | The annual Request for Pre-Proposals is released the first week in September. Pre-proposals are due the second Tuesday of November | http://www.freelink.org/ nucfac |
| Water 2025 Challenge Grant Program | Bureau of Reclamation, Office of Program & Policy Services | Nonprofit Groups, Educational Institution, Conservation District, Water and Wastewater Utilities, Local Government, State/ Territorial Agency, Tribal Agency | The goal of Water 2025 is to prevent crises and conflict over water in the western United States. The Challenge Grant Program is administered by the Bureau of Reclamation and is designed to contribute to this goal by providing 50% funding for projects that will conserve water, increase water use efficiency, or enhance water management, using advanced technology, improvements to existing facilities, and water banks and markets. | A match is required, but the % is not specified. | Typically range between $19,000 and $300,000 median is $140,000 | Visit the Department of the Interior Water 2025 website, www.doi.gov/ water2025/, for current information on any upcoming RFP dates and deadlines | http://www.doi.gov/ water2025 |
| Water Resources Research National Competitive Grants Program | U.S. Geological Survey | Educational Institution | Proposals are sought in not only the physical dimensions of supply and demand, but also quality trends in raw water supplies, the role of economics and institutions in water supply and demand, institutional arrangements for tracking and reporting water supply and availability, and institutional arrangements for coping with extreme hydrologic conditions. | A match is required, but the % is not specified. | Typically range between $5,000 and $250,000 - median is $120,000 | February 16, 2007 (for investigations); March 2, 2007 (for institutes) | http://water.usgs.gov/ wrri/institutes.html |

**Table 3. Grants for Stream and River Restoration Projects (continued)**

| GRANT | SPONSOR | ELIGIBLE | TYPES OF PROJECTS | MATCH | $ RANGE | DEADLINE | MORE INFORMATION |
|---|---|---|---|---|---|---|---|
| Watershed Protection and Flood Prevention Program | USDA | Conservation District, Local Government, State/Territorial Agency, Tribal Agency | Projects related to watershed protection, flood mitigation, water supply, water quality, erosion and sediment control, wetland creation and restoration, fish and wildlife habitat enhancement, agricultural water conservation, and public recreation are eligible for assistance. Technical and financial assistance is also available for planning new watershed surveys. | Approximately 75% | Typically range between $5,000 and $2.16 Million - median is $650,000 | Eligible project sponsors may submit formal requests for assistance to the NRCS state conservationists in each state at any time. | http:// www.nrcs.usda.gov/ programs/watershed/ |
| Wetlands Program Development Grants | EPA | Nonprofit Groups, Local Government, State/Territorial Agency, Tribal Agency | The EPA's Wetland Program Development Grants are intended to encourage comprehensive wetlands program development by promoting the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution. Projects build the capacity of states, tribes and local governments to effectively protect wetland and riparian resources. Projects funded under this program support the initial development of a wetlands protection, restoration or management program or support enhancement/refinement of an existing program. | 25% Non-federal match | Typically range between $11,000 and $500,000 - median is $250,000 | Deadlines are determined annually and vary from region to region. | http://www.epa.gov/ owow/wetlands/ grantguidelines/ |
| Wetlands Reserve Program | USDA - NRCS | Business, Community/ Watershed Group, Nonprofit Groups, Educational Institution, private Landowner, Conservation District, Water and Wastewater Utilities, Local Government, State/Territorial Agency, Tribal Agency | Through this voluntary program, the USDA Natural Resources Conservation Service (NRCS) provides landowners with financial incentives to restore and protect wetlands in exchange for retiring marginal agricultural land. | For restoration cost-share agreements and 30 year easement participants, up to 25% of the cost of restoring the acreage must be provided. | | Applications are accepted year-round. | http:// www.nrcs.usda.gov/ |
| Wildlife Habitat Incentives Program | USDA - NRCS | Nonprofit Groups, Private Landowners | The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat on private lands. It provides both technical assistance and cost sharing to help establish and improve fish and wildlife habitat. Participants work with USDA's Natural Resources Conservation Service to prepare a wildlife habitat development plan in consultation with a local conservation district. The plan describes the landowner's goals for improving wildlife habitat, includes a list of practices and a schedule for installing them, and details the steps necessary to maintain the habitat for the life of the agreement. | 25% Non-federal match | Not available; however, in FY 2007 this program was awarded $259 Million | Continuous sign-up process | http:// www.nrcs.usda.gov/ programs/whip/ |

**Table 3. Grants for Stream and River Restoration Projects (continued)**