2368-00003

STEAMBOAT CREEK RESTORATION PLAN

prepared for
Washoe-Storey
Conservation District

prepared by
JEFF CODEGA PLANNING/DESIGN, INC.
and WESTEC., INC.

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Prepared For:

Washoe-Storey Conservation District
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1. EXECUTIVE SUMMARY

INTRODUCTION

The Steamboat Creek Restoration Plan is a guide for policy makers, land owners, developers, and citizens with interest in land adjacent to Steamboat Creek. The recommendations in this plan are voluntary for current land owners. New developments will be asked to follow the Reach by Reach recommendations and Best Management Practices (BMPs) in this report. Those who are interested in more information on these recommendations should contact the Washoe-Storey Conservation District which has the most up-to-date information and resources to provide direction for assistance in developing technical specifications , plans and permits for work within Steamboat Creek. The plan was developed by studying and inventorying the geomorphological characteristics of the Creek, approved but unbuilt developments adjacent to the Creek, and existing land use policies around the Creek in order to identify strategies to reduce pollution in Steamboat Creek which ultimately enters the Truckee River. Approved but unbuilt developments and land use policies were inventoried to understand the impacts of current and planned developments along Steamboat Creek.

The information presented in the plan should be implemented only after careful technical design, including specifications and plans, is completed. In addition, various permits will be required for many segments of this work. It is important that experienced professionals, including geomorphologists, in combination with civil engineers, are used in preparing the technical designs for actual implementation. Please contact Washoe-Storey Conservation District prior to removal of vegetation and/or earthwork.

WHY SHOULD WE DO IT?

The Steamboat Creek Restoration Plan was initiated by the Washoe-Storey Conservation District because Steamboat Creek has been classified as the largest nonpoint source of pollution to the Truckee River, resulting from bank erosion, geothermal mineral deposits and the cumulative impacts of human activities throughout the watershed and the Regional Water Planning Commission.[1] The plan was funded by the Nevada Division of Environmental Protection (NDEP) through a Clean Water Act and the Regional Water Planning Commission grant in order to promote voluntary efforts by the community to improve our water quality. The plan builds upon information developed by WESTEC, Inc. in their Steamboat Creek Fluvial Geomorphology Study which discussed flow and sediment transport conditions and the potential for physical changes including aggradation, degradation, lateral channel migration, and the potential for excessive bank erosion. The creek originates at the outlet of Little Washoe Lake and meanders for 17.5 miles northeasterly to the Truckee River. The Steamboat Creek drainage basin encompasses approximately 200 square miles. The land within the creek corridor is 98% privately owned. In January of 1996 the Washoe-Storey Conservation District hired the firms of Jeff Codega Planning/Design Inc. and WESTEC to prepare a Stream Restoration Plan for Steamboat Creek.

The approach was to compile existing land-use plans and information about proposed developments adjacent to the creek, identify opportunities and constraints along the creek based on existing and proposed land use conditions, coordinate between Washoe County and the City of Reno, recommend best management practices for specific reaches of the creek, provide design recommendations to establish continuity between restoration projects, increase public awareness, and provide recommendations for public policies and implementation strategies which target implementation by developers and voluntary participation by private property owners.

[1] This statement is based on information presented in the Truckee River Total Maximum Daily Loads & Wasteload Allocations, NDEP, February 1994

STEERING COMMITTEE VISION STATEMENT AND GOALS

Vision Statement

Early in the planning process, the steering committee identified the following vision statement:

> *"The Steamboat Creek Restoration Project is a community-wide, cooperative effort to restore, enhance, and preserve Steamboat Creek."*

The Steamboat Creek Restoration Plan seeks to develop Steamboat Creek into a multi-faceted corridor. The vision presented here would establish the creek as an amenity within future urbanized areas containing recreational trails and open space, as a stable, non-polluting stream channel, as a wildlife corridor and viewing area, and as a respected natural feature through the numerous small ranches and parcels which exist in close proximity to the creek today. Land within the creek should be showcased for the aesthetic and recreational enjoyment of future generations.

Goals

In order to assess opportunities and constraints for stream restoration and determine a plan of action, the following project goals were identified and prioritized by the Steering Committee.

1. Improve the water quality of Steamboat Creek.
2. Restore Steamboat Creek to a sustainable condition.
3. Re-establish wildlife habitat appropriate for individual stream reaches.
4. Re-establish vegetation appropriate for individual stream reaches.
5. Combine stream restoration with recreation in areas designated for public access.

HISTORICAL PERSPECTIVE

MAN-MADE ALTERATIONS

Numerous man-made alterations to Steamboat Creek have occurred to meet the needs of the Truckee Meadows population over the last century. The most significant alteration was the artificial lowering of the water surface in the Truckee River by the Army Corps of Engineers in the early 1960s at Vista Reef. The result was strong erosion and deeply incised banks of 8 to 12 feet in Steamboat Creek from its confluence with the Truckee River and upstream to the grade control structure at Pembroke Drive. A gabion weir structure constructed later raised the base-level for the creek, resulting in deposits of sand and silt in the lower reaches near the Truckee River.

Steamboat Creek has long been used for the transportation of water for agriculture to serve the early settlers in the Truckee Meadows. Water is delivered to and diverted from the Creek through a series of ditches. During peak irrigation use, the Creek delivers water from the Truckee River to farms and ranches in the Truckee Meadows via ditches including the Crane, Chandler and Big Ditch. The purpose of these diversions and ditches is to add more and higher quality Truckee River and Galena Creek water to Steamboat Creek water, improving

the irrigation water quality downstream of the Steamboat Springs/Geothermal area. A significant creek alteration occurs in the north reaches of the Damonte Ranch and Bella Vista Ranch where a ditch diverts flows from the historical low point in the valley to a higher position, effectively drying out acres of land which has been in agricultural production for decades. As a result of the agricultural water diversions, flows in Steamboat Creek are thus varied from the historic flows, and are both higher and lower in various reaches during peak irrigation times of the year.

Today, much of the land use is in transition from agricultural to urban. More changes in the creek have occurred to accommodate adjacent land developments. Several water impoundments, including the Rosewood Golf Course lake system, a pond near little Washoe Lake and a detention structure at Mira Loma Drive, trap sediments and alter the sediment supply along the creek system. Portions of the creek have been channelized into a trapezoidal section to create a large flood channel. Future urbanization and the addition of paved surfaces result in increased pollutant loading and other changes in water use, such as proposed water treatment facilities and other water interceptions to deliver drinking water to new homes and businesses.

NATURAL FORM AND FUNCTION OF STREAM SYSTEMS

Basin and stream systems move rock, sediment and water in a process of geomorphic work. This work consists of removing water from the basin during rainfall and snowmelt, and the transportation of sediment out of the basin. Streams are always trying to establish an equilibrium relationship between the flow which moves the greatest amount of sediment (the mean dominant discharge), which has the greatest impact on the size, shape and character of the channel, and the sediment load being produced by the basin. In attempting to reach this equilibrium, a stream will adjust its hydraulic properties, including channel width and depth, velocity, roughness, slope, sinuosity, etc. Since a "final" equilibrium can never be reached, as a result of ever changing water flow and sediment loads, the term "quasi-equilibrium" is used to describe the dynamic equilibrium desirable for streams. When a stream system is approaching this equilibrium state, it is said to be "in regime". Some of the reaches in the upper portion of Steamboat Creek just below the outlet at Little Washoe Lake are near equilibrium and could be considered "in regime".

Periodically, the quasi-equilibrium state will be upset when the system is stressed by a threshold event, which may be an extreme event such as a flood, or may be activities of man. Once a threshold is crossed, the balance is upset, resulting in dramatic changes in geometry and morphology of the system, and setting off a new round of adjustments as the stream once again tries to approach a new quasi-equilibrium state. The stream can never recover fully to its original equilibrium state. The removal of the Vista Reefs in the Truckee River represents an example of a threshold on Steamboat Creek. When the reef was blasted, lowering the level in the Truckee river, the incision and heat cutting (change in morphology) in the lower Steamboat Creek channel which resulted are the physical signs which demonstrate that the Creek was trying to adjust toward a new equilibrium. By evaluating basin and stream parameters, we can judge where the stream is with respect to the evolutionary history of the basin, and how close the stream system may be to achieving a quasi-equilibrium state. This then allows us to make predictions of stream system response to either expected or proposed changes, and is the principal purpose for using the Rosgen classification system.

Since the vast majority of geomorphic work (that is, transporting water and sediment) and the events that shape the geometry of the channel are associated with intermediate size flow events which occur on average every one to two years (the "mean-dominant discharge"), systems must be designed such that provisions are made for the transport of sediment as well as water, or the equilibrium of the channel will be disturbed. If we assume a "rigid boundary model", or a stream channel which is incapable of changing its boundaries, this will require not only channel armoring such as concrete or riprap, but also periodic maintenance in the form of dredging

to remove sediments associated with aggradation. If instead, the principals of fluvial geomorphology and the in-regime design are applied, the channel will be more natural in appearance and function, with less need for hard lining forms of erosion protection, substantially reduced maintenance requirements, and improved aesthetics. Numerous opportunities exist along the Steamboat Creek channel to preserve, enhance, or restore the natural stream form and function. In general, the upper reaches will involve more preservation and enhancement, while the lower reaches will require more aggressive restoration. See Figure 1 - Succession of States for Alluvial/Nongraded Valley Bottom type and Figure 2 - Full Restoration of In-Regime Geometry.

THE ROSGEN CLASSIFICATION SYSTEM

David Rosgen is a hydrologist who spent many years with the U.S. Forest Service. In that time he amassed a tremendous knowledge of the behavior of stream systems and compiled a substantial data base of nearly 500 different stream systems of varying character from which he derived numerous empirical relationships. These relationships form the basis for his various classifications. The Rosgen Stream Classification System is one way to catagorize river systems by channel morphology and is used here to provide recommendations and modifications for unstable reaches of Steamboat Creek in order to achieve equilibrium or self-stabilization.

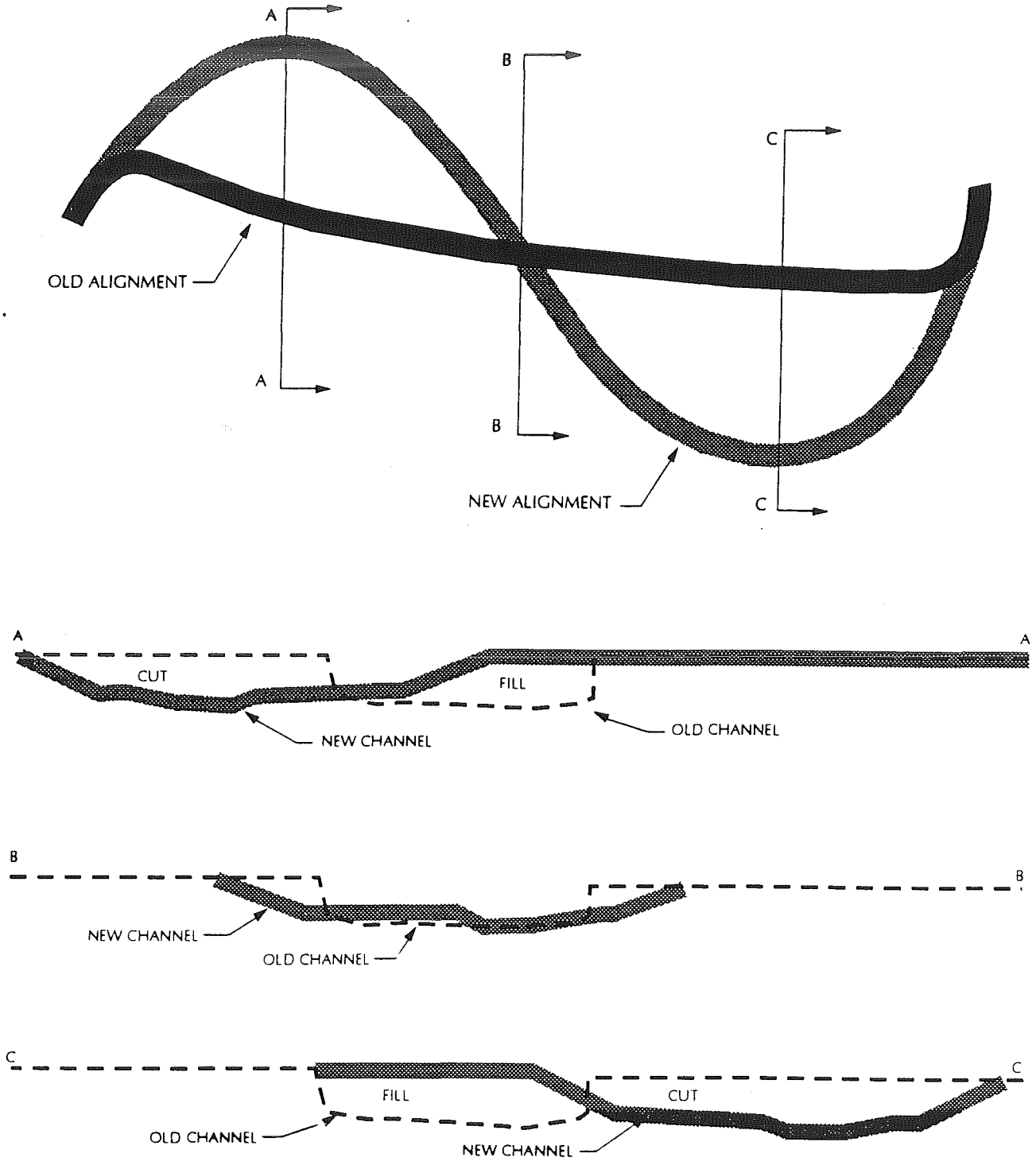

Figure 1. Succession of States for Alluvial/Nongraded Valley Bottom Type

THE RESTORATION PROCESS

HOW SHOULD WE DO IT?

Stream restoration involves the implementation of Best Management Practices (BMPs), which are a collection of techniques that can be applied to help mitigate non-point source pollution and implement effective stream restoration efforts. The BMPs discussed in this report are broken down into several categories as follows:

- Off-Stream BMPs - This type of treatment is placed away from the stream channel to trap pollutants near their source before they flow into the stream channel. Often they involve management and maintenance techniques such as animal waste management, pasture and irrigation management, and septic tank maintenance. Other types of off-stream BMPs include pond, wetland and infiltration system detention systems which are designed to trap and filter non-point pollution near its source. Many of these types of BMPs would be effective for both existing and proposed land uses near Steamboat Creek today to effect stream restoration.

- On-Stream BMPs - These types of treatments are performed directly in the stream channel and are aimed at controlling bed and bank soil erosion. This plan contains recommendations for on-stream BMPs to be incorporated into floodway design for developments. On-stream BMPs can be further broken down into non-structural and structural approaches.

  - Non-structural approaches, also called passive BMPs, use a form of land use management such as stream buffer zones, fencing, and revegetation of banks to accomplish stream restoration.

  - Structural approaches, also called active BMPs, use aggressive, usually engineered techniques to restore natural form and function in areas where a stream has a low potential to recover on its own. These techniques include reconstruction of the geometry of a channel, regrading for modification of bank angles, construction of grade control structures, channel armoring, and extensive revegetation.

    It is extremely important to use professionals properly trained in both engineering and geomorphology to develop construction plans for structural approaches for successful interpretation of the recommendations in this report.

UNIVERSITY OF NEVADA COOPERATIVE EXTENSION SMALL RANCH PROGRAM

The University of Nevada Cooperative Extension provides a voluntary educational program in managing nonpoint sources of pollution. The program is particularly applicable to small properties of several acres which drain directly into Steamboat Creek. Many of these types of properties occur in Pleasant and Steamboat Valleys. The Small Ranch Program provides assistance in determining and implementing BMPs for erosion control, animal waste management, pasture and irrigation water management, integrated pest management, well and septic care and maintenance, and more; through classes, workshops and work parties where BMPs are implemented.

VOLUNTEERISM AND COOPERATION

The process for restoring Steamboat Creek will require cooperation and volunteerism from many sources since there is no single source of funding available to accomplish all the stream restoration recommendations in this report at this time. Consequently, stream restoration efforts will be varied. School children may adopt a section of the creek and plant willows. Land developers may design and construct major civil engineering, regrading projects in certain reaches of the creek. In all cases, the Washoe-Storey Conservation District will provide oversight and coordination for all stream restoration activities in the creek to encourage continuity from one area of treatment to the next, and to assist with suggestions for funding and streamlined permitting, when required, from the Army Corps of Engineers for stream construction work.

HOW STREAM RESTORATION SHOULD BE APPROACHED

Each reach of the creek is described in its current condition, and recommendations made to accomplish stream restoration, in the Reach By Reach Recommendations section of this report. Where degraded reaches of the creek exist, a step-by-step process is recommended for the design of restoration construction plans and specifications. The process includes:

- Data Collection - topography, stream type mapping, sampling for bed and bank materials, soil samples, stream flow, and water quality data.
- Analysis - stream flow hydrographs, sediment studies, estimates of pollutant loading, evaluation for future changes in hydrographs, and sediment qualities.
- Design - selection of appropriate stable stream types, layout of desired geometry, selection of BMPs, evaluate channel hydraulics, evaluate revegetation requirements, evaluate flood levels, complete civil engineering design and construction documents.

As outlined above, the process for design of restoration construction plans is a highly technical endeavor where the collaboration of professionals trained in civil engineering, geomorphology, hydrology, hydraulics, reclamation/botany, and understanding of nonpoint source pollution is imperative. The Washoe-Storey Conservation District can assist with locating such professionals.

IMPLEMENTING THE PLAN

REACH BY REACH RECOMMENDATIONS

Significant reaches of Steamboat Creek along its entire length are described in Chapter Five of the report which includes a description of the existing stream condition, the priority in overall creek restoration, stream type based on the Rosgen Classification system, and recommended BMPs for restoration. These are provided as a guide to facilitate consistency and continuity in detailed stream restoration design and implementation, to be performed by trained professionals. The reaches are designated as follows:

- Truckee Terrace
- Hidden Meadow/University Farms

- Rosewood
- Huffaker Hills
- Bella Vista
- White's Creek Meadows
- North Geiger
- South Geiger
- Steamboat Station
- Steamboat Springs
- Pleasant Valley North
- Pleasant Valley South
- 395 South
- St. James North
- St. James South
- Trestle

CONSTRAINTS TO SUCCESSFUL RESTORATION

Major constraints to stream restoration occur in several areas of Steamboat Creek. Downstream from Steamboat Hot Springs, geothermal waters add minerals to the creek such as boron. Boron is toxic to plant growth even in small amounts. High salinity levels in soils amplify this effect. In these reaches of Steamboat historically effected by boron, few woody plants were supported. Consequently, successful revegetation in these reaches requires soil sampling for minerals such as boron and special plant and soil amendment selection.

Another constraint is the presence of tall white top (Lepidium latifolium a) noxious, invasive weed found in riparian areas and wetlands. It is found in several locations of Steamboat Creek. Successful revegetation must include management against this invasive weed.

POLICY AND IMPLEMENTATION GUIDELINES

The Steamboat Creek Restoration Plan is under review by Washoe County, the Cities of Reno and Sparks, and the Washoe County Regional Water Planning Commission for endorsement. Existing developments are encouraged to follow these recommendations, including viewing the stream as a multi-use feature incorporating recreation and open space. The Washoe-Storey Conservation District will work with all landowners to provide technical guidance, and look for potential funding sources to implement the recommendations in this report. However, all new developments will be requested to follow the Reach by Reach recommendations and BMPs in this report. These requirements will be reviewed at the time of issuance of use and building permits. Washoe-Storey Conservation District will review plans for compliance to these recommendations and provide comment back to the relevant governmental entity. The Army Corps of Engineers will review all construction activities with Steamboat Creek for compliance to the recommendations of this plan.

Mitigation for loss of wetlands on Steamboat Creek must be accomplished within the Steamboat Creek 100 year flood plain. Conservation easements and outright land dedication will be accepted for the Steamboat Creek corridor within the 100 year flood plain to restrict development which would conflict with the recommendations of this plan.

A summary of permits which would be required to implement construction activities in Steamboat Creek is provided in Chapter Five, including Washoe County, Reno, Sparks. The list is not inclusive. A "marketing plan" is also provided which will be used to assist the Washoe-Storey Conservation District in reaching the public about this plan to obtain broad community support. Funding opportunities are also outlined in Chapter Five.

RESOURCE INFORMATION

The following agencies can provide detailed information and resources regarding the Steamboat Creek Restoration Plan.

Washoe County Community Development Department 328-3600
Provides land use information relevant to the creek.

City of Reno Planning and Development Services 334-2062
Provides land use information relevant to the creek.

Washoe- Storey Conservation District 322-9934
Provides technical assistance, information on consultants to prepare technical plans and specifications, education and implementation assistance.

Nevada Cooperative Extension, Small Ranch Program 784-4848
Provides education and implementation assistance for best management practices for erosion control, animal waste management, well and septic care and management, and more.

Natural Resources Conservation Service 784-5408
Provides technical assistance for conservation plans, design and installation of conservation practices and specific investigations of soil, plant, water and other natural resources to improve conservation technology.

Army Corps of Engineers 784-5304
Provides information regarding Army Corps of Engineer permits relevant to work in Steamboat Creek.

Washoe County Regional Water Planning Commission, Stream Committee 328- 6101
The committee is studying existing local policies regarding stream corridors.

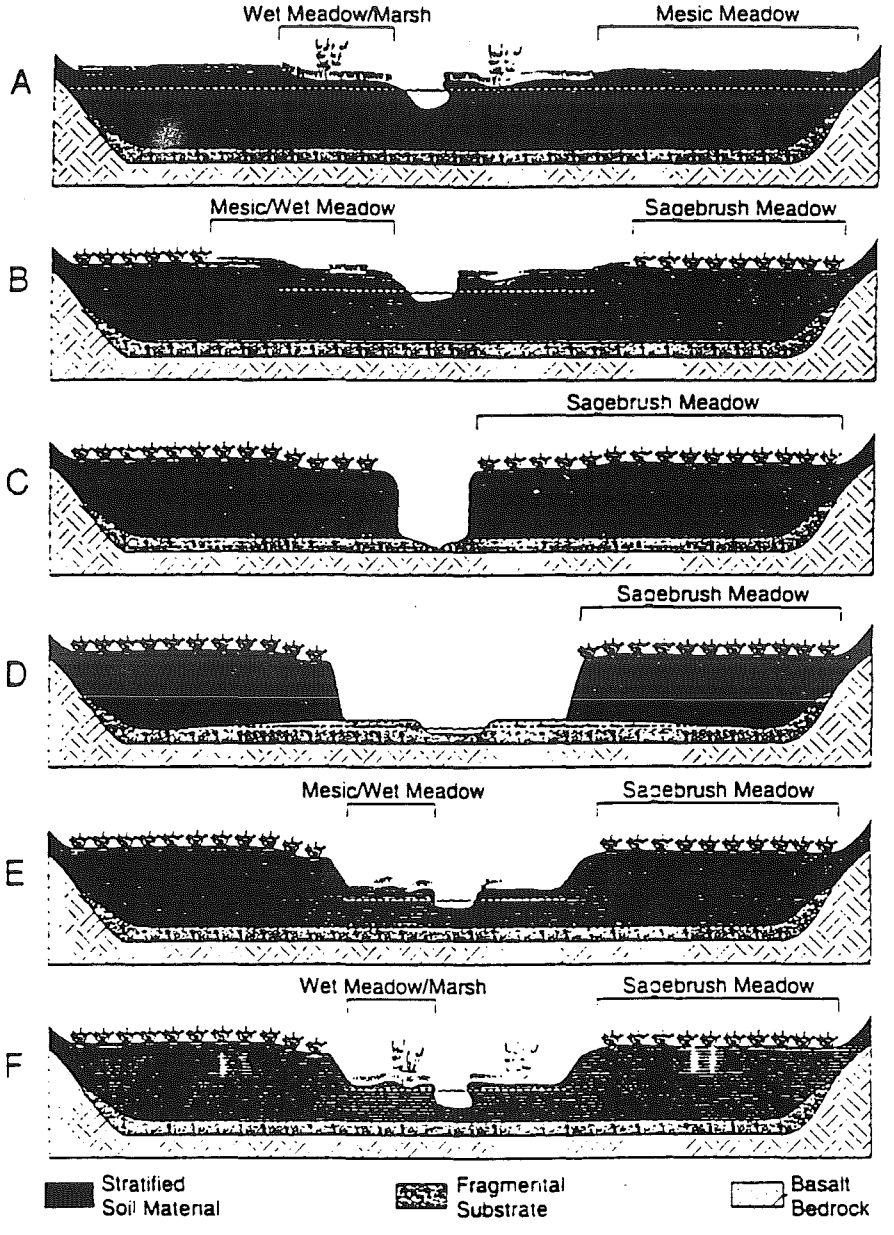

Figure 2. Full Restoration of In-Regime Geometry

2. INTRODUCTION

- How to Use This Plan
- Purpose of Study
- Steering Committee Vision Statement and Goals
- Stream Restoration
- Steamboat Creek - Historical Perspective
- The Behavior of Stream Channel Systems
- Stream Types

2. INTRODUCTION

HOW TO USE THIS PLAN

The Steamboat Creek Restoration Plan is a guide for policy makers, land owners, developers, and citizens with interest in land adjacent to Steamboat Creek. The plan was developed by studying the geomorphological characteristics of the Creek, approved but unbuilt developments adjacent to the Creek, and existing land use policies regarding the Creek in order to identify strategies to reduce pollution in Steamboat Creek which ultimately enters the Truckee River. Recommendations for suggested project, land use and policy modifications are provided in Chapter 3. Recommendations are provided in Chapters 4 & 5 for the technical Best Management Practices to be implemented for each reach of the Creek system. Finally, Chapter 6 outlines implementation guidelines such as permitting requirements, funding sources, and public resource agencies who may be able to assist in meeting the goals for Creek restoration outlined in this plan.

The information presented in the plan is to be implemented only after a careful technical design is completed, which includes specifications and plans. In addition, various permits will be required for many portions of this work. It is important that the proper professionals, including geomorphologists, in combination with civil engineers, are used in preparing the technical designs for actual implementation.

The focus of this plan is on stream restoration but we recognize the need for planning for large flooding events (25 year and higher). We recommend that designs promoted in this study for multi-stage stream cross-sections should be planned in conjunction with flood control management and design.

We also recommend that future flood control projects are designed to minimize the risk of damage to stream restoration projects.

PURPOSE OF STUDY

The Steamboat Creek Restoration Plan was ordered by Washoe-Storey Conservation District because Steamboat Creek has been classified as the largest nonpoint source of pollution to the Truckee River, resulting from bank erosion, geothermal mineral deposits and the cumulative impacts of human activities throughout the watershed. The plan builds upon information developed by WESTEC, Inc. in their Steamboat Creek Fluvial Geomorphology Study which discussed flow and sediment transport conditions and the potential for physical changes including aggradation, degradation, lateral channel migration, and the potential for excessive bank erosion. The land within the creek corridor is 98% privately owned. The creek originates at the outlet of Little Washoe Lake and meanders for 17.5 miles northeasterly to the Truckee River. In January of 1996 the Washoe-Storey Conservation District hired the firms of Jeff Codega Planning/Design Inc. and WESTEC to prepare a Stream Restoration Plan for Steamboat Creek.

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STEERING COMMITTEE VISION STATEMENT AND GOALS

VISION STATEMENT

Early in the planning process, the steering committee identified the following vision statement:

> *"The Steamboat Creek Restoration Project is a community-wide, cooperative effort to restore, enhance, and preserve Steamboat Creek."*

GOALS

In order to assess opportunities and constraints for stream restoration and determine a plan of action, the following project goals were identified and prioritized by the Steering Committee.

1. Improve the water quality of Steamboat Creek.
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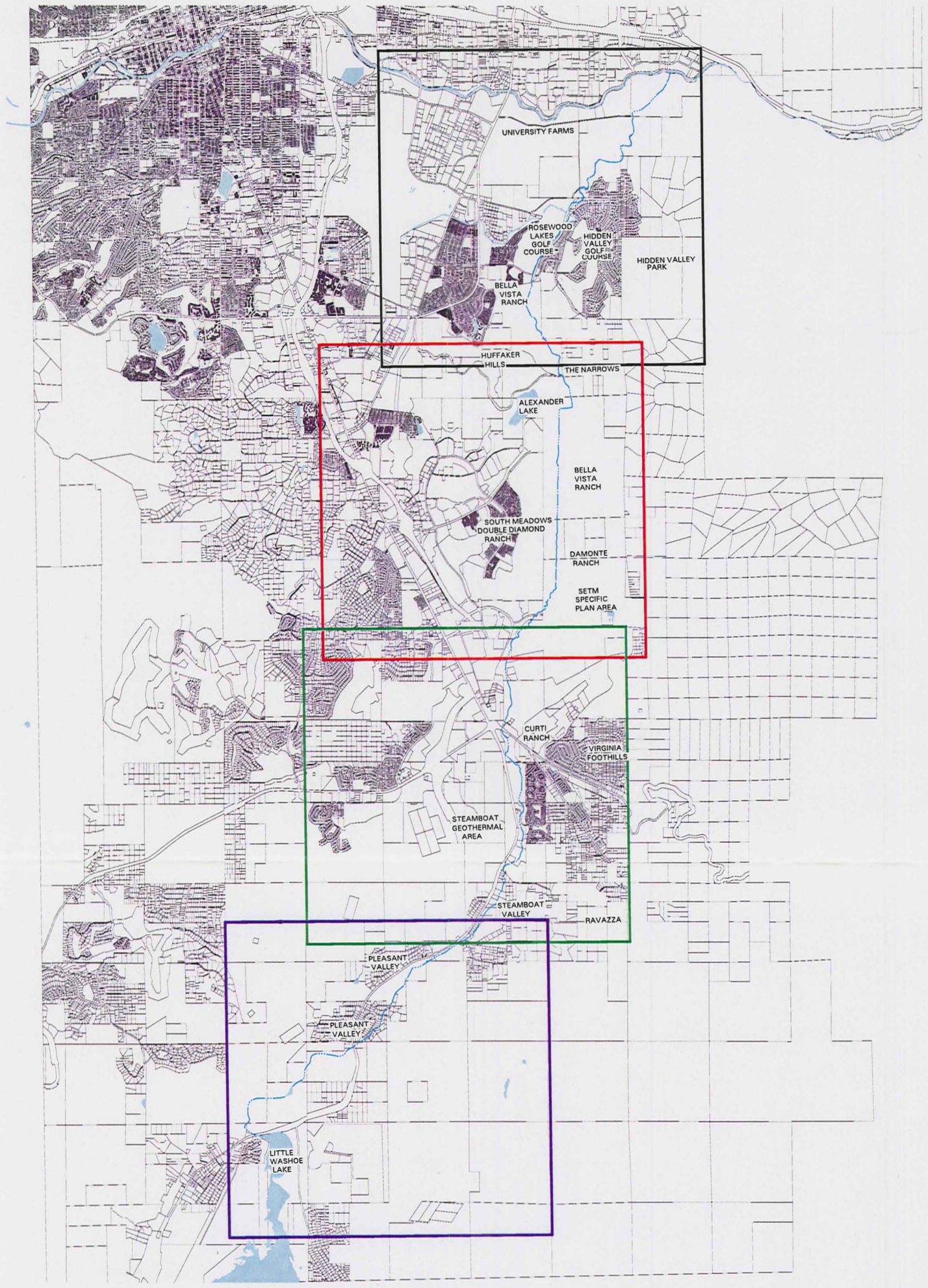
3. Re-establish wildlife habitat appropriate for individual stream reaches.
4. Re-establish vegetation appropriate for individual stream reaches.
5. Combine stream restoration with recreation in areas designated for public access.

Figure 3 - Location Map shows the entire creek corridor from Little Washoe Lake to the Truckee River. The four colored boxes correspond to the areas on detailed maps in Figures 11 - 14 and Figures 18 - 21.



BOUNDARY LOCATIONS

STEAMBOAT CREEK PROJECT

STEAMBOAT CREEK

STUDY AREA BOUNDARIES

SOURCE: WASHOE COUNTY DEPARTMENT OF WATER RESOURCES

DATE: JUNE 1998

Notes: The scale and configuration of all information shown hereon are approximate only and are not intended as a guide for design or survey work. Reproduction is not permitted without prior written permission from the Washoe County Department of Water Resources.

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SCALE IN FEET

Department of Water Resources

WASHOE COUNTY NEVADA

Post Office Box 11130
Reno, Nevada 89520
(702) 954-4600

Figure 3. Location Map

STREAM RESTORATION

WHAT IS IT?

Streams and rivers that are subjected to the increased influence and impact from human activities often become degraded, particularly in a highly urbanized environment. This degradation commonly takes the form of one or more of the following:

- A reduction in the amount and diversity of aquatic wildlife and their habitat
- A reduction in the base flow contributed from groundwater
- An increase in water temperature
- An increase in bed and bank erosion
- Changes in the distribution and character of sediment in the channel with local increases in sediment deposition
- Increases in pollutant loading and a general degradation of water quality
- Changes in channel geometry which tend toward a straightening of the original plan form alignment, an associated steepening of the gradient, and an increase in the channel cross-section (channelization), resulting in a loss of connection with the natural flood plain.

All of these impacts result in the loss of much of the natural form and function of the stream or river leading, in most cases, to a single function which is drainage and flood control. Stream restoration is an intervention, in the case of degraded natural systems, in an attempt to restore most or all of the natural form and function of the original unimpacted stream.

WHY DO IT?

Often in these highly impacted streams much of the degradation of natural form and function is reversible. More naturally functioning hydraulics can be restored, much of the habitat can be replaced (resulting in improved wildlife diversity), water quality can be improved, etc. In the past, as urban development progressed, streams were often viewed as a liability relegated to placement along the back-lot lines. Here the geometry of the channel was determined by easement and property boundaries instead of the physics of open channel flow. Stream channels would be force-fit into the geometry of the development and then held in-place through the use of hard linings and high maintenance.

With this document we would hope to instill a different philosophy among the planners, developers, and engineers who have control over the future status of Steamboat Creek. We recommend they give consideration to preserving or restoring the natural stream environment and make the stream a centerpiece of future developments. Consider placing major access routes adjacent to the stream corridor where the stream amenity can be enjoyed by all (see Figure 4). Provide sufficient space to either preserve or, if necessary, to restore a stable, fully functioning stream environment. If the stream environment is handled as an amenity, then the value of acreage lost in the creation of a natural stream corridor will often be more than compensated for by the increase in the value of the lots that adjoin that stream. Steamboat Creek should be viewed and managed as an asset and not a liability.

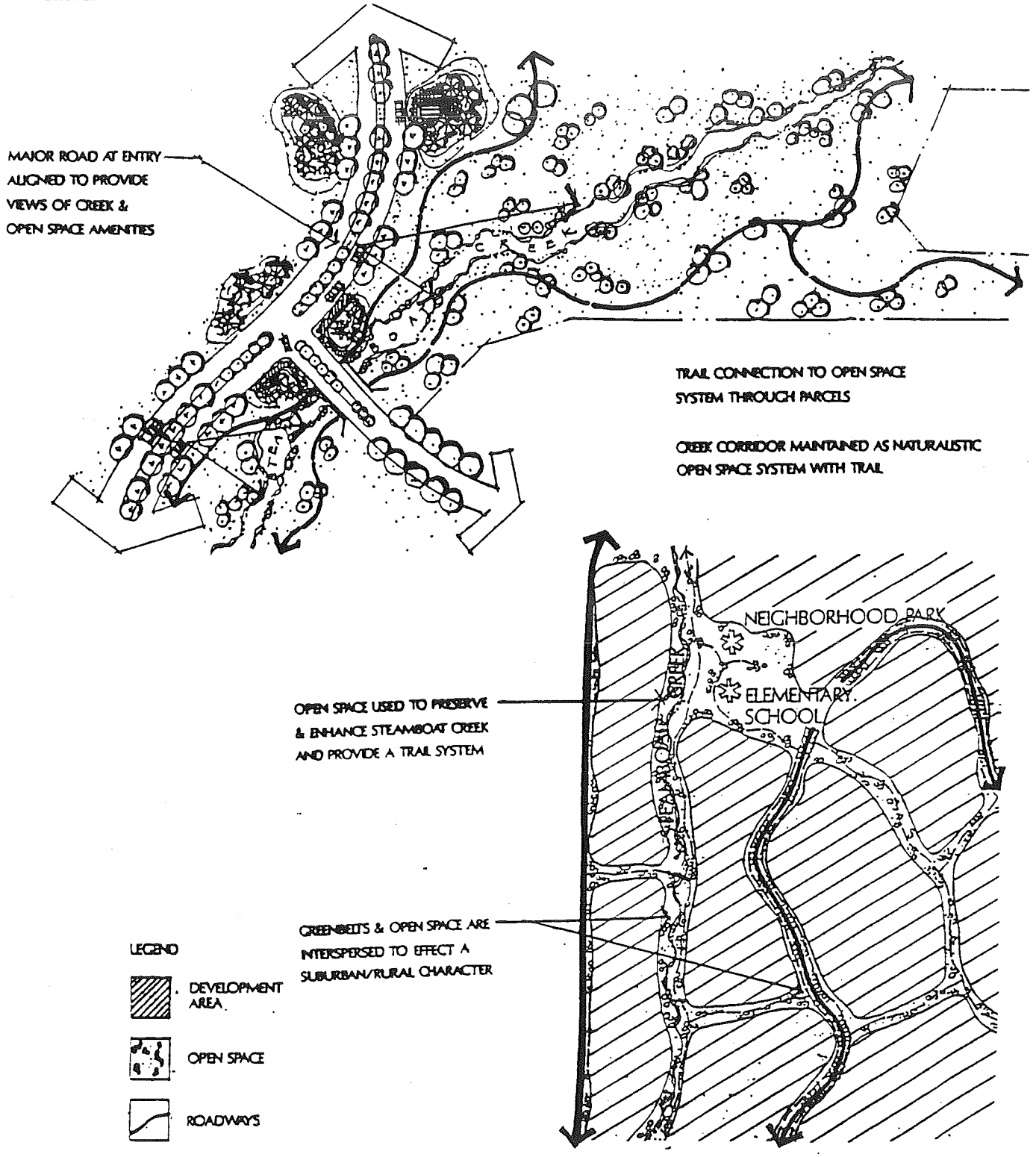


Figure 4. Site Planning Using the Creek as an Amenity

HOW CAN I HELP?

Most often the biggest and most difficult problems of the pollution and degradation in stream systems are the result of a cumulative effect (the accumulation of many, many small impacts throughout the entire catchment). The impacts become more and more problematic as they get further and further from the original source. Therefore, just an increase in awareness by individual property owners can result in a significant reduction in these cumulative effects often referred to as "non-point source pollution." Developers, counties, municipalities, large corporations, and others who have a larger role to play in future planning and development can incorporate some of the "best management practices" (BMPs) that are currently available into the planning and development process to minimize impacts and help preserve the natural form and function of our stream and river systems in the future. The remainder of this document will describe in detail the nature of a single system located in Washoe County in northwestern Nevada — Steamboat Creek. We shall describe its history, its condition, its problems, and its potential. We shall describe what measures might reasonably and realistically be taken along various portions of the system to preserve and restore the value in Steamboat Creek for future generations.

STEAMBOAT CREEK - HISTORICAL PERSPECTIVE

FIRE AND ICE

Some of the events that began to shape Nevada's current-day landscape began in the late Eocene period about 43 million years ago. This marked the beginning of extensive volcanic activity and the emplacement of many igneous rocks. The earth's crust in the vicinity of Nevada began to thin. About 17 million years ago, as the crust continued to thin, extensional faulting began producing the major basins and ranges that characterize the present-day landscape in Nevada. The basins and ranges of Nevada were produced by a complex system of normal faults of late Cenozoic Age. Those blocks of crust, which have undergone relative uplift, formed mountain ranges, while the relative sinking of adjacent segments formed the valleys between ranges. As these valleys or "grabens" continued to sink, erosion from the higher areas began to collect in and fill the fault controlled basins.

This process of crustal extension, faulting, and the formation of basins and ranges is the same process that produced the valley which contains Washoe Lake and Steamboat Creek. The intermountain basins eventually filled with sediment from alluvial fans that formed along the base of the adjoining mountain ranges. These fans consolidated into "bajadas" and often contained playas in the center. Most of these playa basins are of the bolson type with internal drainage and no outlet. These playa lakes often maintain a free-water surface only during wet years and may dry up completely during drought years. A few of these basins have permanent lakes such as Pyramid Lake northeast of Reno, which is maintained by runoff from the Sierra Nevada via the Truckee River. If the rainfall in Nevada were greater, many of the basins would discharge from one to another.

Washoe Lake is a playa lake at the center of the long north/south trending graben valley lying between the Carson Range (to the west) and the Virginia Range (to the east). The north end of Washoe Lake has formed an outlet which drains the graben valley referred to as the Truckee Meadows. This drainage channel which is Steamboat Creek, traverses the Truckee Meadows from the north edge of Washoe Lake northward a little over 17 miles to its confluence with the Truckee River. Formation of the modern-day basin and range topography of the Truckee Meadows probably began between 7 and 11 millions years before the present. However, uplifting of the Carson Range and sinking of the Truckee Meadows has continued into the present day. Numerous young, active faults exist along the west edge of the Truckee Meadows at the foot of the Carson Range

transecting the Mount Rose fan complex.

The Steamboat Creek basin encompasses a total area of about 200 square miles. The geology of the basin is quite complex, however, the major rock types exposed in outcrops in the basin are dominated by Tertiary aged volcanic lava flows of andesite, dacite and moderate to weakly welded deposits of Tertiary aged volcanic tuff (i.e., deposits of volcanic ash). The core of the Carson Range along the western edge of the basin contains igneous intrusive rocks (granites). These rock types have similar volcanic origins and are formed by magmas which do not actually reach the surface and cool more slowly deep within the crust to be later uplifted and exposed by erosion.

The volcanic and tectonic processes that formed the Truckee Meadows are also responsible for much of the economic mineralization found in the area and the mining activity which dates back to the mid-1800s. The Comstock Lode District in the Virginia Range is one of the most famous and well-publicized silver deposits in North America. According to Bonham (1969), as of 1957 the district had produced approximately 8,260,000 ounces of gold and 192,000,000 of silver plus some copper and lead, having a total worth of approximately $400,000,000 at that time.

A somewhat less known district is the Galena District of Washoe County located approximately 20 kilometers (12 miles south of Reno). The district encircles Pleasant Valley and includes portions of the Virginia Range and the Steamboat Hills. Mining operations began in 1860 after the discovery of lead-silver ore at the Union Mine. The University of Nevada, Reno still uses the Union Mine as a training facility for young mining and geological engineers (Gates and Watters, 1992).

Yet another important district is the Steamboat Springs District located approximately 15 kilometers (9 miles) south of Reno. This has been a famous geological study area from the 1880s to the present time. One phenomenon that generated interest in the area was the metallic mineral hot spring association of cinnabar, stibnite, gold, and silver. From 1860 to 1890, because of the presence of the thermal springs and geysers, local entrepreneurs attempted and failed to make the Steamboat Springs area a rural resort and health spa. The springs remained a tourist resort until about the turn of the century when the resort buildings burned and earthquakes reduced the vigor of the springs. In 1875, John Poe discovered cinnabar west of the springs in an area presently known as the Silica Pit. Poe, in partnership with Louis Dean, created the Nevada Quicksilver Mining Company. This company erected a furnace and produced both mercury and sulfur for several years. Since the early discovery, mining has been conducted on and off for nearly 100 years. In 1965 Texierra Mining Corporation delineated approximately 25,000 tons of cinnabar ore which assayed out at approximately 3 to 4 pounds of mercury per ton. However, Bonham (1969) estimated that a total of only 100 flasks of mercury have been produced from the site and suggests that the Steamboat Springs area has future promise as significant mercury producer (Gates and Watters, 1992).

Although the processes of volcanism and tectonics were key in the formation of the Truckee Meadows Valley which contains the Steamboat Creek channel, the nature of the stream channel itself is controlled by the younger, unconsolidated soil deposits which fill the Truckee Meadows graben. Quaternary aged surficial deposits in the Truckee Meadows include: glacial fill, glacial outwash, landslide deposits, alluvial fan deposits, lacustrian sediments, fluvial sands, and flood deposits. The Steamboat Creek channel is a "fluvial" channel, which means that it flows on the same sediments that were deposited earlier by the channel. In general, downstream from the Thomas and White's Creek fan, the channel is formed in silty to clayey sands originally laid down as flood plain and overbank deposits in relatively thin sheets during past flood events. From the Thomas and White's Creek fan upstream (south), channel bed materials are more frequently affected by glacial deposits. Glacial activity around the Truckee Meadows was confined to the Carson Range. Major streams transported glacial debris from the Carson Range into the Truckee Meadows Valley. Most of the glacial deposits

exposed on or near the surface of the Truckee Meadows were of Illinoisan Age (Donner Lake outwash) or the younger Wisconsinan Age (Tahoe outwash). These glacially deposited materials typically vary from coarse-sand to very large boulders (up to 16 feet diameter in places) although the majority of these glacial materials are dominated by gravel to cobble-sized particles. The last major glacial advance (the Wisconsinan Age stage) ended approximately 10,000 years before the present. During this time the climate was significantly wetter than the present day conditions and melt- water floods would have produced much larger flows. Evidence of the larger past flows is preserved in the very large meander bends which can be seen in the north end of Steamboat Creek in the University Farms area. The channel alignment exhibiting these very large bends appears to have become "fossilized" by incision that probably followed a base-level change in the Truckee River channel as flows began to subside in the Truckee River at the end of the Wisconsinan stage. The much reduced modern day flows are now forming side channel bars inside the now-incised and fossilized former channel alignment with a meander wavelength that is much reduced from that of the old alignment.

The modern day climate on the mountainous west side of the basin is dry to sub-humid with an average annual precipitation on the order of 40 inches. The climate change is significant on the valley floor becoming semi-arid with an average annual precipitation on the order of 7 inches. Summertime convective activity over the valley floor and mountains can produce high-intensity thunderstorms and flash flood potential. However, many of the longest duration floods are associated with the spring and early summer snowmelt.

PREHISTORIC STEAMBOAT CREEK - THE WASHOE TRIBE

The prehistoric Washoe Indians occupied an area of approximately 4,000 square miles surrounding Lake Tahoe and from Honey Lake on the north to Sonora Pass on the south, and from the upper slopes west of the Sierra Nevada crest, east to the Virginia Range and the Pine Nut Hills. The Washoe lifestyle involved seasonal travel to sites which provided various plant and animal food sources at various times of the year. This included use of the lower valleys primarily in the winter months where villages of several families often camped together. The Washoe were exceptional basketmakers, utilizing willow from valley drainages. It is known that the Steamboat Creek drainage supported the Washoe lifestyle for encampment and thus many cultural sites occur along the Creek corridor.

The Washoe Tribe, in their Comprehensive Land Use Plan, 1994, have identified Cultural Resource Goals and Policies which deserve recognition within this plan. This plan strives not only to reduce pollutants but to encourage the development of the Creek as an open space recreational corridor. The potential exists to work with the Washoe Tribe to bring to public awareness the relevance and importance of Steamboat Creek in prehistory. The relevant goals and policies are discussed in Chapter 3.

HISTORIC IMPACTS TO STEAMBOAT CREEK

Historic changes along the Steamboat Creek channel are numerous and include the following:

Base Level Alterations

- Numerous changes have occurred in the base-level of Steamboat Creek at its confluence with the Truckee River. The most significant of these base-level changes is the artificial lowering of the water surface in the Truckee River by the Corps of Engineers in the early 1960s (at Vista Reef). This event rejuvenated tributaries and began strong headward erosion in Steamboat Creek between its confluence with the Truckee River and the crossing at Pembroke Drive. Headcutting/knickpoint migration has been arrested

by the construction of a grade control structure at Pembroke Drive. However, the channel downstream of the structure has incised deeply with bank heights of 8 and 12 feet being common in the area. In the late 1960s a waste water treatment plant was constructed near the mouth of Steamboat Creek at its confluence with the Truckee. By the early 1980s it was recognized that low dissolved oxygen discharges from the waste water treatment plant were creating water quality and fish migration problems in the Truckee River at its confluence with Steamboat. To solve this problem, a gabion weir and channel control structure was built to deliver flows from Steamboat Creek down the steep bank into the Truckee River and create a mixing zone parallel to the Truckee River flow. This prevented oxygen depletion across the whole width of the Truckee at that location. Upon construction of the gabion weir the base-level for Steamboat Creek again changed (this time raised) as a result of the new control structure. The base-level increase did help to take some pressure off of the rejuvenation process and actually initiated aggradation in the lower portions of the Steamboat Creek. From 2 to 4 feet of loose, fine sand and silt have now been deposited on top of the underlying boulder and cobble bed which is associated with the floodplain of the Truckee River.

Channelizations

- Numerous sections of Steamboat Creek periodically along its entire length have been "channelized" where the cross-sectional area has been modified into what has been typically a simple trapezoidal section with little or no-flow channel and sized to carry a large flood (typically the 100-year flood) without using its floodplain or spilling over the bank.

Flow Regulation and Diversion

- The Steamboat Creek channel has become a highly regulated system used for the transportation of water for agricultural purposes. Water is delivered to and diverted from Steamboat Creek through a series of constructed ditches. During times of peak irrigation usage the Steamboat Ditch delivers up to 100 cubic feet per second of water from the Truckee River to the Steamboat Creek channel. This water is then diverted out of the Steamboat Creek channel and delivered to irrigation sites, farms and ranches in the Truckee Meadows, through a series of ditches that leave Steamboat Creek upstream of the Steamboat Springs geothermal site. The purpose of these ditches is to provide higher quality irrigation water to agricultural users downstream of the hot springs. These diversion ditches include: the Chandler Ditch, the Crane Ditch, the Big Ditch, and numerous small, often unnamed diversions. Water is also diverted from Galena Creek during the winter months and stored in Little Washoe Lake to be later released down Steamboat Creek as required to satisfy the needs of various water users and their surface water rights. Thus, the flows in Steamboat Creek are no longer "natural" but are artificially regulated to be much greater than the historic flows in some reaches at certain times of the year and often far less than historic flows in other reaches during times of peak irrigation demands in the dry summer months.

Impoundments

- Water has been impounded at several locations along the main stem of Steamboat Creek. This includes the lake system associated with the Rosewood golf course area near Pembroke Drive, a sediment basin/detention structure just upstream of Mira Loma Drive, and an artificial lake only a mile or so below the outlet of Little Washoe Lake. These impoundments tend to trap sediments and alter the sediment supply along the channel.

FUTURE CHANGES

The potential for future changes along Steamboat Creek revolve around continued urbanization of the Truckee Meadows. The typical changes that accompany development include a dramatic increase in the imperviousness of the ground surface. The imperviousness accompanies an increase in the percentage of paved surfaces, roof tops, and other man-made structures which increases both the amount and speed of surface runoff while at the same time reducing the contribution to the groundwater system through infiltration. Pollutant loading is also increased, particularly with respect to constituents like zinc (from galvanized roof tops and gutters), potassium, and hydrocarbons. Sediment supply is also affected, experiencing a dramatic surge in sediment load during the construction phases of a new development, falling to near background levels as construction activity diminishes and developments mature. In addition to changes in the character of runoff, the flow regime in the channel can be altered by changes in water use. For example, a new surface water treatment plant for drinking water is proposed along Steamboat Creek, which, once constructed, may intercept much of the flow in the channel, treat it for domestic use, and deliver it to a distribution network. In this way, flows which would otherwise be left in the channel itself are now diverted into a network of pipes which are delivered to homes and ultimately will be directed through a network of sewer pipes to the waste water treatment facility at the confluence of Steamboat Creek and the Truckee River, effectively bypassing the channel altogether.

THE BEHAVIOR OF STREAM CHANNEL SYSTEMS

NATURAL FORM AND FUNCTION

Basin and stream systems move rock, sediments & water to accomplish geomorphic work. Geomorphic work accomplished by a stream system consists of removing water from the basin area during rainfall and snowmelt and the transportation of sediment out of the basin. Every river and stream strives to establish an equilibrium relationship between a critical flow level, referred to as the mean-dominate discharge, and the sediment load produced by the basin. The mean-dominant discharge is the magnitude of stream flow that, over the long run, moves the greatest amount of sediment and therefore has the greatest impact on the size, shape, and character of the channel. The stream accomplishes the search for an equilibrium by adjusting its hydraulic variables (e.g., channel width and depth, velocity, roughness, slope, sinuosity, etc.). This normal fluvial condition is a state of dynamic equilibrium referred to as "quasi equilibrium." The interrelationship of these variables is extremely complex and the difficultly involved in understanding stream and river behavior is evident when one considers that the water discharge and the sediment load are in a continuous state of flux or change so that all of the hydraulic variables are always adjusting. Obviously a river or stream system will never reach a final steady-state permanent condition, thus the term "quasi equilibrium." However, a stream system that is at any given time approaching this equilibrium state is said to be "in regime." Some of the reaches in the upper portion of Steamboat Creek (just below the outlet at Little Washoe Lake) are near equilibrium and could be considered "in regime".

This quasi-equilibrium state is periodically upset when the system is stressed beyond a "threshold." The crossing of the threshold can be induced either by extreme events in the system or by the activities of man. Whatever the source, once a threshold is crossed, the balance of the fragile equilibrium state is upset resulting in dramatic changes in the geometry and morphology of the system and setting off a new round of adjustments back toward some new quasi-equilibrium state. By definition, once a "threshold" has been crossed the stream can never recover fully to its original equilibrium state. The removal of the Vista Reefs in the Truckee River represent an example of a threshold on Steamboat Creek. The resulting incision and head cutting in the lower Steamboat Creek channel is the physical manifestation of the geometry and mophology changes that accompany the

adjustment toward a new equilibrum. The evaluation of basin and stream parameters (measurable characteristics or indicators) allow one to understand more clearly where the stream is with respect to the evolutionary history of the basin and how close the stream system may be to achieving a quasi equilibrium state. This understanding can permit one to make both qualitative and quantitative predictions of stream system response to either expected or proposed changes and is the principal purpose for using the Rosgen classification system.

The total effectiveness of a stream to do geomorphic work (i.e., to transport water and sediment) is a function of both the magnitude of the event and its duration. Although it is true that very large flow events are capable of transporting enormous amounts of sediment, they occur very infrequently and persist only over a very short duration. The vast majority of the geomorphic work and the events that shape the geometry of the channel are associated with the intermediate events that occur every one to two years. The event that controls the morphology of the channel is referred to as the "mean-dominant discharge" (see Figure 5). This event is usually coincident with "bankfull discharge" which, in a natural and relatively undisturbed stream system that is near its quasi dynamic equilibrium point, is the flow at which the water just fills the bed and banks of the main channel and is about to spill into the floodplain. In perennial streams this flow will have a typical recurrence interval on the order of 1.5 to 2 years. A frequent failing of modern drainage system planning and design is that most designers involved in the evaluation and design of drainage systems can deal effectively with the delivery of the water discharged through the system but often fail to consider the needs of the system to transport sediment. In a drainage channel that has the ability to change its boundaries (i.e., to either aggrade, degrade, or migrate laterally which is the definition of a fluvial system), it is absolutely critical that provisions be made for the transport of sediment and water to avoid upsetting the equilibrium of the channel.

A common way to circumvent the need to consider the movement of sediment in addition to water is to invoke the assumption of the "rigid boundary model" (which means to assume that the stream channel is incapable of changing its boundaries). The physical reality corresponding to this design assumption is the use of channel armoring such as concrete, riprap, or other forms of artificial erosion protection (in order to prevent degradation and erosion). The other physical manifestation of this assumption is maintenance (dredging) in order to remove the sediments associated with aggradation. When applied properly, the principals of fluvial geomorphology and the in- regime design can be used to create a more natural appearing and naturally functioning stream channel system with less need for hard lining forms of erosion protection, substantially reduced maintenance requirements, and improved aesthetics. Numerous opportunities exist along the Steamboat Creek channel to preserve, enhance, or restore the natural stream form and function. In general, the upper reaches will involve more preservation and enhancement while the lower reaches will require more aggressive restoration.

SYSTEM INTERACTIONS

The catchment is the area providing both water and sediment to the stream environment. Each stream network has its own unique catchment defined by the area enclosed within the watershed or drainage divide, which is the high point or ridge that separates one catchment from the adjacent one. Rain falling within the catchment flows overland and underground until reaching the stream network where flow then concentrates and flows along the network with the volume of flow increasing as tributary after tributary join to accumulate higher and higher flows down the stream. This process continues until flows finally reach the downstream end or mouth of the catchment. The size and location of any given catchment is rather arbitrary as any given catchment can be sub-divided almost infinitely into smaller and smaller sub-catchments. Similarly, each catchment is part of another larger catchment into which it will discharge until the mouth of the final catchment reaches the ocean. In general, the larger the catchment the greater the volume of runoff which will be carried by its stream system, although this obviously depends upon other factors such as the amount of precipitation over the catchment. As water flows across the surface of the catchment it also entrains particles of soil which are carried with the water

flow and delivered to the same stream network. The sediment particles may be either transported or deposited at any given point in the system depending upon the characteristics of the flow and the size of the sediment. Land use and the character of the surface in the catchment can have a large impact on streams by affecting

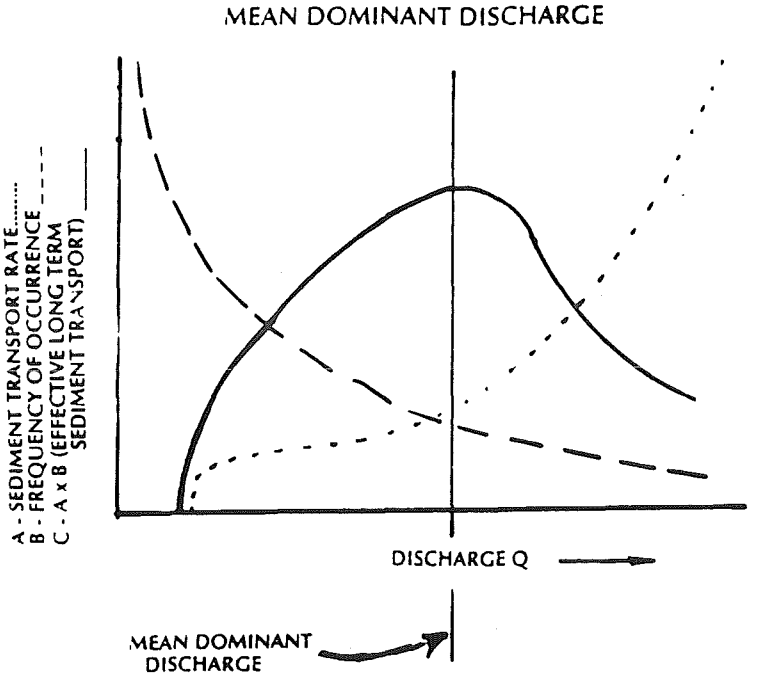


Figure 5. Mean Dominant Discharge

runoff rates and the input rates of sediments, woody debris, and chemical pollutants. A well-vegetated catchment with deep soils will absorb rainwater, releasing it slowly, and the root structures associated with vegetation will help hold soils in place against the erosive effects of rainfall and runoff. If vegetation is removed or changed (for example by development/construction, clearing land for farm land, logging, grazing, wildfires, etc.), both the hydrograph (rate of water delivery) and sedigraph (rate of sediment delivery) will be altered, commonly resulting in an increase in the amount and rate of runoff and a corresponding increase in the amount of sediment delivered to the system. These kinds of changes also reduce the amount of water that infiltrates from the surface into the groundwater system. If groundwater levels are reduced, then the amount of water slowly released into the streams from the groundwater system will also be reduced, causing a reduction in the "base flow". Base flow is the amount of water between storm/runoff events that is released to the stream network by the groundwater.

Dams will also have major effects on both the hydrology and channel morphology of the stream. The artificial lake environment created by a dam tends to absorb high-magnitude and short-duration flood peaks and release lower magnitude, longer duration flood peaks downstream. This process is referred to as "flood attenuation" and is often one of the major benefits used to justify the placement of artificial dams and lakes on streams. The reservoirs created behind dams are also sediment traps which collect the sediment being delivered upstream, which will eventually fill the reservoir, and releases clearer water downstream. Although the sediment load has been reduced downstream, the sediment transport capacity typically has not, resulting in increased erosion and scour in the bed and banks for some distance downstream of the dam.

The impoundment of water in a reservoir also affects hydrologic balance and water quality. The increased surface area causes increased evaporation and an increase in water temperature. The amount locally discharged to the groundwater system through seepage losses and infiltration is also increased. The net result is a decrease in the long-term volume of flow or "yield" of the channel downstream. However, the storage of water and the regulation of its flow from storage provides much more control over how and when the stored water is released and used.

Sediment load in the stream can be greatly affected by other influences in the catchment, both natural and man-made. For example, the occurrence of landslides in a catchment can dramatically increase sediment loads by delivering large volumes of coarse sediment directly into the stream channel. Similarly, highway embankments and other constructed fills which have slopes that come down adjacent to a stream or in its active floodplain, will deliver significantly higher volumes of sediment more frequently to the stream.

The influences described above are just a few of the complex impacts and interactions that occur within a catchment area, all of which affect the delicate balance between water supply and sediment load. Every shift in this balance in a fluvial stream system will result in some degree of stream channel response (see Figure 6).

The Steamboat Creek basin is highly urbanized and, as a result, tends toward increased runoff rates and chemical pollutions, but a reduction in woody debris. Rate of sediment input will vary dramatically with location being slightly less in mature, developed areas and considerably more in construction areas. Only three dams exist along the mainstem of Steamboat Creek (at Pembroke Drive, Mira Loma Drive, and above the confluence with Brown's Creek) and all of them are relatively small. The lowest of these dams (Pembroke Drive) shows the typical effects of increased downstream erosion and scour, while the uppermost dam (above Brown's Creek) rests on coarse glacial outwash which resists increased erosion.

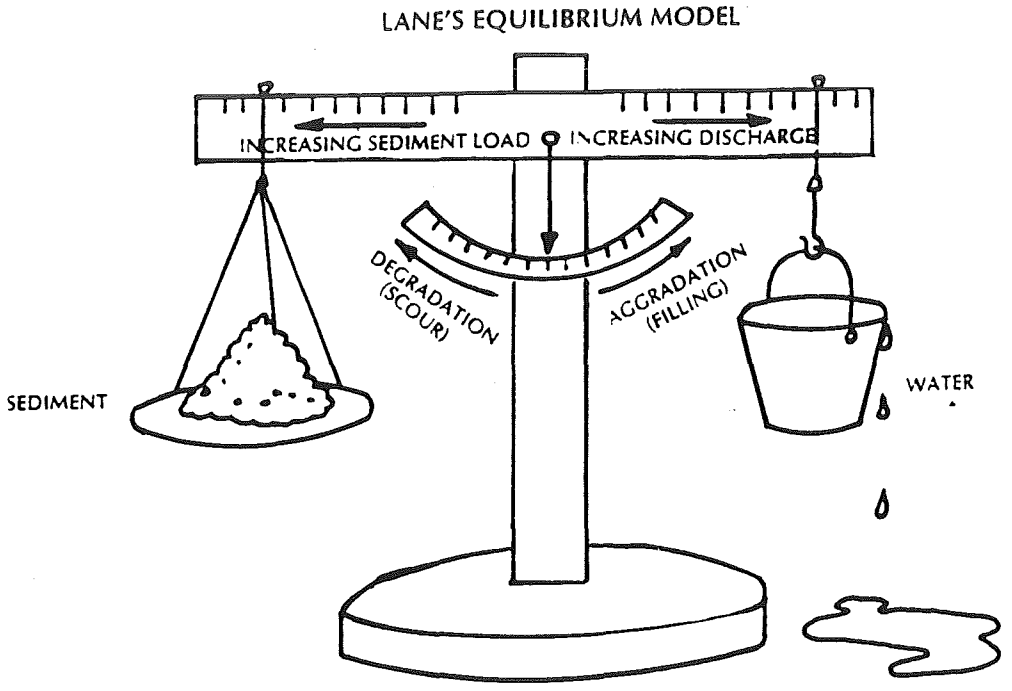


Figure 6. Lane's Equilibrium Model

THE STREAM CORRIDOR — WATER, VEGETATION, AND HABITAT

The focus of the remainder of this document will be on the Steamboat Creek corridor itself; how it has responded in the past and how it may continue to respond to changes in land use in its catchment. Stream systems interact strongly with the local environment. This includes physical interactions with the bed, bank, and groundwater system and ecological interaction with the vegetation and biota, in and adjacent to the stream. A cross section of a typical stream channel corridor is shown in Figure 7. Figure 7 depicts typical characteristics of stream channels. The channel geometry in Steamboat Creek varies widely with location and is discussed in greater detail in a subsequent section on stream types. The character of the stream bed depends primarily on the size of the sediment exposed to the channel flow relative to the depth and velocity of water flowing above that sediment. There is little or no vegetation in this extremely dynamic environment as it is the site of most of the sediment transport in the system. Similarly, the banks, which contain the flow, present another site of strong water/sediment interaction. Portions of the banks are also typically devoid of vegetation, although in backwater areas and during low flow periods floating unrooted plants, rooted plants with floating leaves, reeds, rushes, liver worts, mosses, and other species tolerant of inundation may inhabit this zone. Higher on the bank side a transition exists between the main channel and the floodplain. This zone will often contain grasses, rushes, sedges, and other herbs which form a dense mat of roots helping to protect the banks from erosion. This zone can also support some tree species such as willows, tolerant of a high degree of soil saturation and reduced oxygen level. At the bank tops close into the stream channel you will again find willows, so long as the distance between the floodplain surface and the underlying groundwater level is not excessive (typically 3 to 8 feet). More water-loving woody tree species will also be found in this zone, including alder and cottonwood. This

zone can also contain other species of woody plants and shrubs which transition with distance from the channel to the vegetation types common to upland areas.

A detailed discussion of the biota (creatures) that inhabit the stream corridor environment is beyond the scope of this document; however, they fall into three broad categories: aquatic (living in the water), amphibious (living both on land and in the water), and terrestrial (living on the land). Aquatic biota may be further subdivided into vertebrate (such as fish) and invertebrate (such as aquatic insects). The diversity and density of aquatic biota are often sensitive to factors such as water quality, temperature, water velocity, size and character of the channel bed, sediment or "substrate," etc. All these factors are in turn directly affected by the hydrology of the stream and the sediment load, as well as the interaction of the stream with vegetation immediately adjacent to the stream, often referred to as the "riparian" corridor. The vegetation in this zone helps shade portions of the stream channel affecting water temperature. The roots help hold the banks together affecting bank erosion and the sediment load. They provide a food source and shelter for a host of other terrestrial and amphibious creatures which frequent the riparian corridor.

The water within the stream channel system and the groundwater system underneath frequently interact. In some sections of the stream during some times of the year, water levels in the stream may exceed water levels in the bank, causing water to flow from the stream to the groundwater system. When this happens, the stream is said to be "influent." At other locations and times the water table in the banks may be higher than the water levels in the stream so that the water seeps out of the banks and into the stream channels supporting the "base flow" of the stream. Under these conditions the channel is said to be "effluent."

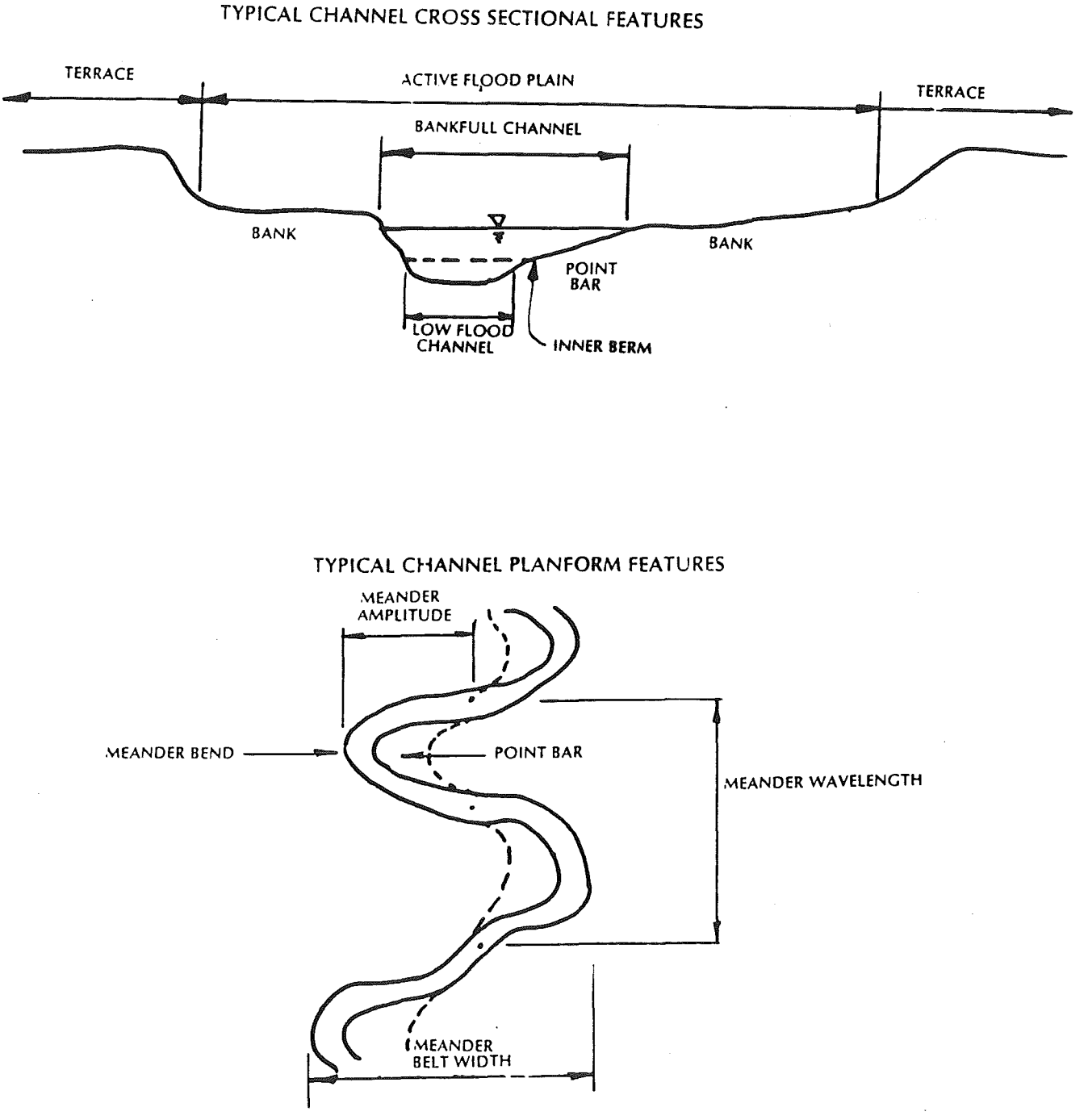


Figure 7. Typical Stream Channel Corridor

HUMAN IMPACTS & MITIGATION

All of the foregoing factors are strongly interrelated. If, for example, the urbanization of an area causes a reduction in infiltration rates in the catchment and a drop in the groundwater level, this might in turn reduce the level of the water table to a point where base flows in the stream are reduced and water levels adjacent to the stream fall below the root depth of riparian vegetation, causing the vegetation to die back. If the vegetation dies back, the effectiveness of bank erosion protection is reduced, causing banks to be subjected to higher rates of bank erosion causing an increase in the sediment load and changes in the hydraulic geometry of the channel. These changes produce adjustments in substrate conditions, water temperature, flow velocity, etc. which can directly affect the density and diversity of the aquatic species. Similarly, changes in the channel and banks and the loss of riparian vegetation may affect the density and diversity of terrestrial species in a riparian corridor.

However, many of these potential changes and detrimental consequences can be avoided or mitigated through proper planning and design. The mitigation of potentially detrimental affects, such as those just described, is in fact the purpose of stream restoration. However, it is not always possible to fully mitigate all impacts nor is it always practical or economically feasible. In attempting to apply the principles of stream restoration one must also be wary of attempting to push stream systems beyond levels that Mother Nature was willing to support in the first place. For example, the upper reaches of Steamboat Creek only a short distance below the outlet at Little Washoe Lake are capable of supporting and maintaining a full riparian canopy. However, the lower reaches of the Steamboat Creek in the University Farms area never did support a dense riparian canopy of willow, alder, and cottonwood. Therefore, it would be expensive and possibly futile to try and create one at that location now. Similarly, water quality impacts from the Steamboat Hot Springs geothermal area have affected the ability of some reaches of the Steamboat Creek channel to support woody vegetation, primarily due to high levels of boron in the banks. Therefore, it may not be practical to attempt to est..blish woody vegetation in .ome portions of the channel strongly impacted by the geothermal flow.

WATER QUALITY

Typical changes in stream water quality which would accompany unmitigated urban development would include the following:

- a sediment pulse during construction
- increased pollutant loading as a function of imperviousness
- nutrient enrichment leading to benthic algae growth
- bacterial contamination in both dry and wet weather
- greater organic carbon loads
- higher trace metals and hydrocarbon levels
- stream temperature increases
- increased frequency of trash and debris dams

A number of water quality concerns exist in Steamboat Creek and have been described in an October 1993 report entitled *Water Qualitv Conditions in Steamboat Creek, Washoe County, Nevada, 1987 to 1991 with Particular Emphasis on Non-Point Source Loading of Nitrogen, Phosphorous, and Selected Metals* prepared by John Reuter and Charles Goldman with the Institute of Ecology, Division of Environmental Studies, University of California, Davis. The study evaluated the water quality along Steamboat Creek over the course of four water years from 1988 to 1991 and covered the full length of Steamboat Creek from the outlet at Little Washoe Lake to the confluence with the Truckee River. A number of constituents were identified as concerns, the most

significant of which were nitrogen, phosphorous, and the chemical constituents of boron, arsenic, and chloride. Nitrogen is primarily in the form of nitrate and is associated with agriculture return flows. Phosphorous is primarily in the form of ortho-phosphorous. However, in that portion of Steamboat Creek downstream of Boynton Slough, particulate phosphorous dominates and is believed to be associated with excessive bed and bank erosion. Boron, arsenic, chloride, and TDS (total dissolved solids) are strongly correlated with the Steamboat Hot Springs area with concentrations being highest immediately downstream of the springs and decreasing with greater distance downstream as flows are diluted by tributaries. Other water quality problems in Steamboat Creek include the physical transport of silver and mercury contaminated soil found in highest concentration in sections of the channel just downstream of Little Washoe Lake in the upper portions of Pleasant Valley. Unstable conditions that result in increased bed and bank erosion in the Steamboat Creek channel can produce higher concentrations of chemical pollutants and increased transport rates for silver and mercury pollution.

STEAMBOAT HOT SPRINGS

Stream restoration efforts can impact water quality both directly and indirectly by reducing high levels of bed and bank erosion. Direct impacts include the high particulate phosphate loading which is believed to be directly related to high levels of bed and bank erosion. Boron, arsenic, chloride, and high TDS concentrations are clearly associated with discharges from Steamboat Hot Springs. The hot springs is a very old feature and many of the metals associated with these geothermal waters are now stored and locked up in the bed and bank sediments downstream of the springs. Increased erosion in these areas will liberate more of these metals to the waters of Steamboat Creek. In some cases metals transport can actually be a physical process associated with particulate matter and sediment transport as well as a chemical process associated with leach solutions. High nitrogen/nitrate concentrations are not directly related to stream bank erosion, sediment transport, or any of the physical processes associated with instability in the Steamboat Creek channel.

RIPARIAN VEGETATION AND NITRATE REDUCTION

A reduction in the nitrogen/nitrate levels can be accomplished, however, by the establishment of wetlands and increased areas of riparian vegetation. There is an indirect impact in that these wetlands and riparian vegetation communities cannot survive in a geomorphically unstable fluvial environment such as that which exists along much of the Steamboat Creek channel. It will be necessary to create a more natural, more stable fluvial environment for the effective construction of wetland and riparian systems. Further, once this investment is made it would be unfortunate to have the facilities either removed by erosion or buried by aggradation.

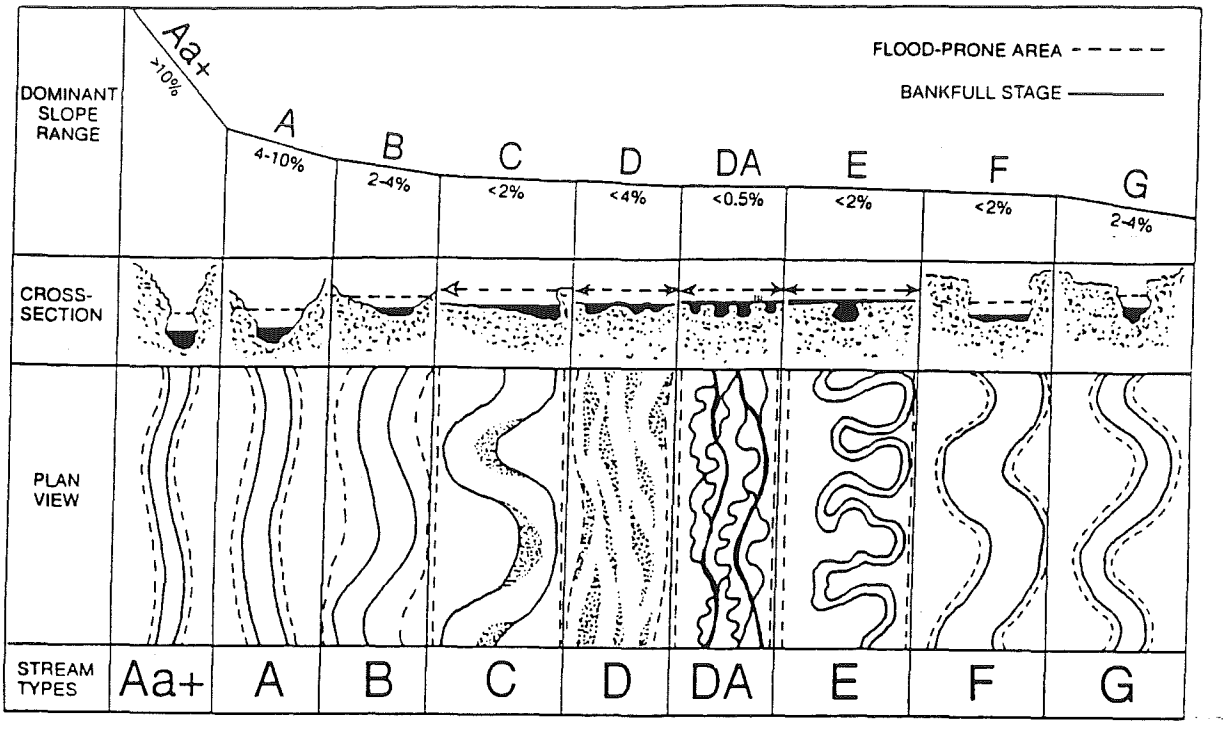
STREAM TYPES

THE ROSGEN CLASSIFICATION SYSTEM

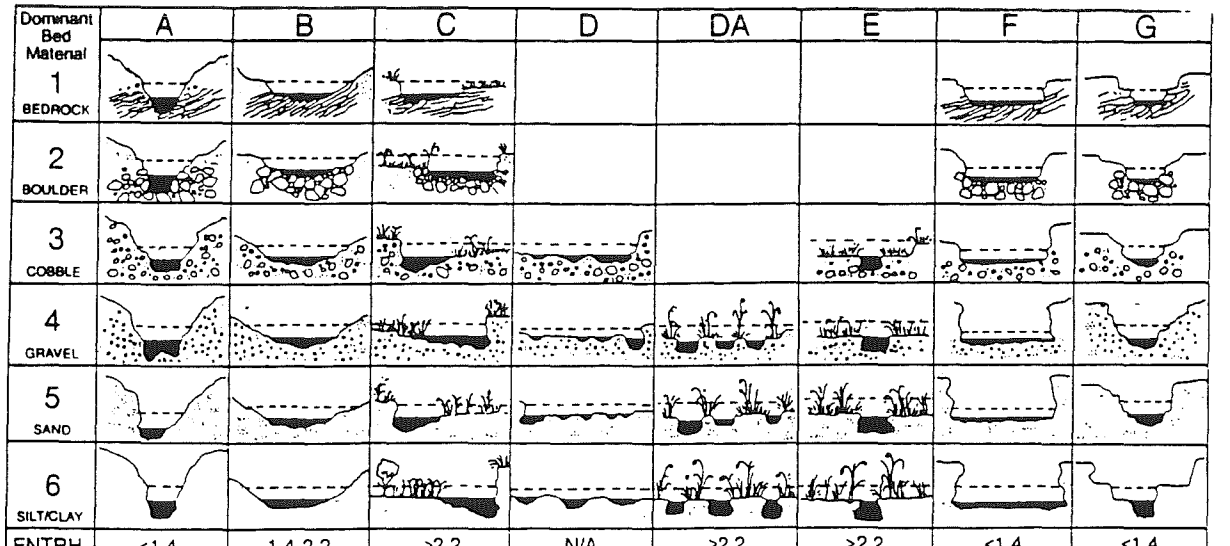
David Rosgen is a hydrologist who spent many years with the U.S. Forest Service. In that time he amassed a tremendous knowledge of the behavior of stream systems and compiled a substantial data base of nearly 500 different stream systems of varying character from which he derived numerous empirical relationships. These relationships form the basis for his various classifications. The resulting physical appearance and character of a stream is a product of adjustments of its boundaries to the current stream flow and sediment regime. Stream form and fluvial process evolves simultaneously and operate through mutual adjustments toward quasi equilibrium or self-stabilization. The Rosgen Stream Classification System is one way to catagorize river systems

by channel morphology in order to better (1) predict a stream or river's behavior from its appearance (2) develop specific hydrology and sediment relations for a given morphological channel type and state (3) provide a mechanism to extrapolate site specific data collected on a given stream reach to those of similar character, and (4) provide a consistent and reproducible frame of reference of communication for those working with river and stream systems in a variety of professional disciplines.

A schematic of the classification system is provided in Figure 8. which corresponds with the description in Table 1. This information was taken from USDA forest Service General Technical Report RM-245, Stream Channel Reference Sites: An Illustrated Guide to Field Technique, Harrelson, Rawlins, Potyondy. The system is based on morphological characteristics of the channel leading to a letter designation A through G (determined by characteristics such as entrenchment, width/depth ratio, sinuosity, and slopes) and by bed material types leading to a number designation ranging from 1 (for bedrock) to 6 (for silt and clay). An F5 stream, for example, would be expected to be a single-thread channel, well-entrenched with moderate to high width to depth ratio, high sinuosity, and flat slope flowing on channel bed materials made up predominantly of sand. The classification system should become more clear as it is used in subsequent specific discussions of the Steamboat Creek channel.



Stream types: gradient, cross-section, plan view (adapted from Rosgen 1994). Original drawings by Lee Silvey. Courtesy of Catena Verlag.



	A	B	C	D	DA	E	F	G
ENTRH.	<1.4	1.4-2.2	>2.2	N/A	>2.2	>2.2	<1.4	<1.4
SIN.	<1.2	>1.2	>1.4	<1.1	1.1-1.6	>1.5	>1.4	>1.2
W/D	<12	>12	>12	>40	<40	<12	<12	<12
SLOPE	.04-.099	.02-.039	<.02	<.04	<.005	<.02	<.02	.02-.039

Cross-section view of stream types (adapted from Rosgen 1994). Original drawings by Lee Silvey. Courtesy of Catena Verlag.

Figure 8. Schematic Drawings of the Rosgen Classification System

Table 1. Description of the Rosgen Classification System

Summary of delineative criteria for broad level classification (adapted from Rosgen 1994). Courtesy of Catena Verlag.

Stream Type	General Description	Entrenchment Ratio	W/D Ratio	Sinuosity	Slope	Landform/Soils/Features
Aa+	Very steep, deeply entrenched, debris transport streams.	<1.4	<12	1.0 to 1.1	>0.10	Very high relief. Erosional, bedrock or depositional features; debris flow potential. Deeply entrenched. Vertical steps with deep scour pools and waterfalls.
A	Steep, entrenched, cascading step-pools. High-energy debris transport assoc. with depositional soils. Very stable if channel dominated by bedrock or boulders.	<1.4	<12	1.0 to 1.2	0.04 to 0.10	High relief. Erosional or depositional and bedrock forms. Entrenched and confined with cascading reaches. Frequently-spaced, deep pools in assoc. step-pool bed morphology.
B	Moderately entrenched, moderate-gradient, riffle-dominated channel with infrequently spaced pools. Very stable plan and profile. Stable banks.	1.4 to 2.2	>12	>1.2	0.02 to 0.039	Moderate relief, colluvial deposition and/or residual soils. Moderate entrenchment and W/D ratio. Narrow, gently sloping valleys. Rapids predominate with occasional pools.
C	Low-gradient, meandering, alluvial riffle-pool, channels with point-bars. Broad, well-defined floodplains.	>2.2	>12	<1.4	<0.02	Broad valleys with terraces in assoc. with floodplains alluvial soils. Slight entrenchment with well-defined meanders. Riffle/pool bed morphology.
D	Braided channel with longitudinal and transverse bars. Very wide channels with eroding banks.	n/a	>40	n/a	<0.04	Broad valleys with alluvial and colluvial fans. Glacial debris and depositional features. Active lateral adjustment with abundant sediment supply.
DA	Multiple channels, narrow and deep with expansive, vegetated floodplain and wetlands. Very gentle relief, highly variable sinuosity. Stable stream banks.	>4.0	<40	variable	<0.005	Broad, low-gradient valleys with fine alluvium and/or lacustrine soil. Multiple-channel geologic-control creating fine deposition with well-vegetated, laterally-stable bars. Broad floodplains and wetlands.
E	Low-gradient, meandering, riffle/pool stream with low W/D ratio and little deposition. Very efficient and stable. High meander width ratio.	>2.2	<12	>1.5	<0.02	Broad valley/meadows. Alluvial materials with floodplain. Highly sinuous with stable, well-vegetated banks. Riffle/pool morphology, very low W/D ratio.
F	Entrenched, meandering riffle/pool channel, of low gradient, with high width/depth ratio.	<1.4	<12	1.4	<0.02	Entrenched in highly weathered material. Low-gradient, with high W/D ratio. Meandering, laterally unstable with high bank erosion. Riffle/pool bed.
G	Entrenched, "gully" step-pool channel, on moderate gradients, with low width/depth ratio.	<1.4	<12	>1.2	0.02 to 0.039	Narrow valley, or deeply incised in alluvial or colluvial material (i.e., fans or deltas). Unstable, with grade control problems and high rates of bank erosion. Gully, step-pool bed.

STABLE OR UNSTABLE?

As already discussed, stream channel systems are undergoing constant change and adjustment. Therefore, stability in the context of a stream must be viewed as a dynamic form of stability where the long-term condition and character of the stream are seen to change very little over time. In the context of the of the Rosgen Classification System and the Steamboat Creek environment, the most stable stream types will be the B, C, and E type channels. The more unstable stream types will consist of the D, F, and G type channels. Probably the most important factor in the physical stability of channels involves the accessibility of the flow to its floodplain. In the case of B, C, and E type channels, flow width will increase as the discharge increases and spills out onto an active floodplain. This limits the rate of increase in depth of the flow which in turn limits the rate of velocity increase and the potential for bed and bank erosion. The F and G type channels, on the other hand, are deeply incised and have been detached from their floodplain. Therefore, as large magnitude floods pass through the channel they cannot spread out and the result is a very rapid increase in the depth and velocity within the channel causing a much more aggressive attack on the bed and banks. In the case of D type channels (braided channels), the problem is usually one of extremely high sediment load causing aggradation or filling of the channel bed, destroying low flow channels, and causing the main channel to rapidly change direction and location during storms (referred to as an avulsion) This causes the flow to wander laterally using a wide, flat stream bed with frequent attacks on its banks by laterally migrating high velocity flows.

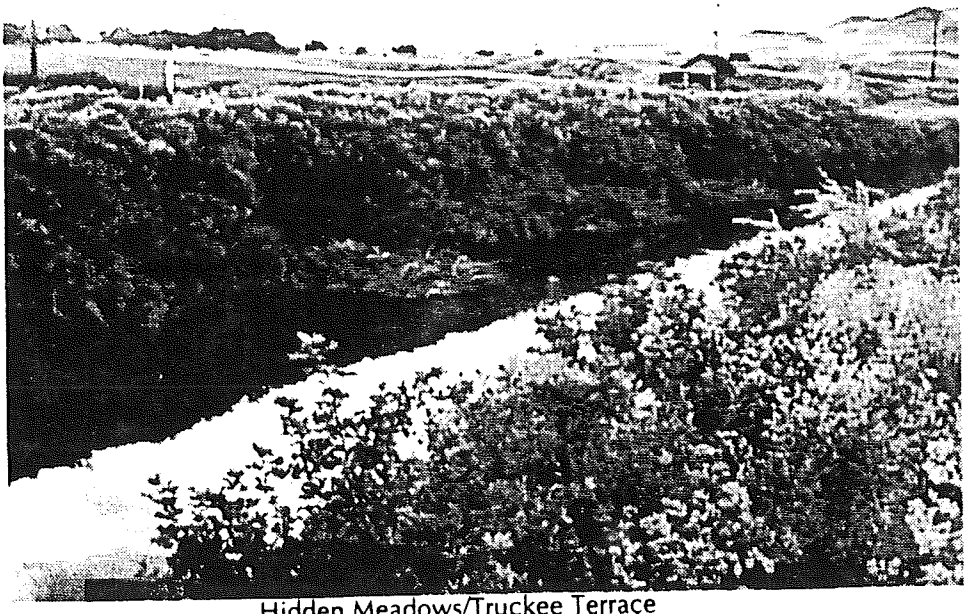
The deeply incised channel types, like the F and G, would not always be considered unstable under all circumstances. For example, many of the stream types in the Grand Canyon and the Canyonlands of Utah classify as F type streams and yet most would be considered quite stable. This is because the Colorado Plateau has been undergoing strong uplift over recent geologic time and the geomorphic work at hand for those stream systems is to try and keep pace with that uplift in order to maintain drainage across the area. Therefore, they are configured for maximum cutting ability. The F and G type channels are capable of putting all of the erosive power of periodic floods to work cutting into the bedrock bed and banks, keeping pace with the regional uplift. However, this same cutting power can cause uncontrolled incision in unconsolidated, uncemented alluvial soil.

THE PROS AND CONS OF ARMORING STREAM BANKS

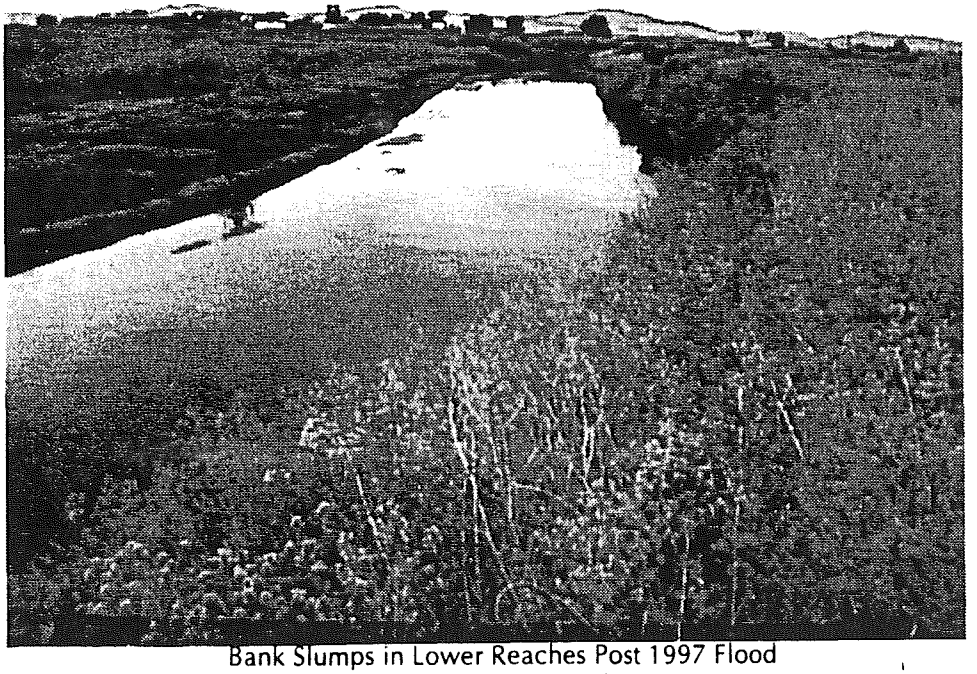
As mentioned in the above discussion, stream channels in the Canyonlands country are configured for maximum cutting because of the difficulty in eroding the bedrock in their bed and banks. A similar condition of artificially induced apparent stability can be created in F and G type channels by armoring the bed and banks with erosion resistant materials such as riprap and concrete. Although if properly designed they can be effective in minimizing bed and bank erosion, they have no value as habitat, conflict with the establishment of bank vegetation, and can be esthetically unpleasing as well. Despite these limitations, armoring with hard lining materials, in particular riprap, will sometimes provide the only practical and affordable solution to some problems and should not be completely discounted in stream restoration efforts. We recognize the limitations to armoring. However, in some cases on Steamboat Creek, it is the only viable alternative. In these areas, esthetically pleasing designs should be established.

A typical side effect from the excessive use of armoring materials is the need for a high level of maintenance over time to preserve the integrity of the artificially armored bed and banks. Yet another problem frequently observed in the armoring of channels is to simply transfer an erosion problem further downstream, causing a large scour hole and increased bank erosion immediately downstream of the armored section. Therefore, consideration should be given to both upstream and downstream impacts in the design of any stream restoration effort.

Some stream restoration can be as simple as altering land use in the stream corridor itself and allowing the stream to heal itself over time (a passive or non-structural approach). Opportunities of this type, where they exist, can be extremely cost-effective. However, in other portions of a channel, few options exist short of actual construction of restored channel sections requiring engineering design and using backhoes and bulldozers (the active approach). These efforts will be expensive. Where non-structural approaches will work, stream restoration efforts utilizing natural materials and leading to a more self-maintaining, long-term condition can often be constructed at a cost equal to or less than the cost of hard-lining and armored solutions to the same problem.



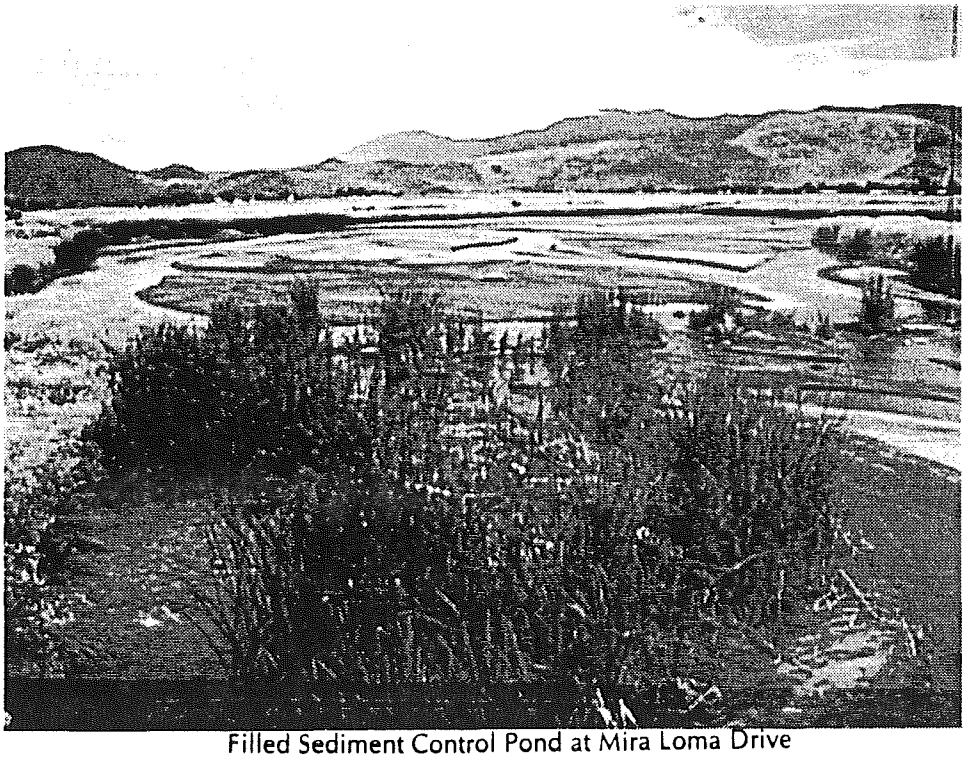
Hidden Meadows/Truckee Terrace



Bank Slumps in Lower Reaches Post 1997 Flood

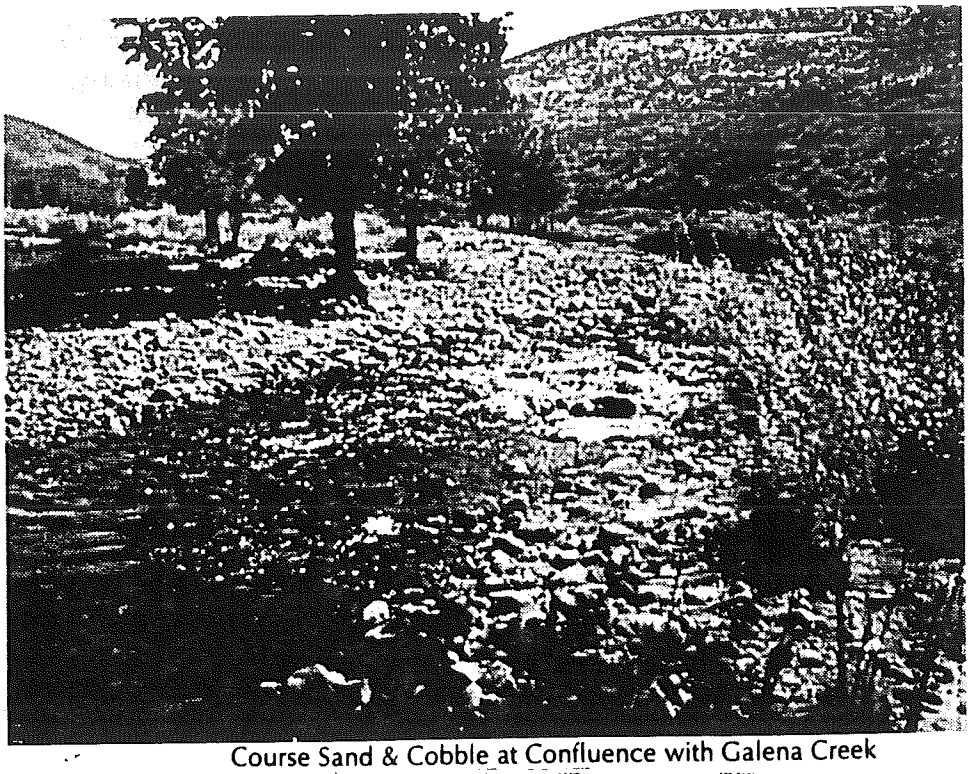
Figure 9. Photos of Existing Steamboat Creek Conditions

Bedrock Ledges in Steamboat Springs Reach

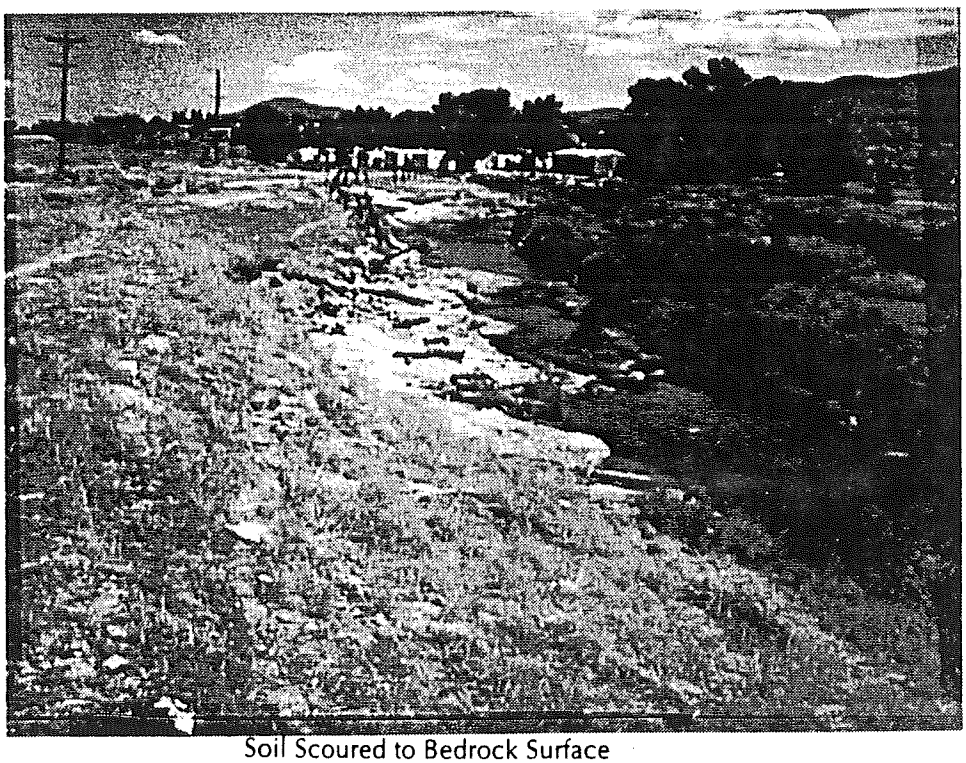


Filled Sediment Control Pond at Mira Loma Drive

Figure 10. Photos of Existing Steamboat Creek Conditions

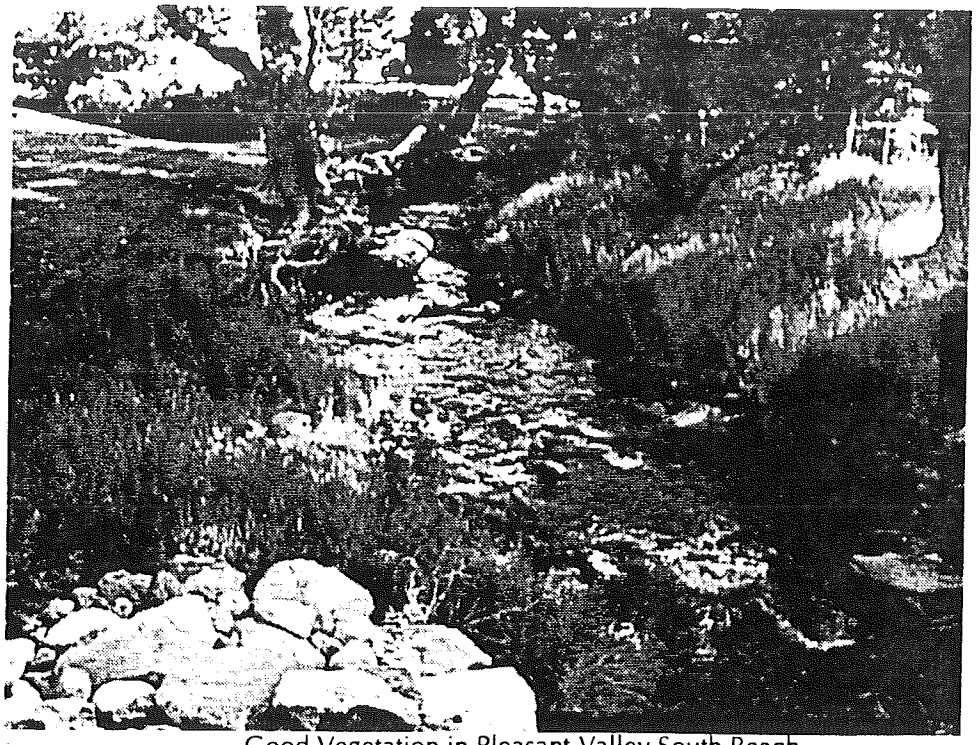


Course Sand & Cobble at Confluence with Galena Creek

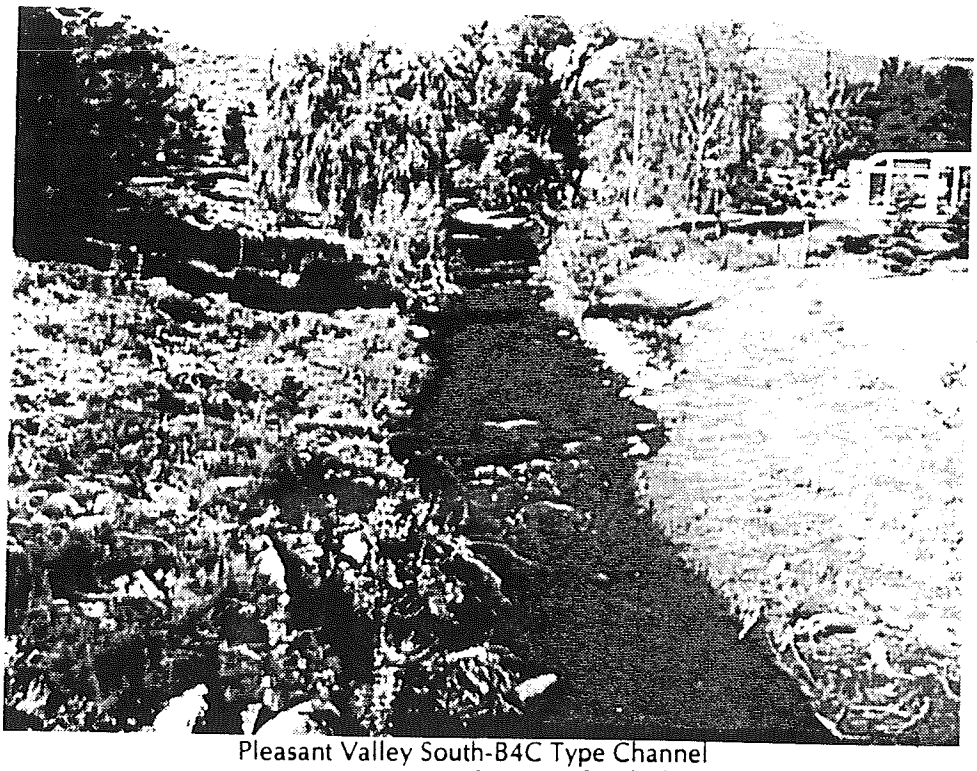


Soil Scoured to Bedrock Surface

Figure 11. Photos of Existing Steamboat Creek Conditions



Good Vegetation in Pleasant Valley South Reach



Pleasant Valley South-B4C Type Channel

Figure 12. Photos of Existing Steamboat Creek Conditions

3. PROJECT INVENTORY

- Truckee Meadows Regional Plan
- Washoe County Comprehensive Plan
- City of Reno Plans
- Approved/Unbuilt Projects
- Flood Control Master Plans
- South Truckee Meadows - Washoe Valley Water-Wastewater Facility and Management Plan
- Cultural Resources Protection - Washoe Tribe
- Conclusions

3. PROJECT INVENTORY - LAND USE

The purpose of the land use inventory was to identify adopted and anticipated land use policies affecting Steamboat Creek which will influence restoration efforts. Another relevant area of research was the inventory of approved but unbuilt projects adjacent to the creek. See also Figures 13 to 16.

A number of local policy documents apply to Steamboat Creek with the most specific falling generally in Washoe County jurisdiction. Steamboat Creek primarily lies within Washoe County. However, at Bella Vista Ranch Road/Short Lane Road, the Creek falls within City of Reno jurisdiction, continuing north until Pembroke Drive. The following policy documents contain information relevant to the creek system.

TRUCKEE MEADOWS REGIONAL PLAN

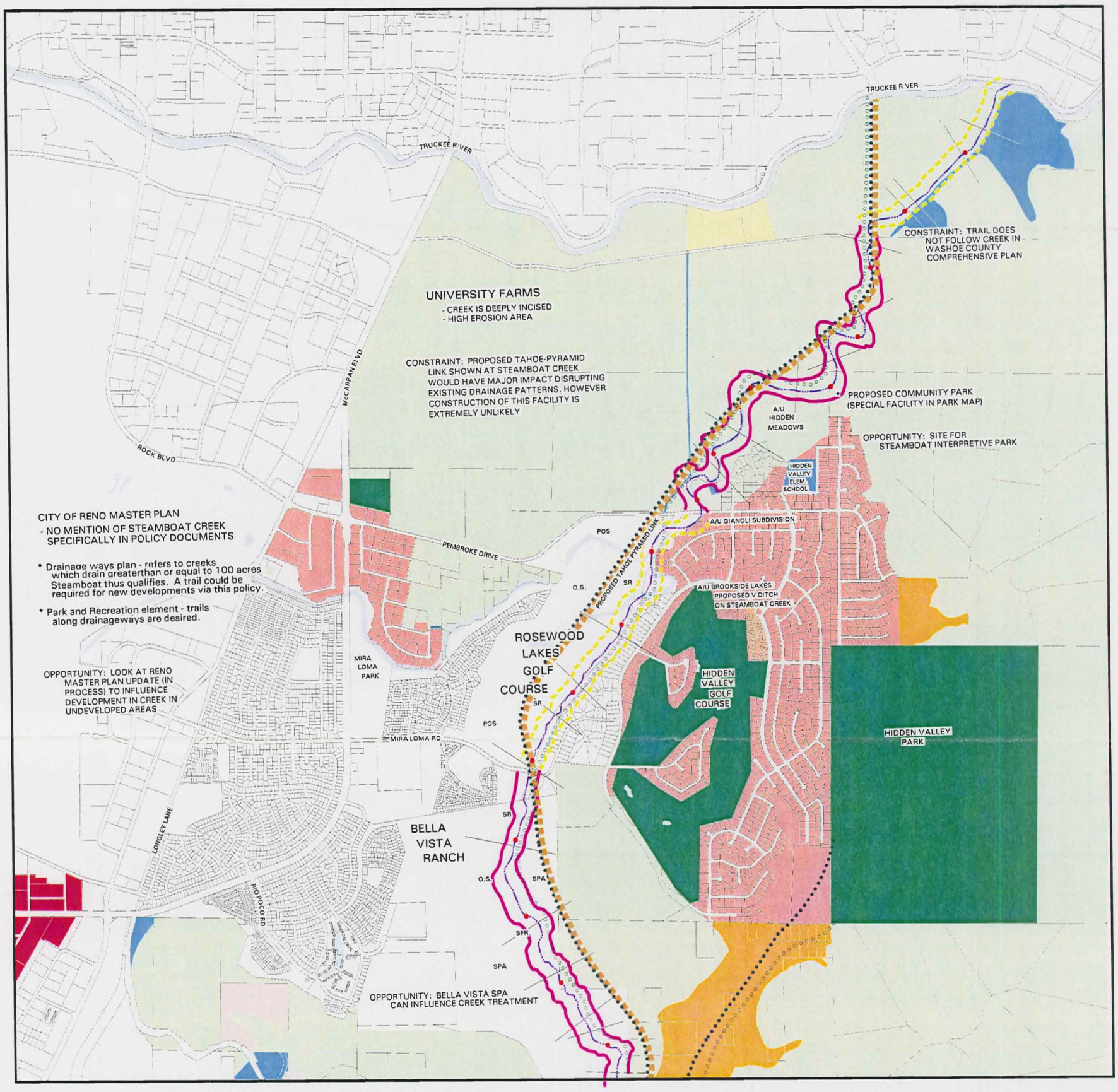
The Truckee Meadows Regional Plan sets guidelines dealing with creeks and drainage ways. It is the most general of the policy documents listed relevant to Steamboat Creek. A large majority of relevant information is located in Chapter IV - Conservation.

CONSERVATION ELEMENT

This chapter defines Steamboat Creek as a "Regional Stream Environment." Thus, many of the policies and objectives in the Water Resources section apply to the creek. Like the regulations set by Washoe County and the City of Reno, the Regional Plan calls for the maintenance of water quantity and quality within the creek. In addition, the plan calls for the Regional Water Service and Facilities Plan to be prepared by Washoe County, as the Regional Water Resource Management Agency (RWRMA). This plan will help to ensure that surface and groundwater sources are protected, and will set strict guidelines for development. The list of policies attached help explain some of the Regional Plan's goals regarding water quality in streams and creeks. The plan also has similar goals for the preservation of wetlands. One major policy is the prohibition of development in wetlands areas. Much of Steamboat Creek flows through this type of area.

Conclusions

The Truckee Meadows Regional Plan has many of the same guidelines set by other agencies within the county. It is the goal of all to protect streams, creeks, wetlands, etc. in order to ensure protection for the future. These areas can provide a source of water, or recreational areas such as bicycle paths, parks, or hiking trails. These agencies hope that through these policies and regulations, areas such as Steamboat Creek can become integral and aesthetically pleasing parts of our urban community.



LAND USE PLAN

STEAMBOAT CREEK PROJECT

- STEAMBOAT CREEK
- ACTIVE, MOST AGGRESSIVE, VERY EXPENSIVE
- ACTIVE, LESS AGGRESSIVE, MODERATELY EXPENSIVE
- PASSIVE, BUT WITH SIGNIFICANT ACTIVE TREATMENT OF TROUBLE SPOTS REQUIRED
- PASSIVE, WITH MINIMAL ACTIVE TREATMENT OF TROUBLE SPOTS REQUIRED
- PROPOSED HIGHWAYS AND ROADS
- WASHOE COUNTY COMPREHENSIVE PLAN TRAIL
- PARK DISTRICT MASTER PLAN TRAIL
- A/U APPROVED BUT UNBUILT DEVELOPMENT

- CITY / PUBLIC ROADS
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- MEDIUM DENSITY RURAL
- HIGH DENSITY RURAL
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- LOW DENSITY URBAN
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- HIGH DENSITY URBAN

- GENERAL COMMERCIAL
- OFFICE COMMERCIAL
- TOURIST COMMERCIAL
- INDUSTRIAL
- PUBLIC AND SEMI-PUBLIC FACILITIES
- PARKS AND RECREATION
- OPEN SPACE
- GENERAL RURAL
- SPECIFIC PLAN

SOURCE: WASHOE COUNTY DEPARTMENT OF WATER RESOURCES

DATE: JUNE 1998

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Figure 13. Land Use Composite

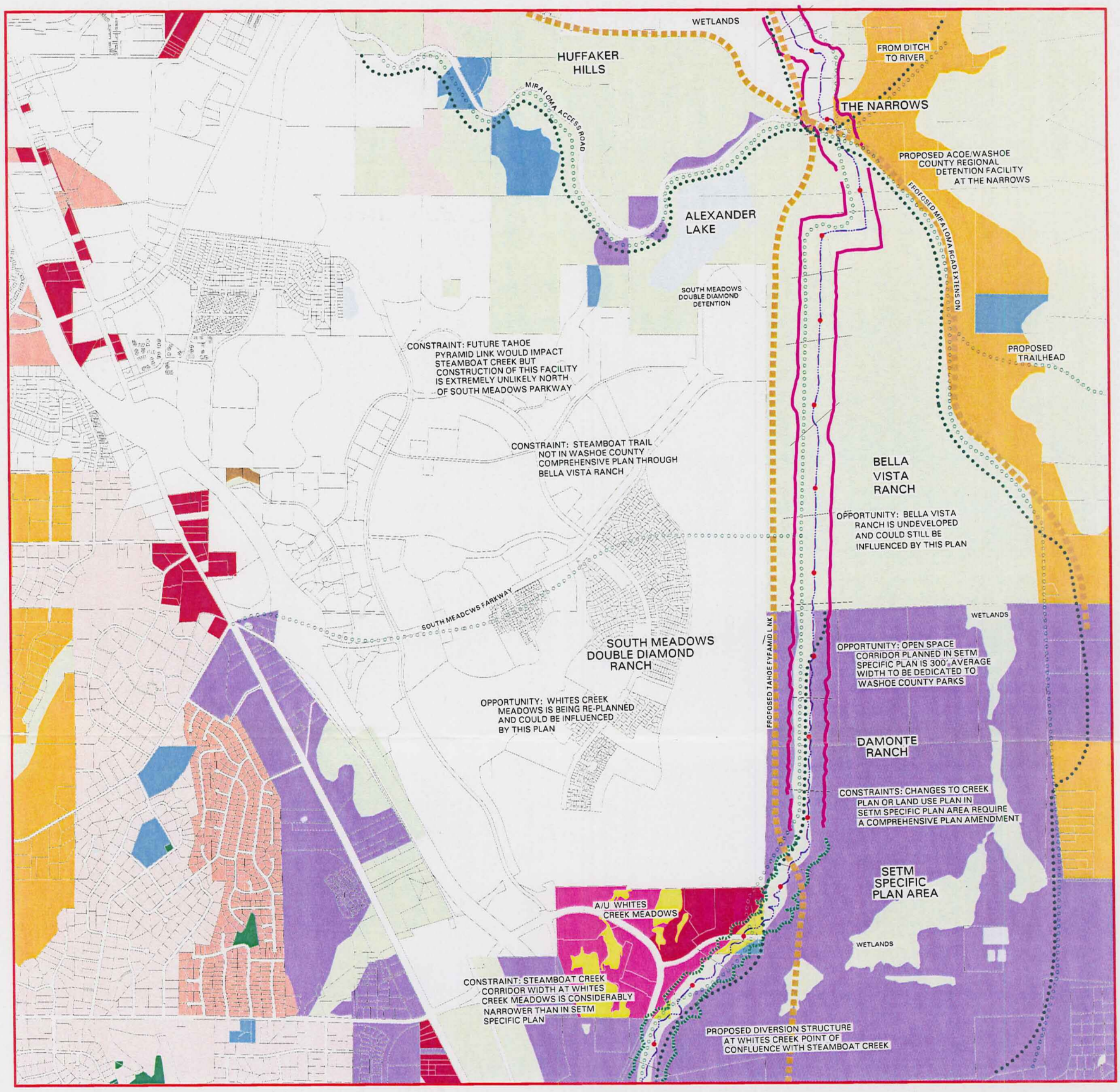

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Figure 14. Land Use Composite

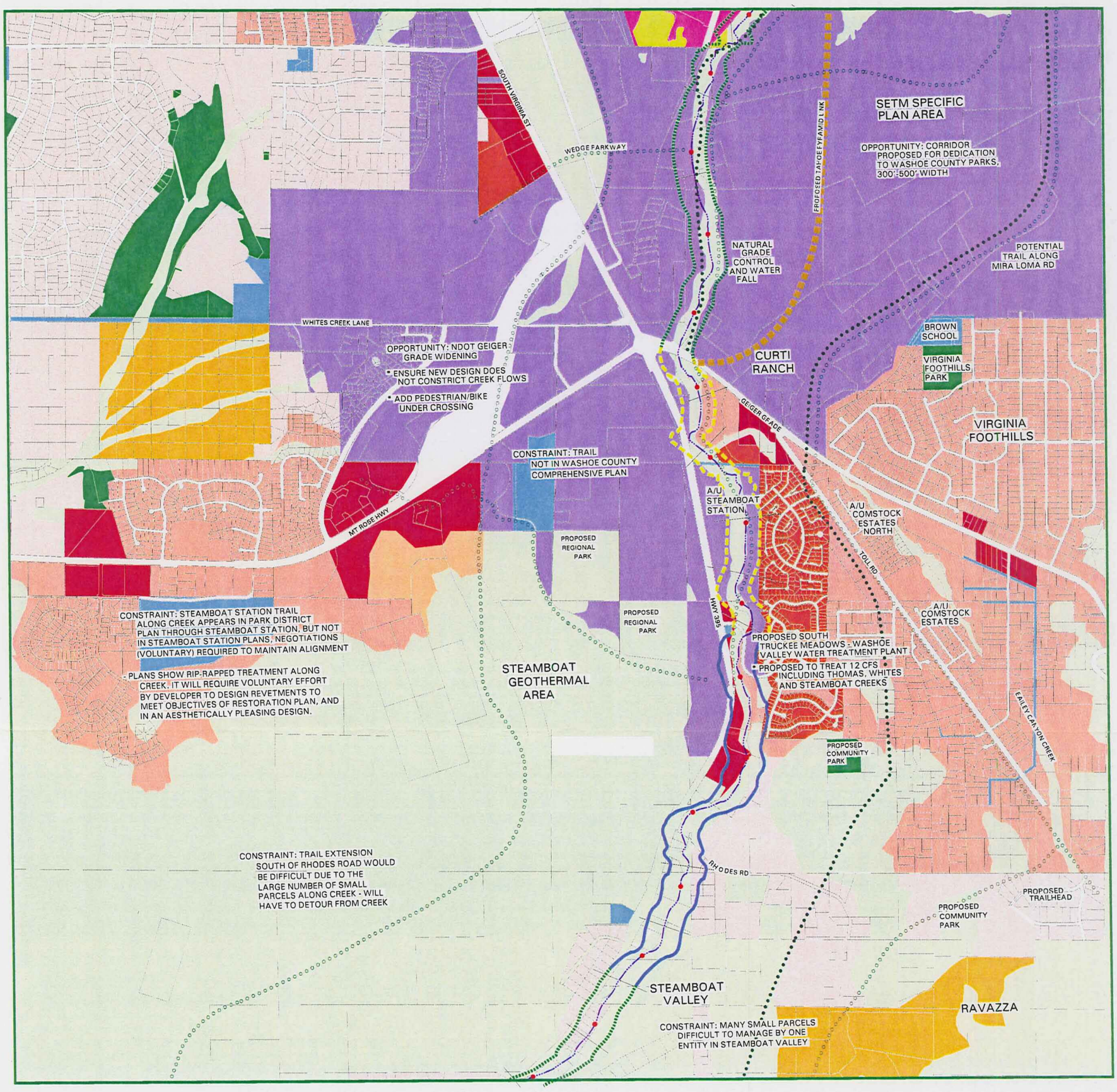

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Figure 15. Land Use Composite

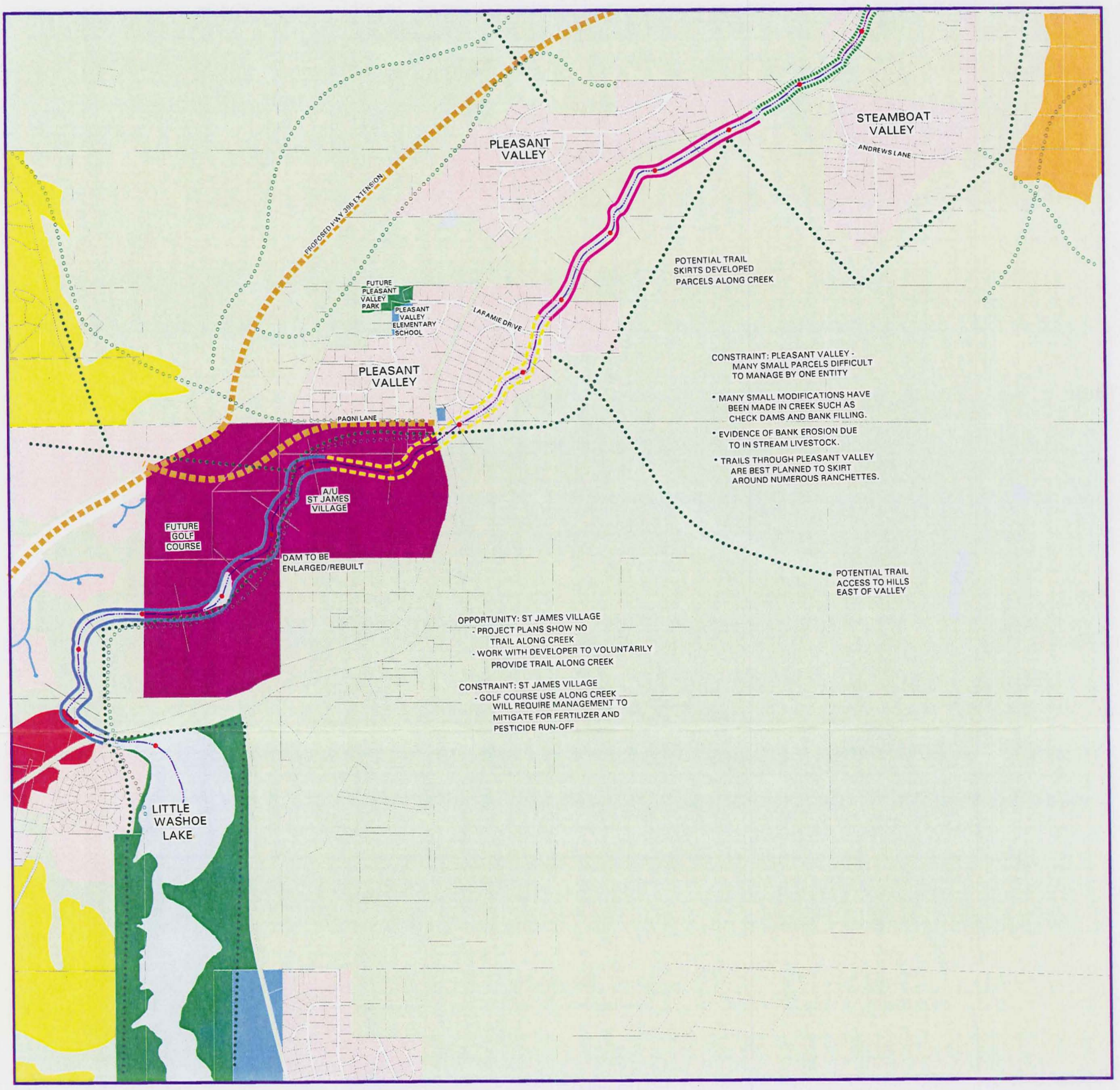

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Figure 16. Land Use Composite

WASHOE COUNTY COMPREHENSIVE PLAN

Washoe County has identified areas of concern and policies dealing with Steamboat Creek. This information is contained in the Comprehensive Plan, and more specifically the Southeast Truckee Meadows and South Valleys Area Plans.

COMPREHENSIVE PLAN - ELEMENTS

This section of the Comprehensive Plan identifies policies and action programs set by the County. One such policy which can be applied to Steamboat Creek is policy C.1.3 which prevents the destruction or loss of scenic resources. Steamboat Creek is identified as a scenic resource in both of the above-mentioned area plans. Also, policy C.2.1 protects "environmentally sensitive and/or critical land, water and wildlife resources that present development hazards or serve highly valuable ecological functions." In addition, policy C.2.4 protects riparian vegetation associated with streams, creeks, and wetlands. All of these policies aim to preserve and enhance the quality and value of Steamboat Creek.

SOUTHEAST TRUCKEE MEADOWS AREA PLAN

The Southeast Truckee Meadows Area Plan includes Steamboat Creek from its confluence with the Truckee River along the east side of the valley to approximately Rhodes Road in the Steamboat Valley. This area includes a portion of land around Steamboat Creek which lies within the City of Reno around the Rosewood Lakes area.

The plan identifies Steamboat Creek as both a scenic area as well as a major water resource. Thus, the county calls for the preservation of riparian zones surrounding the creek as well as wildlife habitats which it supports. To protect fish habitat, development activity should prevent the degradation of this waterway. Also, the creek provides habitat for mule deer as well as birds which depend on the creek and the surrounding wetlands for breeding grounds, etc. Most importantly, the plan lays out Washoe County's goal for the Steamboat Creek drainage south of Huffaker Hills. It is the goal of the county that the quantity and quality of water passing to the north shall not be reduced from historical quantity and quality. Another key goal regarding the creek is the preservation of Washoe Lake, Little Washoe Lake, and the Scripp's and Nevada State Wildlife areas in Washoe Valley. The County hopes that this will be possible by maintaining the historical consumptive losses in drainage. Development of the water resources are dependent upon surface water storage facilities as well as groundwater conditions. Development must prevent any siltation, pollution, erosion, or other surface water damage to the creek, and help to preserve and enhance the area's water resources. In addition, the county identifies that all areas bordering Steamboat Creek are areas prone to flooding. Policy SETM.2.1 sets out to "maintain Steamboat Creek and its environs as a greenbelt to provide scenic diversity as the area develops." Also, this policy calls for the acquisition of land along the creek for use as parks and trails.

Land Uses Shown on Southeast Truckee Meadows Area Plan

The existing land uses along Steamboat Creek within this planning area are predominantly agricultural. The master planned land use for the area immediately adjacent to the creek is General Rural. This zone was designated due to the presence of the creek and associated floodplains and wetlands. This zone can also apply to parcels which are under public ownership, although this does not apply to the creek in this planning area at this time since it is entirely private. The General Rural classification is intended for very low intensity development. (i.e., 1 dwelling unit per 40 acres). This a favorable designation for the creek corridor given the desire to establish a recreational corridor accessible to the public.

Outside of the General Rural designation immediately adjacent to the creek, a large area with the Specific Plan designation occurs south of the Bella Vista Ranch to north of Geiger Grade. This corresponds to the Southeast Truckee Meadows Specific Plan (SETMSP) which is discussed below.

The Public Services and Facilities Plan, a part of the area plan, illustrates a proposed multi-purpose recreational trail along many portions of the creek corridor. Two areas do not illustrate a trail. They are the creek corridor south of Geiger Grade, and the creek corridor through the Bella Vista Ranch. However, these areas are designated for a trail on the Park District Master Plan 3A and 3B. Since developers primarily look to the Washoe County Area Plans for information, it would be useful for the area plan to contain the information which occurs in the Park District plans, or for a reference about the Park District plans to occur in the Area Plan.

SOUTHEAST TRUCKEE MEADOWS SPECIFIC PLAN

The Southeast Truckee Meadows Specific Plan (SETMSP) is a planning policy document within the Southeast Truckee Meadows Area Plan. The SETMSP planning area includes land east of South Virginia Street, north of Geiger Grade, west of the existing Virginia Foothills developments and Mira Loma Road, east of the Double Diamond/South Meadows Development, and south of the Bella Vista Ranch. The SETMSP includes major portions of the Damonte Ranch, the Curti Ranches, the Ballardini and Caramella Ranches, and numerous small parcels. The area is primarily under the control of the Nevada Tri-Partners which is a partnership of DiLoreto Homes, Lewis Homes and Bailey-McGah Homes. The SETMSP establishes master planned land uses, design guidelines, performance standards, and infrastructure plans for the area, in more detail than the area plan. A large portion of Steamboat Creek falls within this plan from north of Geiger Grade to the Damonte Ranch/Bella Vista Ranch border, primarily in the west portion of the planning area.

Key components of the plan along Steamboat Creek are as follows:

- The Creek corridor is planned as open space with a trail system for future operation and maintenance by Washoe County Parks. The creek corridor width is designated as 200'+/-. The creek within this planning area is partially in its natural channel, then occurs in a straight "ditch" in the northern portion. This ditch was created at the turn of the century by farmers who wished to dry out the lowest portion of the valley for agriculture. The ditch also conveys irrigation water to ranches north of the planning area. This ditch runs out of the SETMSP planning area and north through the Bella Vista Ranch until the "narrows", and is recognized as a Water of the United States. Because of the federal jurisdiction and since the ditch occurs on properties owned by several different parties, the SETMSP left the "ditch" in its existing alignment and made it part of the open space and trail system, rather than attempting to realign the ditch and restore the system to the original state.
- A number of jurisdictional wetlands occur within the planning area near the creek. The plan utilizes the wetlands to create a large open space system and also for on-site storm water detention, where flood flows from Steamboat Creek would be routed into the wetland/detention system and then back to the creek at the northern edge of the planning area.
- A community park and several neighborhood park/ school combinations are planned along the creek corridor.
- A variety of land uses are planned adjacent to the creek corridor including residential, office, civic, commercial, and business park.

SOUTH VALLEYS AREA PLAN

The South Valleys Area Plan includes Steamboat Creek from approximately Rhodes Road in the Steamboat Valley through Pleasant Valley and to its origin at Little Washoe Lake. The area lies entirely within Washoe County.

The South Valleys Area Plan, like the Southeast Truckee Meadows Area Plan, identifies Steamboat Creek as a scenic, wildlife, and water resource. The same regulations mentioned in the Southeast Truckee Meadows Area Plan apply to the South Valleys Area Plan as well. In addition, the plan identifies areas around the creek as being prone to flooding. However, the plan sets no policies concerning the creek. Instead, the South Valleys plan focuses more on Washoe Lake than on individual streams, creeks, and drainage ways.

Land Uses Shown on South Valleys Area Plan

The existing land uses along Steamboat Creek within this planning area are predominantly agricultural. The master planned land use for the area immediately adjacent to the creek is General Rural in undeveloped areas. As with the Southeast Truckee Meadows Area Plan, this zone was designated due to the presence of the creek and associated floodplains and wetlands. This zone can also apply to parcels which are under public ownership, although it does not apply to the creek in this planning area at this time since it is entirely private. The General Rural classification is intended for very low intensity development. (i.e., 1 dwelling unit per 40 acres). This a desirable designation for the creek corridor given the desire to establish a recreational corridor accessible to the public.

A number of parcels along the creek corridor, especially in Pleasant Valley in the vicinity of Laramie Drive, are designated as Low Density Suburban. This is because the area consists of many one acre ranchettes with existing homes. The Low Density Suburban designation is intended to create and preserve areas where single-family, detached homes on one acre lots are predominant. This designation is appropriate for the existing land use of one acre parcels. However, due to the small size of the existing ranchette parcels and the high concentration, it is unlikely that the creek will become accessible to the public. Recreational trail linkages will have to be routed around these areas and link beyond these areas or abandoned entirely.

Beginning at Pagni Lane in Pleasant Valley, a large area around the creek is designated as Tourist Commercial, until just before the creek's origin at Little Washoe Lake. This designation corresponds to an approved but unbuilt project known as the Saint James Resort. The land use designation by itself does not promote use of the creek corridor as a recreational facility accessible to the public. However, the Public Services and Facilities Plan in the area plan shows a proposed multi-purpose recreational trail through the Saint James Resort project. It is likely that the proposed trail designation was made after the approval of the Saint James Resort project since current plans for the resort route a recreational trail around the property perimeter to avoid a public trail at the center of the private facilities. The timeline for development of the project is not known at this time. It is possible that contacts could be made with the developers to encourage the location of a trail along the creek corridor. For a more detailed explanation of the project, see the Saint James Resort in the Approved but Unbuilt project list.

Conclusions

All in all, Washoe County has identified numerous areas of concern regarding Steamboat Creek in the Comprehensive Plan as well as the individual area plans mentioned. Like the City of Reno, the County has stated their desire to preserve the creek and its surroundings either in its natural form or by uses such as equestrian/hiking trails, parks, or other public facilities.

WASHOE COUNTY REGIONAL OPEN SPACE PLAN

The Washoe County Regional Open Space Plan discusses creeks and their role in parks, open space, and wildlife areas. This plan focuses less on development restrictions, and more on how these areas help us to build a better quality of life for our communities.

Lakes, Steams, Riparian Corridors and Playas

This section of the plan focuses on issues that would be pertinent to Steamboat Creek. One of the important factors discussed is vegetation, and how it is vital that natural vegetation be preserved around creeks and streams. Preserving natural vegetation will slow runoff, reduce siltation, and aid in ground water recharge. Also, this plan defines both perennial and seasonal streams as resources which require protection. Like the other plans, the Regional Open Space Plan sets standards in defining stream environment zones, playas, and riparian vegetation.

Wetlands

This section of the plan identifies areas of concern regarding wetlands areas. These concerns include urban runoff, siltation, fertilization, flood dangers, etc. Also, the plan discusses the need to preserve these areas for wildlife habitats. In addition, wetlands can provide for education, research, and recreation, as well as an aesthetically pleasing break in the urban environment. Like the section on streams, this section defines the characteristics and criteria of wetlands.

Trails and Bike Paths

The plan identifies the fact that areas around creeks, streams, and wetlands are ideal locations for trails, bikepaths, and other forms of recreation. These trails will not only provide for recreation, but can also allow access to remaining areas of natural or cultural significance. Another factor which the plan considers when dealing with trails are parking concerns. Key parcels or easements could be converted to use as parking areas for those wanting access to the trails. Adequate access to these trails is a major priority of the Regional Open Space Program. The Regional Trail System map shows the potential for trails along or near Steamboat Creek.

Floodplains, Floodways and Flood Control Facilities

The Regional Open Space Plan calls for the preservation of flood zones as open space. Most obviously, this is to provide protection of persons and property. Also, these flood plains, such as some of the areas surrounding Steamboat Creek, can provide buffers between development and recreational opportunities.

Open Space Acquisition

Washoe County hopes to acquire numerous parcels in order to preserve areas as open space. These areas would include flood plains, wetlands, wildlife habitats, etc. The Potential Open Space Acquisition map illustrates these areas, many of which border Steamboat Creek. In addition, the Open Space Composite map illustrates the potential for these areas within Washoe County.

Conclusions

All in all, the Regional Open Space Plan is another measure Washoe County has taken which recommends that we preserve or do not further damage areas which contain scenic and natural resources, such as Steamboat

Creek. The document focuses less attention on development, and more on defining areas which should be considered sensitive. In addition, the plan sets goals for open space acquisition as well as trail construction.

WASHOE COUNTY PARK DISTRICT MASTER PLANS

The Washoe County Parks Department has detailed park master plans for many portions of the County. The Park District plans are approved by the Washoe County Board of Commissioners and are then intended to become part of the Washoe County Comprehensive plan. According to the Washoe County Parks Department, until the items illustrated on the Park District plans are incorporated into each relevant County Area Plan, the park district plan should be used for reference as the most current park plan. However, there is some concern that Washoe County Comprehensive Planning does not recognize these plans in this interim period. This could be an issue since trail development is largely dependent upon easements dedicated as private land development occurs. As mentioned earlier, it would be useful to rectify this discrepancy. Since developers usually look at the Washoe County Area Plans for guidance on land use policies, it would be useful if the area plans contained the same information as the park district plans. If this cannot occur, it would be useful if the area plan referenced the relevant park district plan to guide the user to the most detailed information about policies regarding park plans.

As with all Park District Master Plans the facility location, particularly trail locations, are intentionally schematic to allow for flexible negotiations with affected property owners, or multiple routes to accommodate trail destinations.

DISTRICT 3A & 3B

Park District 3A & 3B covers the area from the Truckee River to Pleasant Valley. Steamboat Creek traverses the central portion of Park District 3A & 3B. The plan denotes several important desired facilities along Steamboat Creek. A primary trail is proposed along the creek from the Truckee River trail continuing south past Geiger Grade up to the Steamboat Hot Springs Resort area. A special facility is proposed in conjunction with a proposed community park off Parkway Drive close to the creek, near the Hidden Valley Elementary School. Several community parks are proposed in the southeast Truckee Meadows in the Damonte Ranch area.

Conclusions

The Steamboat Creek corridor would provide the primary north/south trail corridor in the Southeast Truckee Meadows, providing links to many other proposed trail corridors. However the trail link which is illustrated in the City of Reno jurisdiction is not specifically planned for by the City at this time, particularly in the Bella Vista Ranch area north of the Mira Loma Haul Road. North of Mira Loma Road a trail would align with Hidden Valley Drive rather than the creek due to the Rosewood Lakes Golf Course.

DISTRICT 1C

The Park District 1C Master Plan covers the area of the Southwest and South Valleys portions of the Truckee Meadows. Steamboat Creek runs along the extreme east and south edge of this planning district. Few facilities are illustrated along Steamboat Creek in this area because most of the adjacent properties are already developed into ranchettes and small parcels which are not conducive to trail development. A primary trail is illustrated along Steamboat Creek in the Washoe Hill area, at the Saint James Resort project, then adjoining Little Washoe Lake.

Conclusions

The trail alignment illustrated in the park district plan is incongruent with the Saint James Resort development plan which routes the trail around the project perimeter rather than adjacent to the creek.

CITY OF RENO PLANS

The City of Reno has numerous ways of defining stream environments and restrictions associated with them. The following documents all contain some sort of information regarding stream environments, open space, wetlands, etc. Although Steamboat Creek is not directly addressed in each document, all contain pertinent information.

CITY OF RENO MASTER PLAN PART ONE: GROWTH AND DEVELOPMENT

The City of Reno Master Plan (dated March 28, 1997) contains Land Use Designation maps which illustrate proposed land uses. The areas which include Steamboat Creek include north Bella Vista Ranch and Rosewood Lakes. The north Bella Vista Ranch is designated Special Planning Area which allows individual and combinations of land uses and where large land holdings can be developed with a mix of uses in one entity. This will allow for flexibility to plan around the creek if this land is developed in the future. The Rosewood Lakes area is designated as Open Space where Steamboat Creek already occurs within the Rosewood Lakes Golf Course and flood control channel. These are the only areas of Steamboat Creek within the City of Reno at this time, and also within the Reno sphere of influence for annexation. The area downstream of Rosewood Lakes, University Farms, is within Washoe County and is out of Reno's Sphere of Influence for annexation.

The Master Plan sets the goal of preserving as open space all natural drainage courses within developing areas. These drainage courses are defined on the Major Drainage Ways Plan or in the Wetland and Stream Environment Policy. Neither of these documents identify Steamboat Creek as a major drainage way, although it meets all criteria. In addition, the Master Plan discourages channelization of these areas. If channelization is an absolute necessity, natural materials must be used. Also, it is set in the plan that " there shall be no net loss of wetlands, stream environments, playas, stream fed riparian and non-404 wetlands in the city in terms of both acreage and value." Thus, new development must not interfere with key wildlife habitats, and mature trees should be retained in the development process. Buffers or open corridors are required along Alum and Hunter Creeks, as well as any other identified corridor. This too would apply to Steamboat Creek. All in all, the Master Plan discourages development in these sensitive areas, and requires that special engineering efforts be made to preserve them.

WETLAND AND STREAM ENVIRONMENT POLICY

This document expands on the conditions laid out in the Master Plan. To begin with, a Stream Environment Zone is defined as an area which surrounds a major/minor stream, or drainage way which owes its characteristics to the presence of water; an area inundated by a stream; land located within the normal high water mark; or an area where human actions can directly affect the stream, etc. These zones can include streams, ponds, lakes, and wetlands. There are three classes in determining significant hydrological resources. Class I is a prime resource which provides public value. Public value includes but is not limited to: endangered plants and animals, riparian vegetation, and surface water areas. Also laid out in the document are all city building and development codes dealing with Drainage ways. Steamboat Creek is defined by this document as being a "Potential Stream Environment." Thus, the creek would be protected from pollution, as well as

erosion. Also, appropriate recharge levels would be maintained, as well as natural drainage. Finally, the drainage way would serve as a flood control channel for urban areas. All in all, the Wetland and Stream Environment Policy, like the Master Plan, calls for the preservation of these areas not only for recreation and aesthetic reasons, but for plants and animal habitats as well.

MAJOR DRAINAGE WAYS PLAN

This plan identifies critical drainage within the city and its sphere of influence, and concerns itself with environmental results and appearance. The document defines a drainage way as an area with some or all of the following characteristics. An area draining more than 100 acres; having biological and physical characteristics associated with the conveyance of water; connecting open spaces or neighborhoods, provides for pedestrian/bicycle paths or wildlife corridors; provide open space between similar or different development types. The document lays out three drainage way types: disturbed, natural, and landscaped. Thus, Steamboat Creek would once again qualify for these regulations despite the fact that it is not identified by the city. The plan, like the others, aims to ensure that wildlife areas are monitored, groundwater is recharged, and erosion is minimized. In addition, the plan discourages the building of solid fences along Drainage ways, and encourages the construction of bike paths along these channels. Bike paths are typically constructed of asphalt or concrete and are a standard eight feet in width. If a path is limited to use by pedestrians only, then the standard path width may be reduced to four feet. Pedestrian paths do not necessarily require paving as do bike paths. The plan also lays out engineering requirements. For example, discharge of storm drain waters in to a drainage way is not allowed to increase flows above that which exist, or which will negatively effect those downstream of the site. Finally, the plan calls for all Drainage ways to be dedicated to the City of Reno, which compels them to maintain the areas.

BIKEWAYS PLAN

The bikeways plan simply identifies standards for bike paths, as well as the areas to which they are most well suited. The plan identifies drainage rights-of-way as an ideal location for a bicycle pathway. Thus, Steamboat Creek would qualify for this type of recreational use.

CONCLUSIONS

All of the plans implemented by the City of Reno call for the preservation and consideration of Drainage ways within the city in regards to development. The Drainage ways can serve as open space and recreational areas within urban clusters, thus allowing for development to be more aesthetically pleasing. However, one discrepancy which exists in all of the above mentioned plans is that Steamboat Creek is not identified as a major drainage way. The only mention of Steamboat Creek is in the *Wetland and Stream Environment Policy*, where it is defined as a "Potential Stream Environment." Thus, it would be up to the City of Reno to decide whether or not all of these policies apply to Steamboat Creek. As part of the region's trail network system, it would be helpful if stronger statements were included in policy documents and also graphically for the Steamboat Creek system if a link is to occur in the City of Reno portions of the corridor.

APPROVED/UNBUILT PROJECTS

Approved but unbuilt projects located adjacent to Steamboat Creek were compiled for land use and technical reference. The projects were compiled primarily from information by Washoe County Development Review and City of Reno Community Development Department. The intent of this research was to analyze potential developments adjacent to the creek and determine the relationship to the Steering Committee goals for stream

restoration. The following list corresponds to the previous figures illustrating the composite land use where the project location can be found.

1. Hidden Meadows Subdivision

In Washoe County, the proposal is for an 87 lot subdivision with minimum lot sizes of 15,000 square feet. The 72.85 acre property is located north and west of the intersection of Native Dancer Drive and Alphabet drive, adjacent to Hidden Valley Elementary School. The parcel is designated Medium Density Suburban (MDS) and General Rural(GR) in the Southeast Truckee Meadows Area Plan.

The proposal contains a proposed 5.2 acre wetland mitigation site adjacent to Steamboat Creek which was permitted by the U.S. Army Corps of Engineers in exchange for offsite filling of 2.6 acres of wetlands on Dermody Properties. The mitigation project has been constructed.

Altmann Construction
539 Riverside Drive
Reno, NV 89503

2. Hidden Meadow South Subdivision

In Washoe County the proposal is to develop a 14-lot single family subdivision on an 11.8 acre property designated Medium Density Suburban (MDS) and General Rural(GR) in the Southeast Truckee Meadows Area Plan. Since the project proposed using the E-1 (First Estates) zoning, a site review was required by the transition policy. The properties are adjacent to the previously-approved Hidden Meadow Subdivision (TM12-18-94) and northwest of Tamarisk Drive and Pembroke Drive. The site would be developed as a common open space development with 5.3 acres of open space and minimum lot size of 15,000 square feet.

Altmann Construction
539 Riverside Drive
Reno, NV 89503

3. Gianoli Subdivision

Gianoli Subdivision is a single family residential subdivision creating 12 lots on 5.2 acres. The site is located in Reno on the west side of Hidden Valley Drive and to the north of Hidden Valley Golf Course. The majority of storm flows generated by the project will be directed to Hidden Valley Drive and not to the Boynton slough. This will prevent petrochemical contamination associated with street runoff from discharging into the Boynton slough. The project is located in a zone A flood area, area of 100-year flooding.

Engineer:
Mountain West Consulting
499 West Plumb, Suite 4
Reno, NV 89509

4. Brookside Lakes Subdivision (the original name, now called Rosewood Lakes)

The Brookside Lakes Subdivision is an ongoing single family subdivision located east of the Rosewood Lakes Golf Course. It is unclear how many lots are still to be constructed at this time. The significant aspect of the proposal are plans for the channelization of a portion of Steamboat Creek east of the golf course and west of Hidden Valley Drive. See reach by reach descriptions for assessment of the project.

Engineer:
CFA
1150 Corporate Boulevard
Reno, NV 89502

5. Proposed Tahoe- Pyramid Link

The proposed Tahoe-Pyramid link is intended to provide an arterial roadway along the east side of the Truckee Meadows from Mount Rose Highway to the City of Sparks. The southerly portion from Mount Rose Highway to approximately Mira Loma Road is the only likely portion of the roadway to be built. The link to the north is now blocked by the Rosewood Lakes Golf Course. The significance of the roadway is that it aligns closely with Steamboat Creek. Consequently, surface flows will be disrupted and many culvert crossings would be needed to accommodate flows into the Steamboat Creek.

6. Double Diamond/South Meadows PUD

The Double Diamond/South Meadows PUD is very near Steamboat Creek, but not quite adjacent. The project is located in the City of Reno east of Virginia Street, north of Zolezzi Lane, south of Huffaker Hills, and west of Steamboat Creek. The area is planned for golf courses, a business park, and many residential uses. The significance of the project is that the urbanization of the land which is now pasture, will increase impervious coverage and potentially petrochemical runoff which could eventually impact Steamboat Creek.

7. White's Creek Meadows Subdivision

The proposal is for a 519-lot single family density transfer subdivision situated on a +172.5 acre portion of the original Damonte Ranch, immediately south of and adjacent to the Double Diamond Subdivision in Washoe County. The property is zoned R-3 (Multiple Residential), R-2a(Limited Multiple Townhouse, A-1 (First Agricultural) and C-2 (General Commercial) and was developed under zoning with site review. Several hundred feet of Steamboat Creek flow into the southeast corner of the site. A 50' - 100' wide corridor is provided for the creek.

The developer has applied for a master plan amendment to change the use from single family to business park. They intend to comply with requirements of the Southeast Truckee Meadows Specific Plan (SETMSP). The corridor allowed for Steamboat Creek in their subdivision plan is currently inconsistent with the 200' creek corridor designated for the creek in the SETMSP, which occurs on either side of the project. The developer has agreed to match the creek corridor size of that in the SETMSP.

Developer:
Nevada Tri-Partners
Charlie Carter
DiLoreto Construction

1425 E. Greg
Sparks, NV 89431

8. Steamboat Station/Sam's Town

The project is located south of Geiger Grade and east of South Virginia Street on 101 +/- acres of land zoned General Commercial. The project contains a multi-story hotel/casino, an RV park, and an equestrian facility. Steamboat Creek runs through the center of the site, and Bailey Creek flows into Steamboat Creek in the northeast portion of the site. The plans illustrate no pathways along Steamboat Creek. The plans also illustrate many 2:1 rip rap bank treatments along the Creek, presumably to narrow the corridor and create more developable space. Discussions with the Washoe Tribe representative for the area and with local residents indicate that this portion of the Creek may contain many artifacts since native people were very active at the Steamboat Hot Springs and in this part of the valley.

The plans do not illustrate a trail along Steamboat Creek even though the Park District 3A & 3B Master Plan shows a trail in this area. It is possible that no trail was illustrated on master plans for Steamboat Creek in this area when the Steamboat Station was first approved in the 1980s. It is unclear how a trail along this portion of Steamboat Creek would tie in to parks or other trails farther to the south since the Steamboat and Pleasant Valleys are parceled into many ranchettes precluding a trail along Steamboat Creek. Plans for the widening of Geiger Grade are supposed to include culverts for Steamboat Creek and for a mixed use trail crossing. If there is a useful trail connection to the south of Geiger Grade, the developer could be approached about continuing a trail in this location. However, we recognize that this would be voluntary.

Additionally, influencing the type of slope stabilization treatments made along the Creek in areas planned for rip-rap to encourage an attractive and functional treatment which coincide with recommendations in this study would be timely as well.

Developer:
Boyd Gaming Corporation
2950 South Industrial road
Las Vegas, NV 89109-1100

9. St. James Resort and Conference Center

The 572.7+/- property is located on the west side of Highway 395 south of Pleasant Valley, northeast of Washoe Hill, and north of Little Washoe Lake. The master plan includes a hotel/conference center/casino, condominium units, and a golf course. Steamboat Creek flows through the center of the property and Browns Creek flows through the property entering from the west to join Steamboat Creek at a central lake. The lake occurs due to a dam which creates water impoundment.

One of the stated goals in the project description is to leave as much of the site as possible undisturbed. Brown's Creek and Steamboat Creek are scheduled to be " reworked" to assure conveyance of the 100-year storm event. The water impoundment structure, including the basin, dam, and spillway are to be reconstructed.

The project does not include a trail along Steamboat Creek although one is illustrated in that location on the Park District 1C Master Plan, and in the South Valleys Area Plan - Public Services and Facilities map. Instead, the developer proposed a trail "in compliance with the Regional Parks and Trails Plan" along the periphery of the project site along the south and eastern perimeter. It is unknown whether the project was approved before

or after the Park District and Area plans which illustrate a trail adjacent to Steamboat Creek, or whether the developer was approached about aligning the trail with the creek. The status and timing of the project are also unclear. It may be worthwhile to contact the developer regarding a modification of the trail location. However, we recognize that this would be voluntary.

Property Owner/Developer:
The Dahlawi Nevada Corporation
11766 Wilshire Blvd., Suite 780
Los Angeles, CA 90025

CONCLUSIONS

The projects listed have generally obtained some level of entitlement such as a tentative map or special use permit approval; several of the projects have approved final maps. Thus, if modifications to these projects are desired, the property owner will have to be approached for voluntary changes while the entitlements are still active.

FLOOD CONTROL MASTER PLANS

The focus of this plan is for stream restoration. However, we recognize the need for planning for large flooding events (25 year and higher). We recommend that designs promoted in this study for multi-stage stream cross-sections should be approached in conjunction with flood control management and design.

We also recommend that future flood control projects be designed to minimize the risk of damage to stream restoration projects in this study.

Several flood control master plans have been approved adjacent to Steamboat Creek.

1. Southeast Truckee Meadows Flood Control Master Plan

The Flood Control Master Plan was developed to complement the Southeast Truckee Meadows Specific Plan. The Flood Control Master Plan was approved as a Washoe County Comprehensive Plan Amendment in the fall of 1995. The plan describes many flood control features adjacent to Steamboat Creek and the proposed detention facilities. See Section 4 for recommendations regarding this plan in these reaches of Steamboat Creek.

2. Washoe County Regional Detention Facility

The Regional Detention Facility is proposed at the Huffaker Narrows by the Army Corps of Engineers and Washoe County. The facility would detain storm flows in the southeast Truckee Meadows. See Section 4 for recommendations regarding this plan in these reaches of Steamboat Creek.

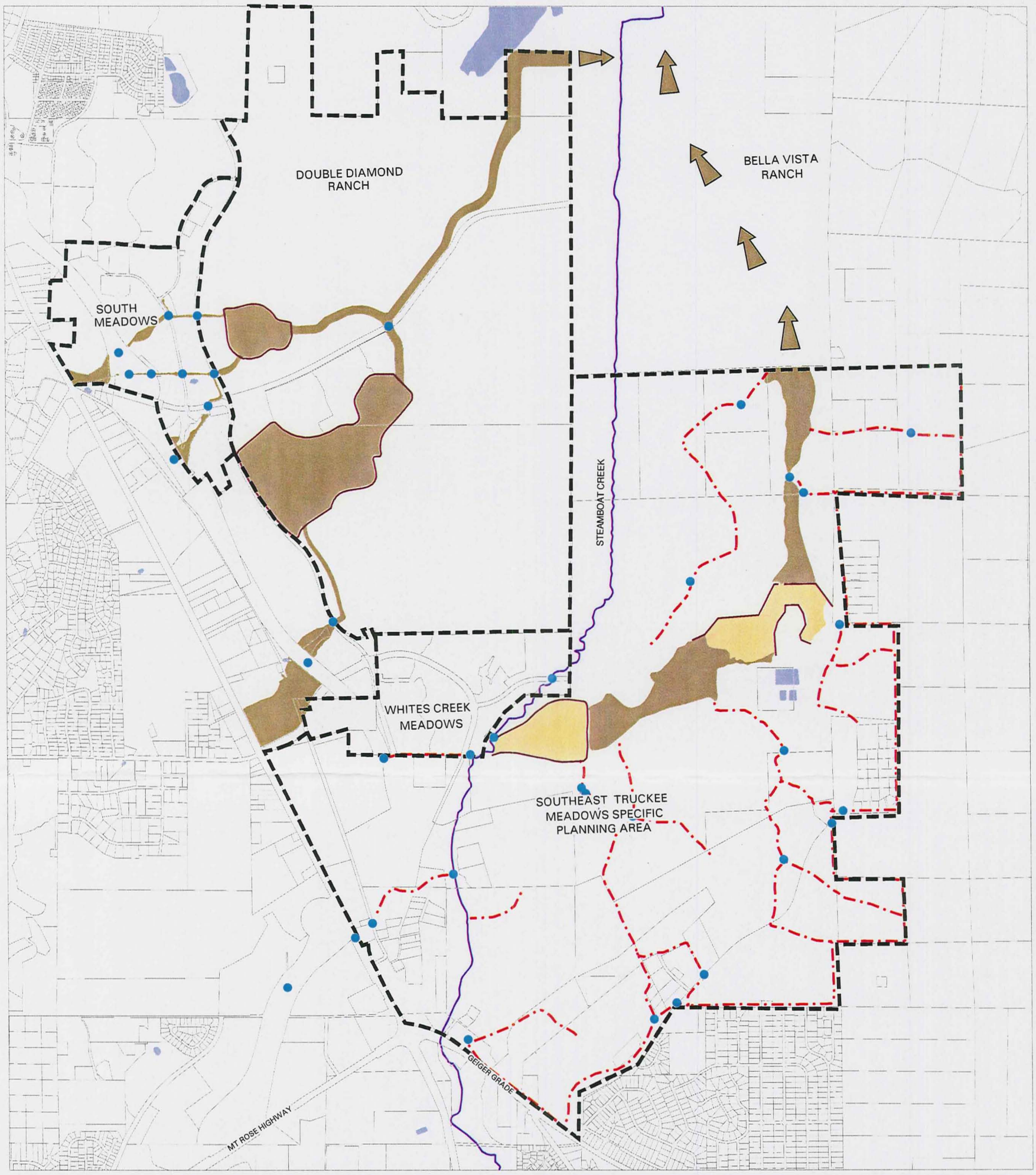
TAHOE-PYRAMID LINK

The proposed highway corridor would link Geiger Grade at Mt. Rose Highway to Pyramid Highway in Sparks. The land use composite Figures 13 - 16 illustrate the alignment proposed in the Washoe County Comprehensive Plan. Additional alignment studies prepared by the Regional Transportation Commission in 1997 showed alternatives including one in close proximity to Steamboat Creek. Where this or any other roadway occurs close

to the Creek, space should be provided to allow for the Creek restoration and provision of a multi-stage channel.

PLEASANT VALLEY SEWER INTERCEPTOR

The proposed sewer interceptor, by Washoe County Utilities, will occur within the Steamboat Creek drainage and south to the St. James Village development in Pleasant Valley. Where it occurs near the Creek, construction and maintenance access facilities should be designed to be compatible with recommendations of this plan. The maintenance access roads can also be used for multi-purpose trails.



SOUTH TRUCKEE MEADOWS

FLOOD CONTROL MASTER PLAN

- FULL CHANNELIZATION
- DETENTION BERMS
- PARCEL LINES
- SPECIFIC PROJECT AREAS
- CULVERT OR BRIDGE
- DETENTION FACILITY
- FLOODWAYS
- WATER BODIES

SOURCE: WASHOE COUNTY DEPARTMENT OF WATER RESOURCES

DATE: JUNE 1998

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SCALE IN FEET

Department of Water Resources

WASHOE COUNTY NEVADA

Post Office Box 11130
Reno, Nevada 89520
(702) 954-4600

Figure 17. South Truckee Meadows Flood Control Masterplan

SOUTH TRUCKEE MEADOWS - WASHOE VALLEY WATER- TREATMENT FACILITY AND MANAGEMENT PLAN

The water treatment facility is proposed at the junction of Steamboat Ditch and Steamboat Creek in the vicinity of Rhodes Road. The facility would provide treatment of ground water and surface water in the southwest and southeast Truckee Meadows. The plant is proposed by Washoe County Utilities. Steamboat Creek stream flows would be altered by the treatment facility, as well as flows from Thomas and White's Creeks. It would desirable to maintain a minimum level of stream flow if this project is implemented. The Washoe County Utility Division should be contacted regarding this issue. See Section 4 for recommendations regarding this plan in these reaches of Steamboat Creek.

CULTURAL RESOURCE PROTECTION - WASHOE TRIBE

The Washoe Tribe, in their Comprehensive Land Use Plan, 1994 identifies Goals and Policies for Cultural Resources. The following Goals and Policies are relevant to management of cultural resources in the Steamboat Creek efforts.

CULTURAL RESOURCE GOALS

Goal One: Maintain an effective cultural resource program at the Tribal level, including implementation of a cultural heritage management program.

Goal Two: Preserve and protect sacred areas, significant archeological sites, and resources critical for maintaining cultural practices in contemporary life on Tribal lands.

Goal Three: Interact with agencies and governments in the aboriginal area to preserve cultural resources.

Goal Four: Ensure that cultural resource surveys are performed on Tribal lands planned for future development.

Goal Four: Develop a facility for archival storage of Washoe materials and artifacts, contemporary cultural events, and for education of the public on the rich Washoe heritage of the region.

Goal Five: Seek to protect all known ceremonies and ancestral burials in a safe, undisturbed state throughout traditional Washoe lands.

Cultural Resource Policies:

Policy One: Concerning burials and ancestral remains outside of contemporary Washoe control, mitigation criteria will include, in priority order: 1) Assurance of long-term safety from disturbance and destruction; 2) Preserve original burial site; 3) Maintain closest proximity to original site when reburial is essential; and 4) adequately care for the spiritual implications of reburial or disturbance.

Policy Two: The Cultural Resource program will decreasingly rely on outside information sources and instead develop internal Washoe expertise in all cultural heritage domains. This will include research library material, archival data, databases, and qualified personnel.

Policy Seven: Complete archeological/cultural resource surveys on all Tribal lands to at least similar standards as those used by the Bureau of Land Management. Establish a database of known sites and a geographic record of surveyed areas.

Policy Eight: Archeological and other sensitive cultural resource records will be maintained in a strictly confidential manner and not released to the public.

CONCLUSIONS

The preceding information in this section is intended to be objective and informative. The information intends to respond to the goals for this study (see page 1). We recognize that many of the aforementioned plans are already approved and that modifications to them will be voluntary for the relevant developer or owner.

However, we recommend that the following projects be approached about potential modifications to their approved plans in order to achieve the goals of this plan.

1. Land Uses Shown on Southeast Truckee Meadows Area Plan

   The Public Services and Facilities Plan, a part of the area plan, illustrates a proposed multi-purpose recreational trail along many portions of the creek corridor. Two areas do not illustrate a trail. They are the creek corridor south of Geiger Grade, and the creek corridor through the Bella Vista Ranch. However, these areas are designated for a trail on the Park District Master Plan 3A and 3B. Since developers primarily look to the Washoe County Area Plans for information, it would be useful for the area plan to contain the information which occurs in the Park District plans, or for a reference about the Park District plans to occur in the Area Plan.

2. City of Reno Plans

   All of the plans implemented by the City of Reno call for the preservation and consideration of Drainage ways within the City in regards to development. The Drainage ways can serve as open space and recreational areas within urban clusters, thus allowing for development to be more aesthetically pleasing. However, one discrepancy which exists in all of the above mentioned plans is that Steamboat Creek is not identified as a major drainage way. The only mention of Steamboat Creek is in the *Wetland and Stream Environment Policy*, where it is defined as a "Potential Stream Environment." Thus, it would be up to the City of Reno to decide whether or not all of these policies apply to Steamboat Creek. As part of the region's trail network system, it would be helpful if stronger statements were included in policy documents and also graphically for the Steamboat Creek system if a link is to occur in the City of Reno portions of the corridor.

3. Steamboat Station/Sam's Town

If there is a useful trail connection to the south of Geiger Grade, the developer could be approached about continuing a trail in this location. Contacting the developer regarding trail access would be timely as plans for the Steamboat Station (to be called Sam's Town) appear to be well underway. Additionally, influencing the type of slope stabilization treatments made along the Creek in areas planned for rip-rap to encourage an attractive and functional treatment which coincide with recommendations in this study would be timely as well.

4. St. James Resort and Conference Center

It may be worthwhile to contact the developer regarding a modification of the trail location to align it more closely with Steamboat Creek. It is likely that a public trail along the creek will be perceived as undesirable and in conflict with the private resort/conference center concept.

5. South Truckee Meadows - Washoe Valley Water Treatment Facility and Management Plan

It would desirable to maintain a minimum level of stream flow if this project is implemented. The Washoe County Utility Division should be contacted regarding this issue. See Section 4 for recommendations regarding this plan in these reaches of Steamboat Creek.

4. OVERVIEW OF BEST MANAGEMENT PRACTICES

- Off-Stream BMPs
- On-Stream BMPs
- General Guidelines for Stream Restoration in Steamboat Creek

4. OVERVIEW OF BEST MANAGEMENT PRACTICES

Best management practices (BMPs) are a collection of techniques which can be applied to help mitigate non-point source pollution and implement effective stream restoration efforts. They fall into two broad categories; off-stream (source control) and on-stream. Off-stream BMPs are subdivided into two categories: pollution prevention BMPs and pollution detention systems. On-stream BMPs will also be further subdivided into two categories; passive approaches and active approaches. This section will provide only a general description of the BMPs available and describe some of their limitations. More specific information on BMPs will be found in the appendices. Subsequent sections will discuss the relevance of specific on-stream BMPs to the stream types found along the Steamboat Creek channel and recommend BMPs to be considered on specific reaches of the channel.

OFF-STREAM BMPs

POLLUTION PREVENTION BMPs

Pollution Prevention BMPs are a broad category of practices which all property owners in a watershed should know about and implement as appropriate. These are designed to collect precipitation and infiltrate it to groundwater where it falls. They are designed to prevent erosion in home landscapes, small ranches, agricultural operations, and all public and private properties. They include general guidelines for nutrient management, animal waste management, and pasture and irrigation management. They often involve maintenance and management activities such as septic tank system maintenance, proper hazardous waste disposal and Integrated Pest Management. The State of Nevada has published a Handbook of Best Management Practices. The Washoe-Storey Conservation District can assist property owners with these BMPs. Cooperative Extension's Small Ranch Manual (and ongoing educational program) gives specific how-to information on how average property owners can implement appropriate pollution-prevention BMPs.

South of Geiger Grade, there are many small properties ranging from one to two acres in size, particularly in the Pleasant/Steamboat Valley areas. These properties, some of which were built upon 30 or more years ago, either abut or drain to Steamboat Creek. With a recognition that the actions of all residents will impact water quality in Steamboat Creek, the University of Nevada Cooperative Extension provides a voluntary educational program in managing nonpoint sources of pollution. Assistance is available in determining and implementing best management practices for erosion control, animal waste management, pasture and irrigation water management, integrated pest management, well and septic care and maintenance, and more. Streambank stabilization and creek protection are an integral part of the Small Ranch program. Program events include classes, workshops, work parties in which BMPs are implemented, site visits, reading material, and more. A publication titled "Small Ranch Manual: A Guide for Green Pastures and Clean Water" is available from the Reno office of Cooperative Extension. For more information or for assistance, call Program Coordinator Sue Donaldson at 702-784-4848.

POLLUTION DETENTION SYSTEMS

Pollution detention systems (off-stream) are directed at trapping non-point source pollution at or near its source. In general, these techniques are more effective the closer they are to where the pollution is being released into the system, their effectiveness diminishing rapidly with distance downstream. They are designed for application on or adjacent to low order ephemeral drainages and, with the possible exception of some of the wetland systems, would not be appropriate on the main stem of Steamboat Creek. However, they may well be appropriate in the catchment on small tributaries to Steamboat Creek. Pollution detention systems (off-stream)

fall into three groups:

- Pond systems
- Wetland systems
- Infiltration systems

Pond Systems

The list of current pond-type BMPs includes the following:

- Dry stormwater pond
- Dry extended detention pond
- Enhanced dry extended detention pond
- Micropool extended detention pond
- Enhanced wet pond
- Enhanced wet extended detention pond
- Multiple pond systems

The systems differ primarily in terms of whether they are dry or wet (whether they can maintain a perennial water pool or not), the degree of pre-treatment (usually the dropping out of coarse sediments in a forebay), and the amount of detention time (which affects the trap efficiency). Their purpose is to attenuate increased flood peaks, promote infiltration to the groundwater system, and to settle out particulate pollutants. In general, wet ponds are more effective than dry ponds and efficiency increases in direct proportion to the degree of pre-treatment and the amount of detention time.

Wetland Systems

The list of current wetland-type BMPs includes the following:

- Shallow marsh system
- Extended detention wetland
- Pocket stormwater wetland
- Pond/wetland system
- Pond/marsh system

Wetland and marsh systems differ from pond systems primarily in the degree of vegetation supported. The presence of vegetation in these systems permits the treatment of non-particulate pollutants such as nitrates, soluble chemical constituents, and even metals which are taken up by the root systems and trapped in the biomass. However, the vegetation must be periodically harvested and properly disposed of in order to be permanently effective. The various wetland systems differ primarily in the relative percentage of open water versus fringe vegetation. Pond and wetland combinations are simply an attempt to get the best of both worlds by providing the benefits of vegetation along with the greater volume (detention time and settling ability) of a deep open water pond which also has a lower risk of remobilizing pollutants from the system (flushing them out) with the next storm. A pocket stormwater wetland is just a tiny wetland that can be tucked into a small space (opportunity is where you find it).

With respect to pond and wetland system design, one should be cautious about designing a well-intended wet pond or wetland/marsh system in the dry climate of the Truckee Meadows. A thorough hydrology and water balance study should be completed to provide a reasonable certainty that your wet pond will not in fact turn out to be an expensive but far less efficient dry pond.

Infiltration Systems

The list of current infiltration system-type BMPs include the following:

- Infiltration trench
- Enhanced infiltration trench
- Infiltration basin
- Porous pavement
- Sand filters
- Peat, sand, and compost filters
- Grassed swales
- Biofilters
- Bioretention
- Vegetated filter strip
- Oil and grit separators

The purpose of most of these systems is to filter out pollutants and increase infiltration to the groundwater system. All of these systems are for small loads at the source. Their effectiveness varies widely and most of them have a high maintenance requirement. Some of them have a very short useful life (to the point where it is hard to justify their use). Porous pavement and infiltration basins are particularly bad in this respect. Among the most useful in new planned developments are grassed swales and vegetated filter strips.

The BMPs described in this document are those designed to be long term, quasi-permanent installations incorporated into a planned development. There are a host of other temporary BMPs associated with erosion control during construction which will not be discussed (straw bale check dams, silt fences, mulches, etc.).

ON-STREAM BMPs

On-stream BMPs are most directly applicable to stream restoration in that they are directed at controlling bed and bank erosion on the main stem of a channel and by so doing, help mitigate the risk of entraining and transporting nonpoint source pollutants downstream. As mentioned previously, they fall into two broad categories; active and passive. A recommendation of this plan is to incorporate these BMPs into floodway design for developments.

NON-STRUCTURAL APPROACHES: PASSIVE BMPs

Passive BMPs are low impact, low maintenance techniques directed at enforcing some form of land use management change that allows the stream zone to be preserved, or in the case of a degraded stream, to begin to heal itself. They include the following:

- Provision of stream buffer zones
- Fencing of the stream zone to exclude livestock
- Regulation of permitted land use and activities within the stream zone
- Revegetation of banks (used primarily to supplement the above techniques and accelerate the healing process)

These techniques generally have application on stream systems which have experienced little or no degradation or on moderately degraded stream types that have a high recovery potential.

STRUCTURAL APPROACHES: ACTIVE BMPs

Active BMPs are more aggressive, usually engineered techniques directed at restoring natural form and function and/or artificially reducing bed and bank erosion on degraded stream channels which have a low potential to recover on their own (or alternatively, where the time required and the consequences of a natural recovery are unacceptable). They include the following:

- **Full restoration of in-regime geometry (plan, profile, and cross-section):** This involves the design and complete reconstruction of the hydraulic geometry of the channel. It requires a very thorough knowledge of the hydrology, sediment load, bed and bank material characteristics, and the appropriate "type section" characteristics (stream type) to which the channel is to be restored. It typically requires temporary diversion of baseflow and the use of heavy equipment in the channel itself and is in fact a major civil engineering design and construction project with substantial earthwork. It will involve the application of many of the other active BMPs to be discussed subsequently (See Figure 18).

- **Provision of a multi-stage cross-section (floodplain) within the existing planform geometry:** This technique is similar to the full restoration of in-regime geometry described above but is applied where there are severe limitations on changes to the channel alignment (a common constraint in existing urban settings). It provides a more stable cross-section and profile with a bankful channel that is reconnected with its floodplain but may fail to produce a stable meander geometry (See Figure 19).

- **Flood Planning:** The channel design discussed herein is based on stream restoration which will pass at least a 25 year flood event. Developers need to plan for 100 year events in their overall design as required by Washoe County. The plans should be coordinated so that flood impacts on the restored stream channels are minimized.

- **Grade control:** These techniques attempt to arrest active incision of the bed by installing non-eroding "control sections" in the profile of the channel. Except in low sediment transport stream types (type E and some type B channels) it is extremely important to design grade control structures that have the ability to pass coarse sediment (the "bed/material load"). Failure to do so will result in headward aggradation and the "out flanking" of the grade control structure, producing even more severe bed and bank erosion with time.

- **Reduction of bank angles:** Steep bank angles result in greater flow depth and therefore higher flow velocities in the vicinity of the bank toe which leads to scour at the toe of the bank, collapse of the bank, and increased sediment loads. Flattening the angle of the bank shifts the high velocity flows toward the center of the channel, over the bed.

- **Revegetation:** Revegetation is critical to the success of stream restoration activities. Vegetation serves to stabilize slopes, adds friction to dissipate flow velocities, decreases erosion, and provides important water quality benefits. Riparian vegetation and soil serve as water filters, intercepting surface-water runoff before it reaches the stream or river. This filtering process removes and recycles nutrients, processes chemical and organic wastes, and reduces sediment loads reaching streams and rivers.

  In a well vegetated riparian area, waterway channels are deep and narrow with overhanging banks that are stabilized by plant roots. When vegetation is removed by grazing, road or house construction, stream restoration activities, or any other disturbance, the plant roots die and are unable to hold the banks together. During spring runoff and other high water occurrences, the banks cave in and the channel is widened. Large amounts of erosion can occur, and bare, disturbed soils provide an ideal site for noxious

weed infestation.

When restoration efforts require disturbance to the streambanks or adjacent floodplain areas, it is essential that a carefully thought-out plan for revegetation be included in the restoration efforts. This plan must incorporate native species whenever possible, and should include the use of locally grown plant materials which will have the best chance of survival. In the first year after planting, maintaining adequate soil moisture to allow root growth is essential. This may require the addition of a drip system or other supplementary irrigation until plants are well established. It may take a number of years for a healthy riparian area to become established. Long-term follow-up observation is crucial. Very often, plants will appear to survive the first summer, only to perish during the winter months. Part of the revegetation plan should include provisions for long-term monitoring and replacement of failed vegetation when necessary, and for management and control of noxious weeds, most notably tall whitetop (*Lepidium latifolium*, also called perennial pepperweed).

Tall whitetop is a non-native, competitive, noxious, invasive weed of riparian areas and wetlands. It is found in many locations along the entire length of Steamboat Creek, notably at Rosewood Lakes and the University Main Station Farm. This weed has the ability to outgrow desirable vegetation, choking out new plants and establishing a monoculture. Unfortunately, tall whitetop has no redeeming riparian benefits. Its extensive root system is weak, and does not provide the soil stabilization benefits desired of riparian vegetation. It has the ability to concentrate salts at the soil surface, further inhibiting the germination of native vegetation. Every revegetation plan must include management against this damaging weed. The Tall Whitetop Taskforce (702-322-9934) can assist with control recommendations. Publications and a video describing the weed and its associated problems can be obtained from University of Nevada Cooperative Extension (702-784-4848).

Special constraints to successful revegetation exist for that portion of Steamboat Creek located downstream from Steamboat Hot Springs. The geothermal waters which reach the ground surface in this area add many toxic minerals to the creek, including boron, arsenic, chloride, and other salts. Boron is of particular concern since it is toxic to plants in small amounts, and high salinity levels amplify its effects. The open pastures in the Double Diamond area did not support tree growth prior to development, most likely due to high soil boron levels. Levels measured north of Zolezzi Lane have ranged from 7.5 to 50+ parts per million (ppm) in the soil. These high salt levels are suitable for salt-tolerant noxious weeds such as tall whitetop.

Boron is an essential element for plant growth in very small amounts, and as concentrations increase, toxicity increases. Boron has been shown to retard or prevent seed germination. In established plants, toxicity symptoms normally show first on older leaves as a yellowing, spotting, or drying of leaf tissue at the tips and edges. Drying and chlorosis (yellowing) often progress toward the center between the veins as more and more boron accumulates with time.

Most prior research related to boron toxicity has focused on crop plants. Most fruit trees, including peach, cherry, plum and apricot are sensitive to boron at concentrations of 0.5 to 0.75 ppm in the soils water. Other plants, including tomato, alfalfa, and parsley, will tolerate 4 0 to 6.0 ppm. Given the high soil boron levels measured, boron will provide a challenge for revegetation efforts.

Research is currently underway to determine which species of landscape plants will best survive high soil boron levels. Prior to planting, soil samples should be submitted to a commercial laboratory for boron assessment. Special site preparations, including soil amendment and tilling, may be necessary to enhance plant survival. Contact your local Natural Resources Conservation Service office (702-784-5408), Washoe-

Storey Conservation District (702-322-9934) or Cooperative Extension Plant Science office (702-784-4848) for soil preparation and plant species recommendations. Be aware that this portion of Steamboat Creek may never support the type of vegetation often considered to be desirable along stream channels.

Riparian Vegetation:

1. Slows flood flows and reduces erosion and property loss. The vegetation along a protected stream corridor reduces the speed of overland runoff water as it nears the stream. A slower flow not only helps stop soil erosion, but also causes sand and other large particles from upland areas to be deposited along stream banks, not in streams.

2. Secures food and cover for fish, birds, and other wildlife. When overhead cover is available, the number of fish and fishing success increase substantially compared with areas where banks have slumped or failed.

3. Keeps water cooler in the summer and prevents ice damage in winter. Popular game fish such as trout and bass need cool water temperatures to survive.

4. Reduces water pollution by filtering out sediment, chemicals, and nutrients from runoff. When plants reduce water velocity, sediments drop out of water, adding to flood plains.

5. Provides important breeding habitat for birds. Wildlife use riparian areas more than any other single habitat. More than half the vertebrates living on rangeland need riparian areas or use them for some critical period of their life.

6. Shelters animals during calving, lambing or fawning.

7. Holds more water in the soil, slowly releasing it for longer season streamflows and groundwater recharge. Stream riparian areas that have healthy vegetation and a flood plain trap some of the water, hold it, and then slowly release it.

- **Channel armoring:** This technique involves the use of "hard" materials to shield the bed and/or banks from erosive flow velocities. The typical materials used include riprap (large diameter rock), concrete, soil cement, rock and wire mattresses (sometimes called Reno mattresses), gabions, rock fill trenches, and windrow revetments (self-deploying piles of riprap placed along the top edge of an eroding bank). Although effective at resisting erosion, these materials have virtually no value as habitat.

- **Revetment construction:** This technique involves the construction of a dual purpose structure along the stream bank which provides erosion protection and also helps to retain the steep bank (commonly used along the steep outer bank of a meander bend). These structures can be built from a variety of materials including concrete, gabions, and timber cribs. A very useful application of revetments involves the construction of a log and boulder structure (where the logs and boulders are placed to interlock) providing temporary (10 to 20 years) protection of the bank while lines of planted willows mature and get protective root systems established in the bank. The bank then becomes self-maintaining after the revetment has outlived its useful life and has begun to come apart. When the logs used contain the tree's root boles, they also provide excellent fisheries habitat.

- **Bank modification:** This technique involves the use of structures to deflect high velocity flows away from an eroding bank. Common applications include spurs, hardpoints, retards, and jetties.

Where restoration efforts are to include enhancement of aquatic fisheries habitat, there are a number of techniques which can be applied to artificially create or enhance habitat. They include the following:

- Low stage check dam
- Boulder placement
- Bank-placed material
- Single wing deflectors
- Double wing deflectors
- Channel constrictors
- Bank cover
- Floating log cover
- Submerged shelters
- Half-log cover
- Migration barriers
- Gravel traps

Extreme care must be taken in the use of these structures in a channel as they all affect the local hydraulics of the channel and can actually do a great deal of harm if improperly deployed. Their effectiveness varies widely with the stream type in which they are used.

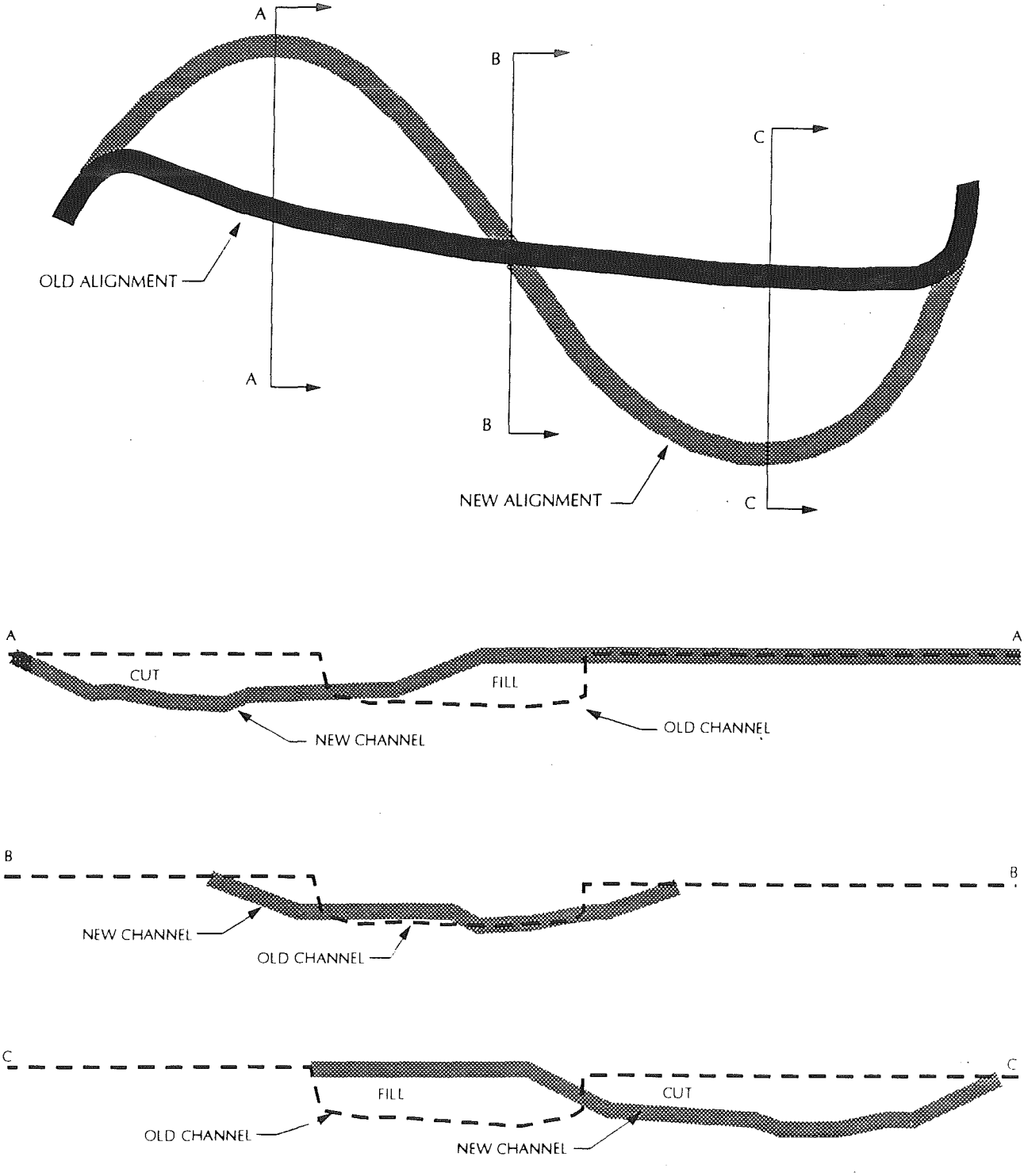
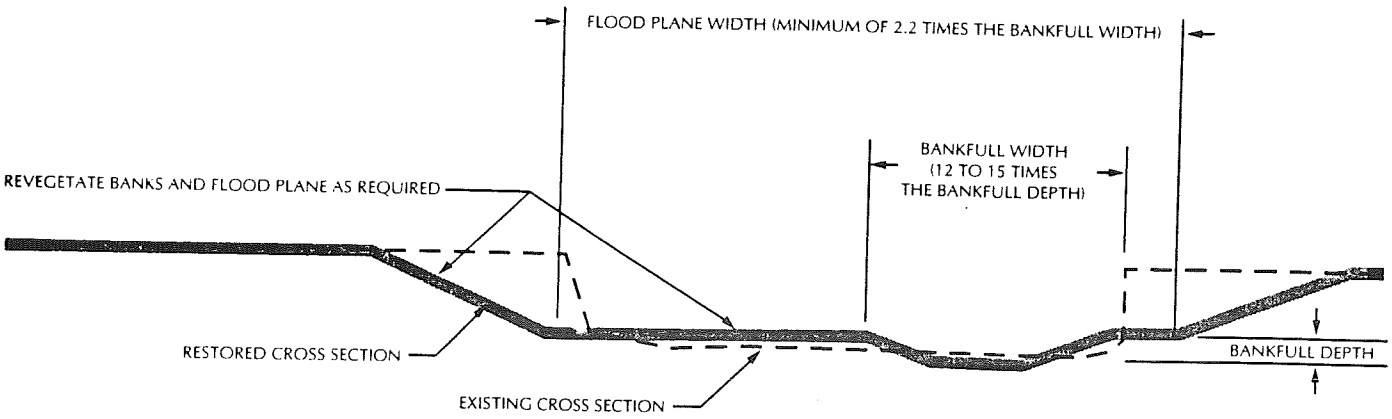


Figure 18. Full Restoration of In Regime Geometry



NOTES:

1. Designer should provide as much floodplain surface as possible based on limitations created by physical space constraints or economics. If possible, try to achieve a floodplain width which will pass the 100 year flow at non-scouring conveyance velocities on the floodplain surface. However, space constraints will often make this impossible. In all cases, the design should be able to pass the 25 year flood or the benefit/cost ratio (based on useful life) is likely to be unacceptable.

2. Example shown depicts conversion of an F-type channel to a C-type channel using the profile of Transect 5 as the existing channel. Conversions of other stream types will require different width/depth ratios and floodplain width ratios as appropriate.

Figure 19. Multi-Stage Cross-Section

GENERAL GUIDELINES FOR STREAM RESTORATION IN STEAMBOAT CREEK

The level of effort required for design and implementation of a stream restoration project depends on the goals to be accomplished and the size and scope of the effort on any given reach. It could vary from scheduling a weekend to plant willows along the creek bank, to the design and construction of a major civil engineering project. The procedure which follows describes a step-by-step process for the design of a full restoration project on a degraded reach of the stream. Procedures fall into three categories: data collection, analysis, and design.

Data Collection

- Obtain site specific topography (min. contour interval of two feet) including a detailed plan, profile, and cross section of the stream (the recommended frequency of thalweg profile points is not more than 1/10 of the mean meander wavelength).
- Map existing stream types along the design reach.
- Sample and obtain particle-size distributions of bed materials and bank materials (separate distributions for riffles and pools).
- Collect soil samples from bank areas and analyze for possible constituents detrimental to revegetation efforts (boron for example).
- Collect all available measured data on stream flow, precipitation, water quality, sediment transport rates, etc. (generally sparse to non-existent for most of Steamboat Creek).
- Check with local, state & federal agencies for existing data.

Required Analyses

- Construct stream flow hydrographs for the design reach (an annual hydrograph and 24 hr. storm hydrographs for the 2, 10, 25, 50, and 100 year return frequencies).
- Perform a sediment yield/sediment delivery study for the contributing catchment.
- Evaluate the potential for future changes in the catchment and quantify the potential impacts on hydrographs and sediment yield/sediment delivery.
- Estimate pollutant loadings for existing and potential future conditions in the catchment.

Design

- Based on the existing stream types identified and the hydrology as described above, select appropriate "stable" stream types to be targeted for restoration design goals. Care must be taken to select reasonable, realistic target stream types. For example, avoid any temptation to attempt to alter a low gradient, high sediment transport, riffle and pool stream type like F5 into a low sediment transport stream type like E5 or into a high gradient step/pool system stream type like B5. A more realistic target would be a low gradient, high sediment transport, riffle and pool type stream like C5. Try to identify actual existing reaches of the target stream type in the same or a similar catchment to serve as a model or "type section" for determining the design characteristics of the restored reach. If it is not possible to locate an appropriate type section, then select appropriate characteristics from the Rosgen classification system and hydraulic geometry relationships. Characteristics required for design would include bankful depth, width/depth ratio, entrenchment ratio, water surface gradient, sinuosity, and meander wavelength.
- Layout the planform and profile geometry and size the channel cross section as appropriate using the site specific topography.
- Select and design appropriate BMPs as required. Table 2 may be used as a preliminary guide to BMP compatibility versus stream type. Evaluate the effectiveness of non-point source pollutant removal

for the selected BMPs and optimize design as appropriate.

- Evaluate channel hydraulics, including sediment transport, and check for detrimental upstream or downstream impacts (basically for excessive scour/degradation or filling/aggradation).
- Evaluate revegetation requirements and identify any significant constraints.
- Evaluate impacts on design flood levels at existing structures and mitigate as appropriate.
- Complete civil design requirements including earthwork balance, borrow areas or waste disposal areas as may be required, equipment ingress and egress, temporary diversion structures, permitting requirements, etc. Prepare construction bid documents as required to include construction plans, contract documents, quantity and cost estimates, and technical specifications.

Restoration design efforts should include an evaluation of the potential for future changes in either hydrology or sediment supply. Whenever possible, designs should attempt to accommodate the expected changes.

Table 2 - Compatibility Matrix for on Stream BMPs vs. Stream Types

	To be used in restoration or as enhancement in existing stream types.					Includes modification or improvement only if full restoration is not feasible.					
	Stream Types										
On Stream BMP	**B3**	**B4**	**B5**	**C4**	**C5**	**D5**	**D6**	**F4**	**F5**	**F6**	**G4**
Stream Buffer Zone	◗	◗	●	●	●	●	●	●	●	●	●
Fencing out livestock	◗	◗	●	●	●	◗	◗	○	○	○	●
Full redesign of geometry	○	○	○	○	○	◗	◗	●	●	◗	●
Multistage cross-section only	○	○	○	○	○	◗	◗	●	●	◗	●
Grade Control	○	○	◗	◗	◗	◗	◗	◗	◗	◗	●
Reduction of bank angles	○	○	○	◗	◗	◗	◗	●	●	◗	●
Revetments	○	○	○	●	●	◗	◗	●	●	◗	○
Channel armoring	○	○	◗	◗	◗	○	○	●	●	◗	●
Bank modifications	○	○	○	◗	◗	◗	◗	◗	◗	◗	○
Fisheries enhancement structure	●	●	◗	●	◗	○	○	◗	◗	○	○

Key:

Applicability - High ●
Moderate ◗
Low ○

5. REACH BY REACH RECOMMENDATIONS FOR APPROACH AND APPROPRIATE BEST MANAGEMENT POLICIES

- Truckee Terrace
- Hidden Meadow/University Farms
- Rosewood
- Huffaker Hills
- Bella Vista
- Whites Creek Meadows
- North Geiger
- South Geiger
- Steamboat Springs
- Pleasant Valley North
- Pleasant Valley South
- 395 South
- St. James North
- St. James South
- Trestle

5. REACH BY REACH RECOMMENDATIONS FOR APPROACH AND APPROPRIATE BEST MANAGEMENT PRACTICES

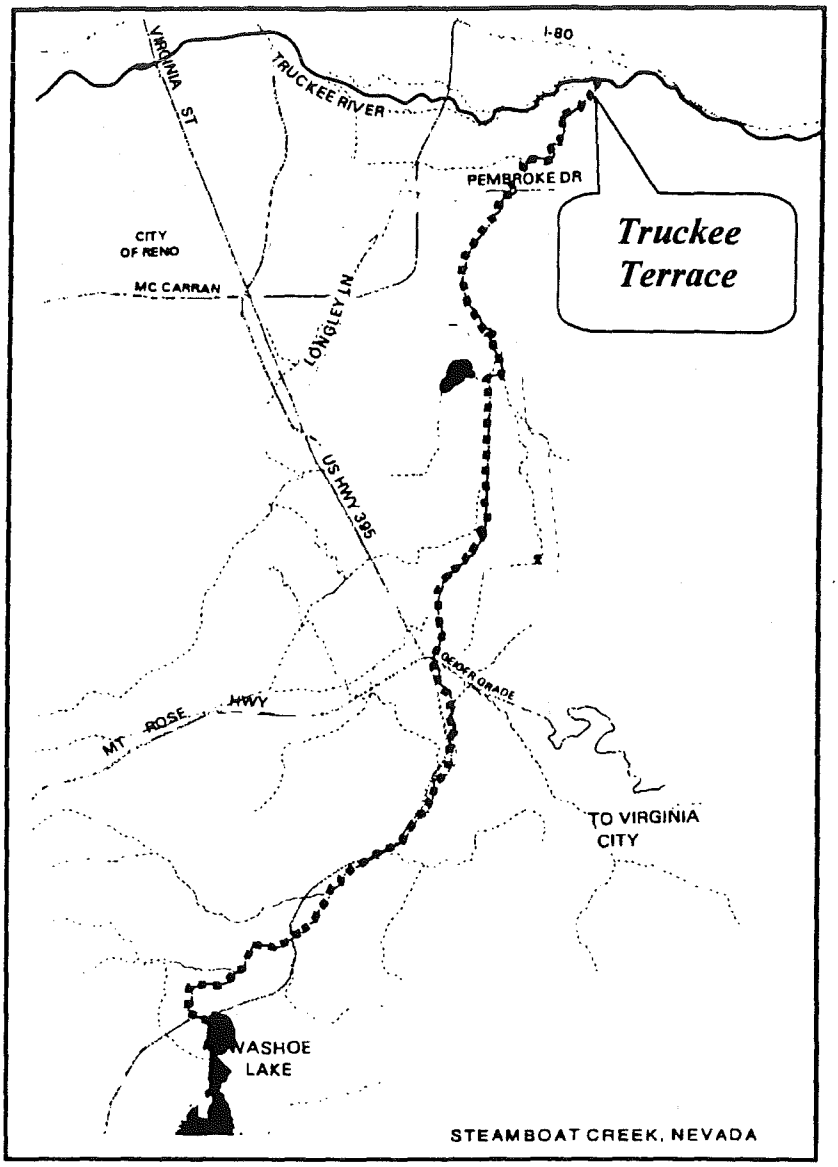
A recommended approach and list of appropriate BMPs to be considered is being provided for each significant reach along the full length of Steamboat Creek as a guide to help facilitate consistency and continuity in future stream restoration design and implementation on the creek. Reaches have been assigned a name and their locations are shown on Map Figures 20 through 23. Also provided for each reach, located in the appendix, is a detailed tabulation of information pertinent to restoration design in that reach. This tabulation contains additional information on the location of each reach including beginning and ending stations along the channel length and landmarks near the beginning and end of each reach. The tabulations also contain information on stream types, bed materials, bank conditions, tributaries, potential for change, recommended BMPs, etc. This section of the Steamboat Creek Restoration Plan contains an overview of the recommended approach and appropriate BMPs for each significant reach beginning at the confluence of Steamboat Creek with the Truckee River and proceeding upstream.

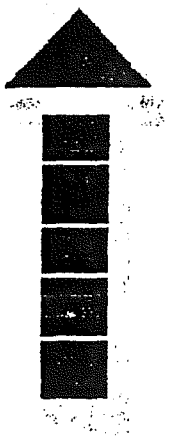
Truckee Terrace

Description:

This reach begins at the Truckee River and proceeds upstream across the floodplain and terrace of the Truckee to near the crossing at Clear Water Way. It is a very straight reach paralleling the road that leads to the waste water treatment plant. It is deeply incised with extremely steep, high (six to twelve feet), unstable banks. Much of the former tendency for incision has been arrested by the construction of a grade control structure where it enters the Truckee and the current channel has actually begun to aggrade in the lower portions of the reach.

Geographic Location:





High Priority

Priority:

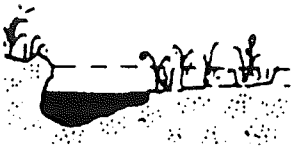
The reach is severely degraded and has been assigned a high priority for restoration to impact water quality concerns (primarily particulate phosphorous).

Stream Type:

The reach is dominated by F5 channel types.

Existing:

Recommended:



Recommended BMP's:

Passive approaches will have little or no impact here and an active approach is recommended. Space constraints are severe in this reach due to the presence of the road. In addition, some of the straightness in the channel is probably associated with the increased erosion resistance encountered in the cobble and boulder-rich outwash along the Truckee. Therefore, modification of the planform geometry (meanders) is probably impractical. An appropriate procedure would be development of a multistage channel along the current alignment including a reduction in bank height and angle and an appropriate reduction in the width depth ratio (restoring the cross section to characteristics appropriate to a C5 channel with a working active floodplain). Some rugged, persistent willows are still present locally along a portion of this reach. Therefore, log and boulder revetments backed by willow plantings may be a real possibility (although soil boron content concerns still need to be checked). If bank protection with vegetation looks marginal, then other revetment materials and riprap may be used as required for protecting bank toes from erosion.

Planting/Revegetation

Revegetation of slopes and soils in the Steamboat Creek vicinity is difficult and challenging due to high mineral content of soils in reaches beginning at the Steamboat Geothermal area downstream to the Truckee River. The limitations come from boron, arsenic and other minerals.

Technical Data Truckee Terrace

Reach:	Truckee Terrace			
Beginning Station:	0+00	***Ending Station***	36+50	
Downstream End Landmark:	Truckee River	***Upstream End Landmark:***	Clean Water Way	
Stream Types Represented:	F5	***Dominant Stream Type:***	F5	
Bed Materials Represented:	Sand	***Dominant Bed Material:***	Sand	
Bank Erosion Index:	***Range:***	Moderate to High	***Typical:***	High
Water Surface Gradient:	***Range:***	0 to 0.0017	***Typical:***	0.0001
Estimated Bankfull Flow:	***DS End:***	170 cfs	***US End:***	130 cfs
Major Tributaries Entering:	Water treatment plant outfall			
Major Diversions Exiting:	None			
Overall Stability Assessment:	***Bed:***	Fair	***Banks:***	Poor
Potential for Future Changes To:		***Flow Regime:***	Moderate	
		Sediment Supply:	Moderate	
		Land Use:	Low	
Water Quality Concerns:	Particulate phosphorous, nitrogen/nitrate			
Opportunities:				
Constraints:	Soil boron levels			
Recommended On Stream BMP's:	Develop multistage channel within existing alignment with reduction of bank angle.			

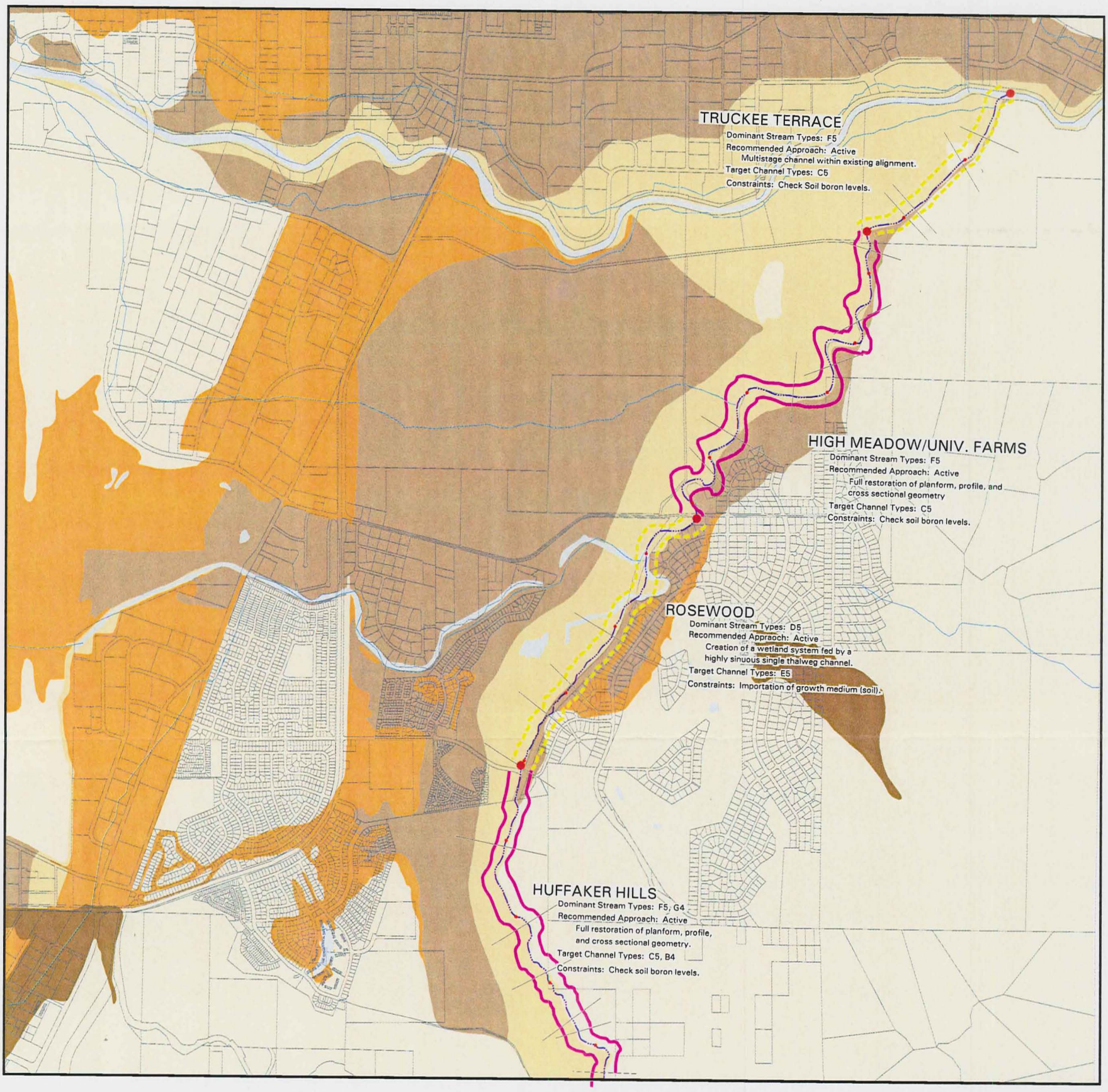


Figure 20. Reach By Reach Best Management Practices

REACH BY REACH RECOMMENDATIONS

STEAMBOAT CREEK PROJECT

- STEAMBOAT CREEK
- CREEKS AND DITCHES
- ACTIVE, MOST AGGRESSIVE, VERY EXPENSIVE
- ACTIVE, LESS AGGRESSIVE, MODERATELY EXPENSIVE
- PASSIVE, BUT WITH SIGNIFICANT ACTIVE TREATMENT OF TROUBLE SPOTS REQUIRED
- PASSIVE, WITH MINIMAL ACTIVE TREATMENT OF TROUBLE SPOTS REQUIRED
- FLOODWAYS
- ZONE A (A100) 100-YEAR FLOOD ZONE (NO BFE)
- ZONE AE (A101) 100-YEAR FLOOD ZONE (BFE)
- ZONE AO (A103) 100-YEAR FLOOD ZONE (FLOOD DEPTH)
- ZONE AH (A102) 100-YEAR FLOOD ZONE (BFE & FLOOD DEPTH)
- ZONE D (A110) POSSIBLE FLOOD HAZARD (UNDETERMINED)
- ZONE X 500-YEAR (A108) 500-YEAR FLOOD ZONE
- ZONE X (A109) OUTSIDE 100 & 500 YEAR FLOODPLAIN
- OUTSIDE AREA OUTSIDE STUDY LIMITS
- WATER BODIES

SOURCE: WASHOE COUNTY DEPARTMENT OF WATER RESOURCES

DATE: JUNE 1998

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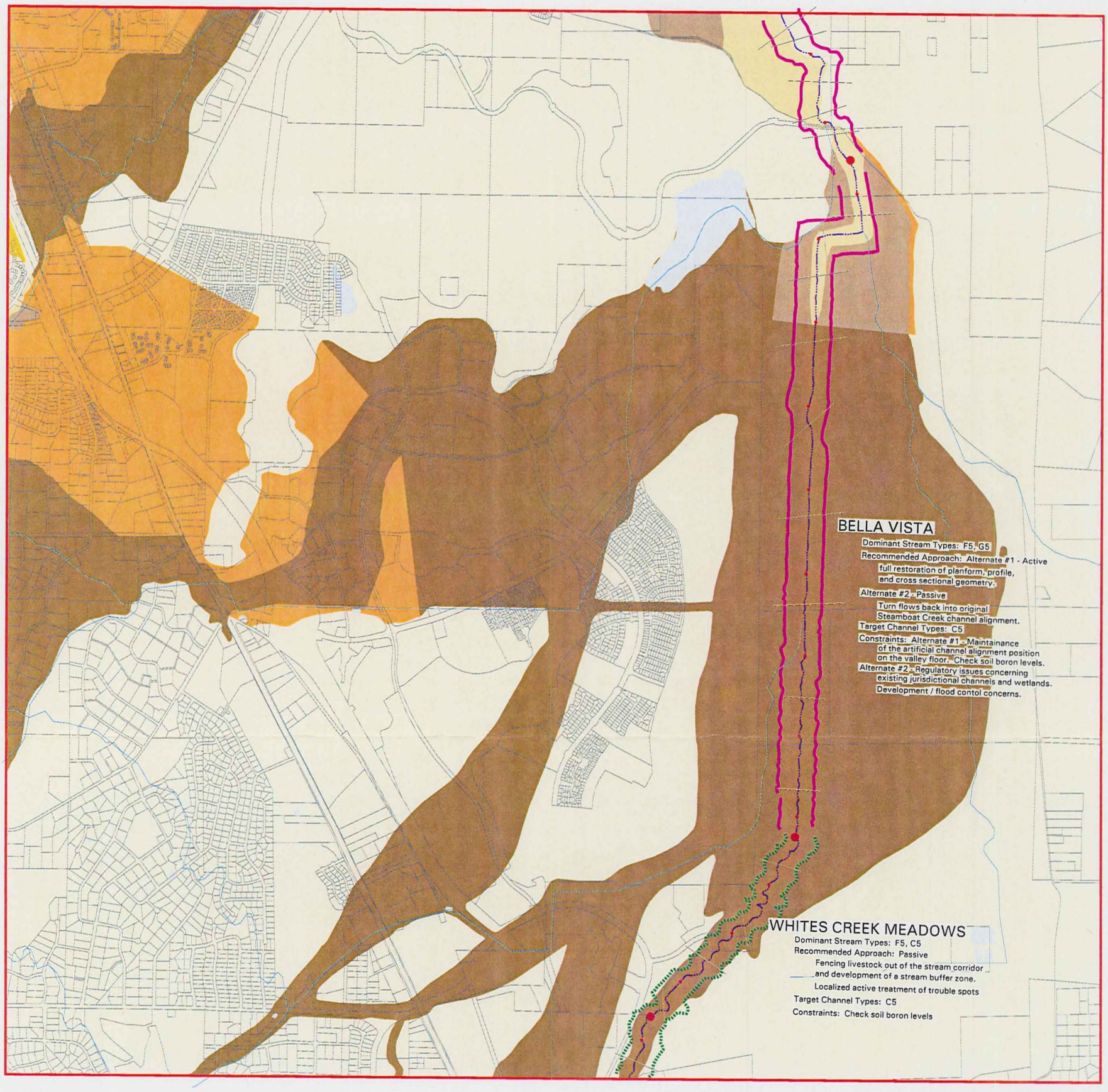

REACH BY REACH RECOMMENDATIONS

STEAMBOAT CREEK PROJECT

- STEAMBOAT CREEK
- CREEKS AND DITCHES
- ACTIVE, MOST AGGRESSIVE, VERY EXPENSIVE
- ACTIVE, LESS AGGRESSIVE, MODERATELY EXPENSIVE
- PASSIVE, BUT WITH SIGNIFICANT ACTIVE TREATMENT OF TROUBLE SPOTS REQUIRED
- PASSIVE, WITH MINIMAL ACTIVE TREATMENT OF TROUBLE SPOTS REQUIRED
- FLOODWAYS
- ZONE A (A100) 100-YEAR FLOOD ZONE (NO BFE)
- ZONE AE (A101) 100-YEAR FLOOD ZONE (BFE)
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- ZONE AH (A102) 100-YEAR FLOOD ZONE (BFE & FLOOD DEPTH)
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- ZONE X 500-YEAR (A108) 500-YEAR FLOOD ZONE
- ZONE X (A109) OUTSIDE 100 & 500 YEAR FLOODPLAIN
- OUTSIDE AREA OUTSIDE STUDY LIMITS
- WATER BODIES

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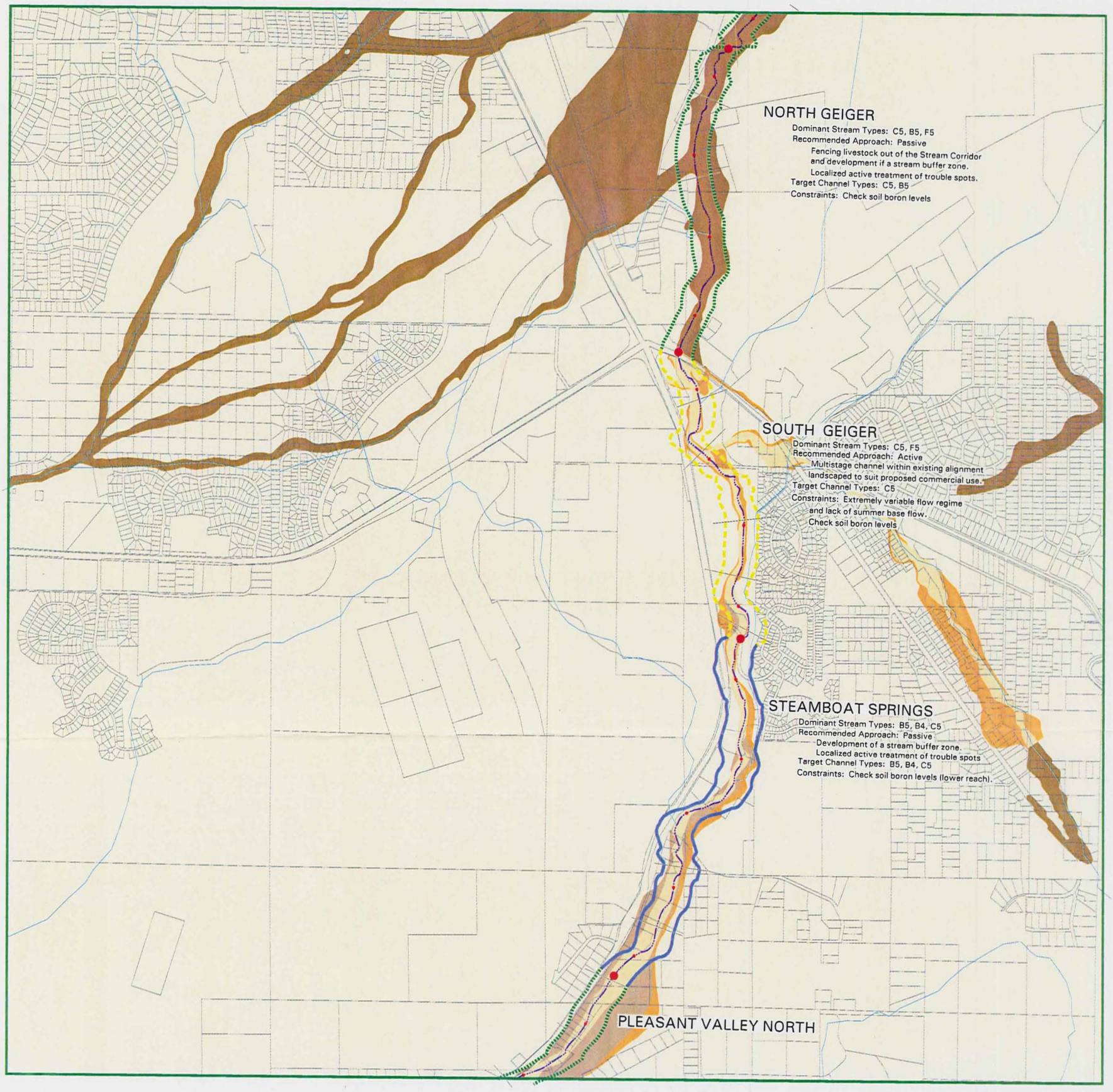
Figure 21. Reach By Reach Best Management Practices



REACH BY REACH RECOMMENDATIONS

STEAMBOAT CREEK PROJECT

- STEAMBOAT CREEK
- CREEKS AND DITCHES
- ACTIVE, MOST AGGRESSIVE, VERY EXPENSIVE
- ACTIVE, LESS AGGRESSIVE, MODERATELY EXPENSIVE
- PASSIVE, BUT WITH SIGNIFICANT ACTIVE TREATMENT OF TROUBLE SPOTS REQUIRED
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- ZONE D (A110) POSSIBLE FLOOD HAZARD (UNDETERMINED)
- ZONE X 500-YEAR (A108) 500-YEAR FLOOD ZONE
- ZONE X (A109) OUTSIDE 100 & 500 YEAR FLOODPLAIN
- OUTSIDE AREA OUTSIDE STUDY LIMITS
- WATER BODIES

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Figure 22. Reach By Reach Best Management Practices

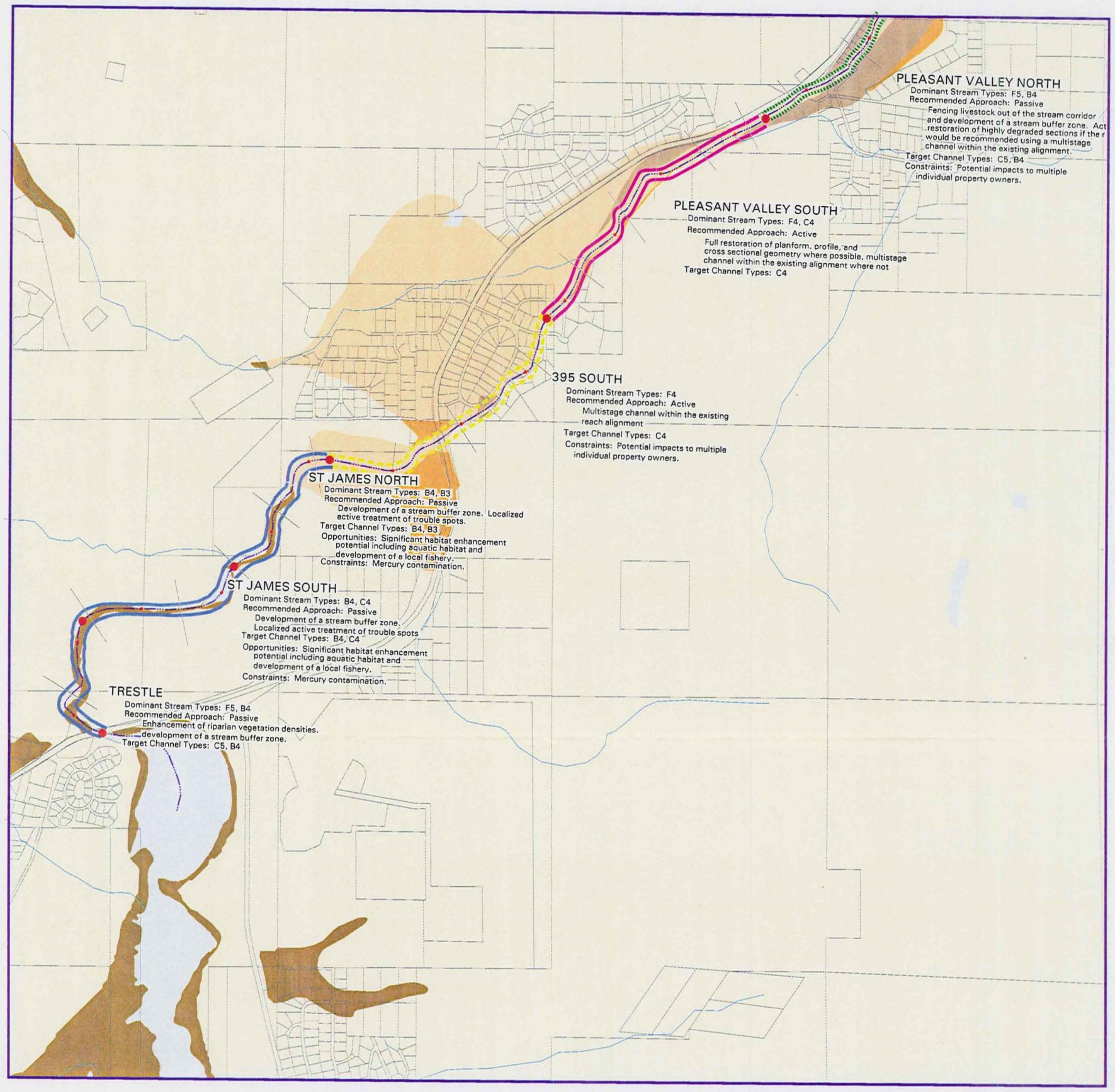

Figure 23. Reach By Reach Best Management Practices

REACH BY REACH RECOMMENDATIONS

STEAMBOAT CREEK PROJECT

- STEAMBOAT CREEK
- CREEKS AND DITCHES
- ACTIVE, MOST AGGRESSIVE, VERY EXPENSIVE
- ACTIVE, LESS AGGRESSIVE, MODERATELY EXPENSIVE
- PASSIVE, BUT WITH SIGNIFICANT ACTIVE TREATMENT OF TROUBLE SPOTS REQUIRED
- PASSIVE, WITH MINIMAL ACTIVE TREATMENT OF TROUBLE SPOTS REQUIRED
- FLOODWAYS
- ZONE A (A100) 100-YEAR FLOOD ZONE (NO BFE)
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- ZONE AH (A102) 100-YEAR FLOOD ZONE (BFE & FLOOD DEPTH)
- ZONE D (A110) POSSIBLE FLOOD HAZARD (UNDETERMINED)
- ZONE X 500-YEAR (A108) 500-YEAR FLOOD ZONE
- ZONE X (A109) OUTSIDE 100 & 500 YEAR FLOODPLAIN
- OUTSIDE AREA OUTSIDE STUDY LIMITS
- WATER BODIES

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Hidden Meadow/University Farms

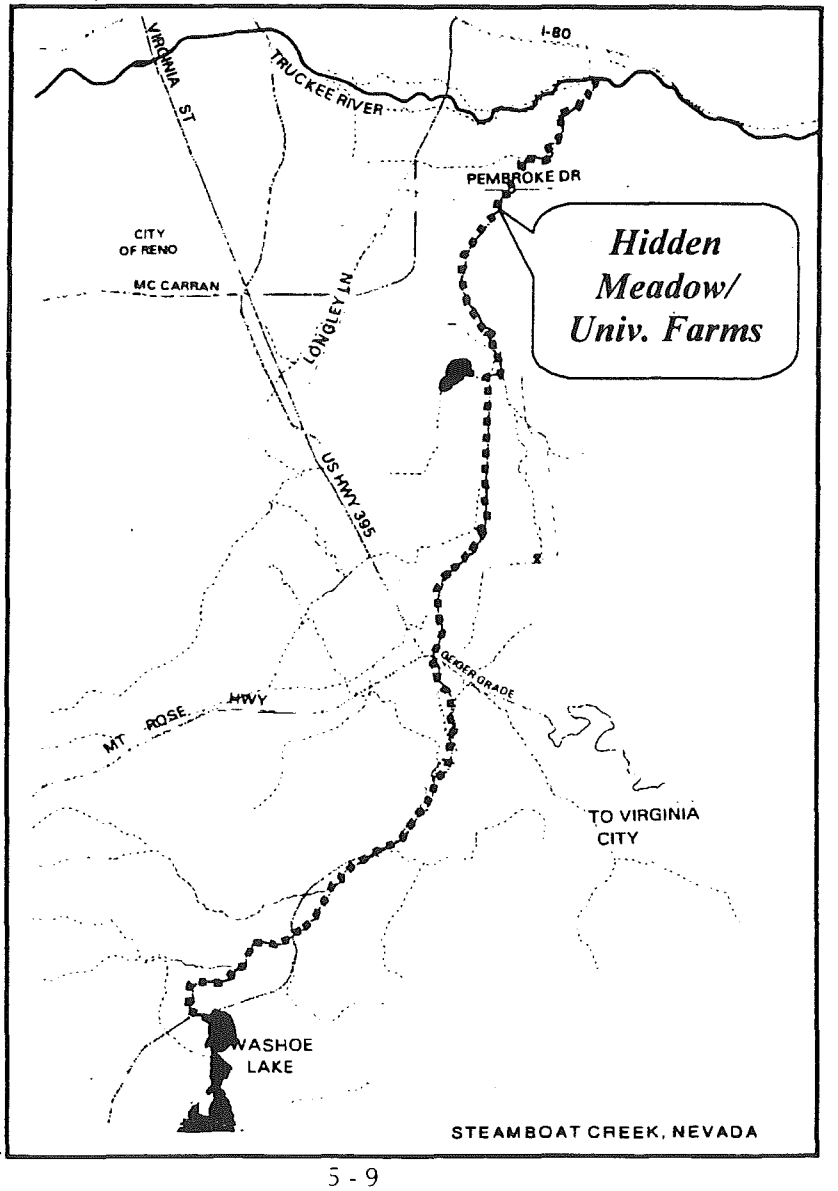
Description:

The reach begins near the Clear Water Way crossing and proceeds upstream to Pembroke Drive. It is very similar to the Truckee Terrace reach in that it has experienced deep incision with steep, high, unstable banks. Bank heights tend to be lower however, typically ranging between four and six feet high. The planform geometry contains very large meanders which are now underfit by the stream (the flows which created these large meanders no longer exist). The stream is trying to fit a new geometry into the existing one by placing alternating side channel bars against the steep banks at the bottom of the incised channel.

Priority:

The reach is severely degraded and has been assigned a high priority for restoration to impact water quality concerns (primarily particulate phosphorous).

Geographic Location:

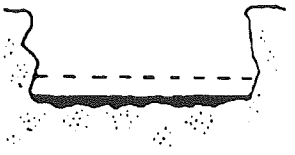


High Priority

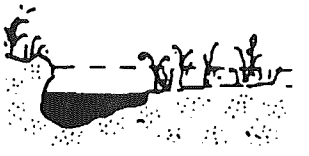
Stream Type:

The reach is dominated by F5 channel types

Existing:



Recommended:



Recommended BMPs

The preferred approach here would be an active one with full restoration of the plainform, profile, and cross sectional geometry (to correct the underfit problem and provide a more stable meander geometry). The new channel type should be a C5 channel. Work would include a reduction in bank height and angle. Log and boulder revetments backed by willow plantings would be preferred along the outside of meander bends (although soil boron content concerns still need to be checked). If bank protection with vegetation looks marginal, then other revetment materials and riprap may be used as required for protecting bank toes from erosion and the outside of meander bends. Some grade control and flow centering structures (rock vortex weirs) may be needed to initiate riffle and pool formation in the new profile geometry.

The Airport Authority wetlands restoration project exists within this reach. This project was not directed at stream restoration but simply wetlands mitigation. No effort was made to correct channel plan form, however the cross sectional geometry of the affected portion of the reach was in fact improved in such a way that the channel's ability to safely pass large floods was significantly improved. The project represents an example of multistage cross section development by re-attaching the channel to its flood plain.

Planting/Revegetation

Revegetation of slopes and soils in the Steamboat Creek vicinity is difficult and challenging due to high mineral content of soils in reaches beginning at the Steamboat Geothermal area downstream to the Truckee River. The limitations come from boron, arsenic and other minerals.

Technical Data Hidden Meadow/University Farms

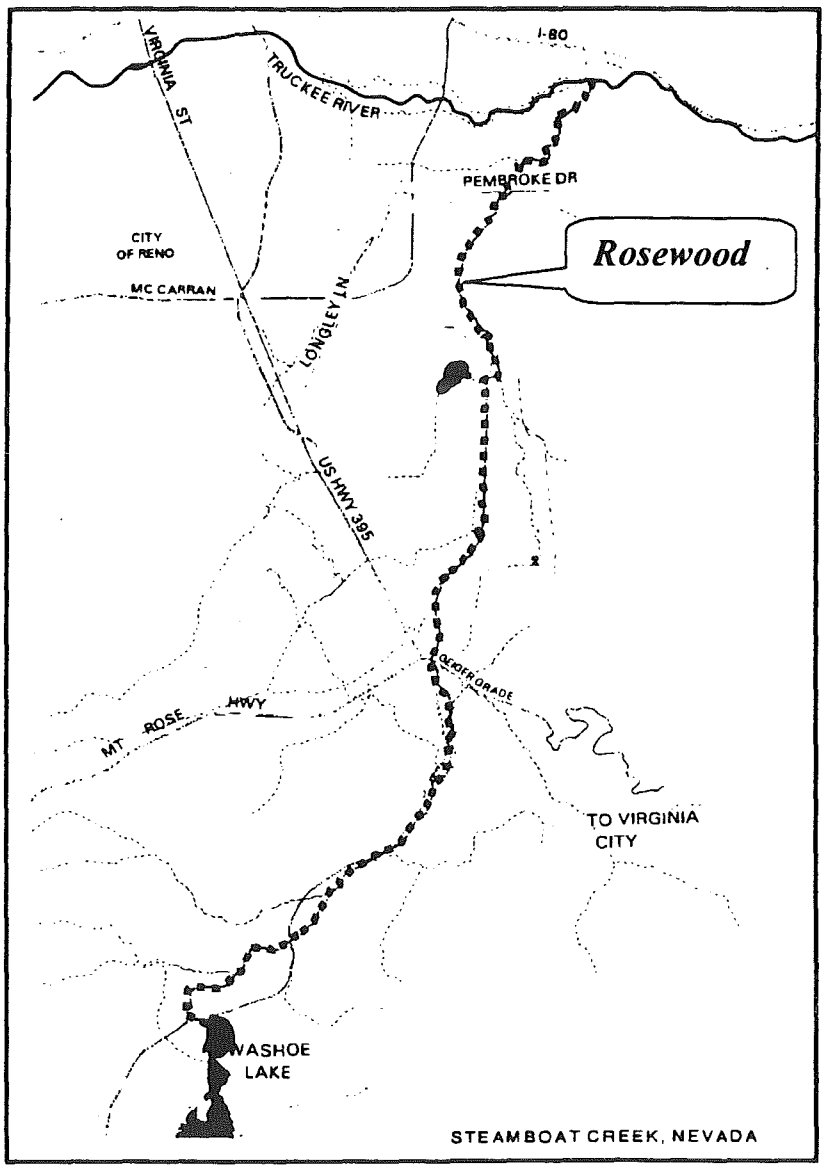
Reach:	Hidden Meadow/University Farms			
Beginning Station:	36+50	***Ending Station***	133+00	
Downstream End Landmark:	Clean Water Way	***Upstream End Landmark:***	Pembroke Drive	
Stream Types Represented:	F5, F6	***Dominant Stream Type:***	F5	
Bed Materials Represented:	Sand, Silt	***Dominant Bed Material:***	Sand	
Bank Erosion Index:	***Range:***	Moderate to Extreme	***Typical:***	Very High
Water Surface Gradient:	***Range:***	0 to 0.010	***Typical:***	0.00056
Estimated Bankfull Flow:	***DS End:***	130 cfs	***US End:***	110 cfs
Major Tributaries Entering:	Yori Drain			
Major Diversions Exiting:	None			
Overall Stability Assessment:	***Bed:***	Fair	***Banks:***	Poor
Potential for Future Changes To:		***Flow Regime:***	Moderate	
		Sediment Supply:	Moderate	
		Land Use:	Moderate	
Water Quality Concerns:	Particulate phosphorous, nitrogen/nitrate			
Opportunities:				
Constraints:	Soil boron levels			
Recommended On Stream BMPs:	Full restoration of planform, profile, and cross sectional geometry, with bank angle reduction and revetments along the outside of meander bends.			

Rosewood

Description:

The Rosewood reach begins at Pembroke Drive and proceeds upstream to Mira Loma Drive. The lower portion of the reach contains a lake created by the grade control dam built at Pembroke Drive. The entire reach parallels the Rosewood golf course and a natural protected wetland along the west side of the current channel.

Geographic Location:



High to Moderate Priority

Priority:

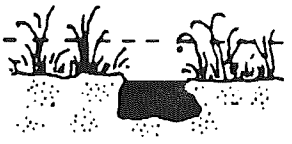
Priority would be how to moderate from a water quality perspective since particulate pollution is in large part, mitigated by ponds/lakes on both ends of the reach. Water temperature would be significantly degraded (raised) in this reach. The principal benefit from restoration in this reach would be the enhancement of habitat and the indirect benefits from nitrogen and metals uptake that would accompany revegetation of the reach.

Stream Type

D5 channels dominate the reach but, unlike the normal high sediment load, choked channels seen in braided systems, this wide, flat, nearly featureless cross section was artificially created at the bottom of a large trapezoidal flood control channel.

Existing

Recommended:



Recommended BMPs

If left alone long enough the reach would probably restore its own sinuous low flow channel and recruit enough sediment to revegetate the active floodplain. Therefore, a passive approach could be utilized in this reach. However, recovery could be significantly accelerated by taking an active approach. Although the gradient is a little steep for creation of an E type channel, the channel bed at the bottom of the trapezoidal floodway is a weathered shale which will be somewhat erosion resistant. The sediment supply to the reach should be low due to the presence of wetlands and a sediment detention basin immediately upstream of the reach. It should be possible to create a highly sinuous E type channel that meanders back and forth across the bottom of the floodway in a narrow, low width/depth ratio channel which will distribute water through a restored wetland. The narrow and deep channel will collect all the shallow distributed flow now on the bottom of the floodway, resulting in less evaporative loss, reduced water temperatures, and better channel maintenance. The floodplain surface would require the importation of growth medium and revegetation with grasses and forbes.

Control of the incoming sediment supply in the reach would be critical to the restoration of an E type channel system in the reach. During the flood of January 1997 the sediment control structure at the upstream end of the Rosewood reach completely filled with sediment and delivered a substantial volume of sediment into the reach. Regular maintenance of this structure would be critical to the success of the restoration of the Rosewood reach. If Alternative No. 2 is selected in the Bella Vista Reach (to be discussed subsequently) then the existing rejuvenated wetland environment should provide an adequate level of sediment control for the reach. Should there be any doubt about long term control of sediment supply to the reach, then a potential alternative to restoration of a wetland and E type channel would be to restore a C type channel through the reach (which would be capable of transporting more sediment through the reach) and using small sinuous E type channels off of the C channel thalweg to water the wetland floor creating in effect an anastomosed channel system.

Planting/Revegetation

Revegetation of slopes and soils in the Steamboat Creek vicinity is difficult and challenging due to high mineral content of soils in reaches beginning at the Steamboat Geothermal area downstream to the Truckee River. The limitations come from Boron, Arsenic and other minerals.

Technical Data Rosewood

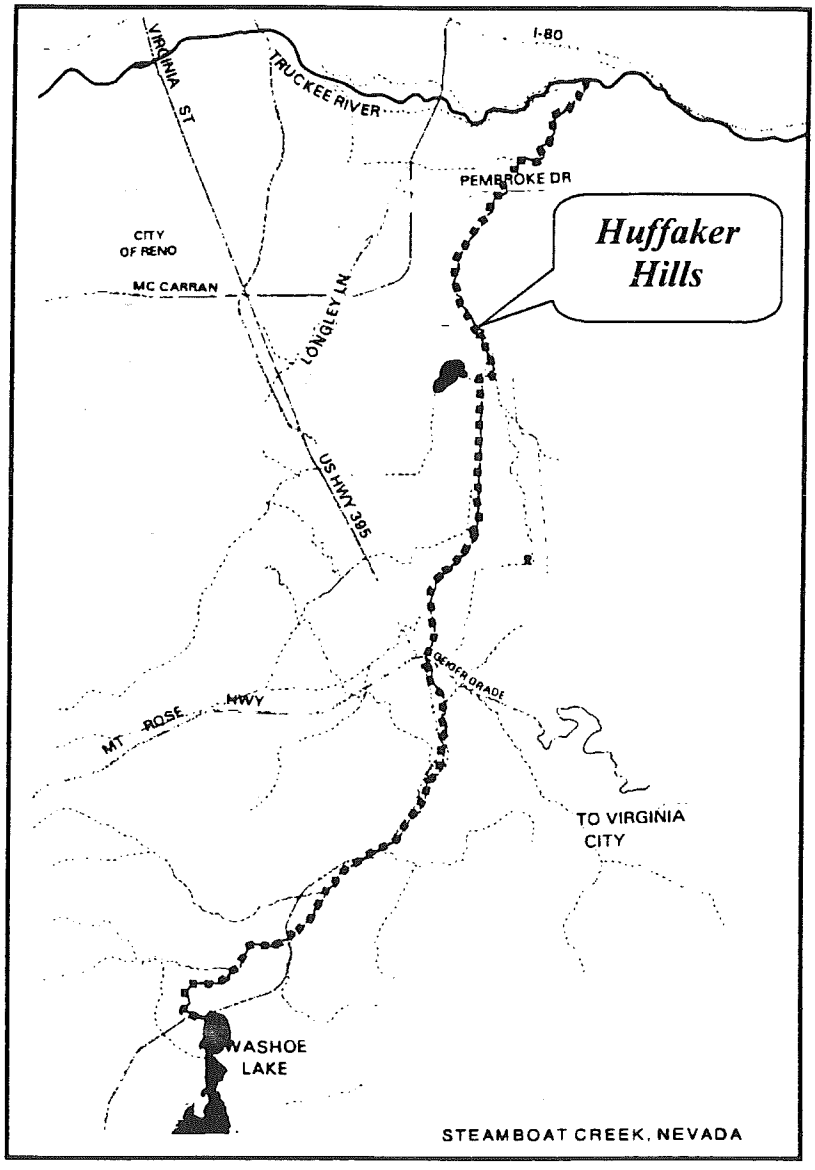
Reach:	Rosewood			
Beginning Station:	130+00	***Ending Station***	202+00	
Downstream End Landmark:	Pembroke Drive	***Upstream End Landmark:***	Mira Loma Drive	
Stream Types Represented:	D5, D6	***Dominant Stream Type:***	D5	
Bed Materials Represented:	Sand, Silt	***Dominant Bed Material:***	Sand	
Bank Erosion Index:	***Range:***	Moderate to Very High	***Typical:***	Moderate
Water Surface Gradient:	***Range:***	0 to 0.0062	***Typical:***	0.0013
Estimated Bankfull Flow:	***DS End:***	110 cfs	***US End:***	50 cfs
Major Tributaries Entering:	Rio Poco drain, Boynton Slough			
Major Diversions Exiting:	None			
Overall Stability Assessment:	***Bed:***	Poor	***Banks:***	Fair
Potential for Future Changes To:		***Flow Regime:***	Low	
		Sediment Supply:	Low	
		Land Use:	Low	
Water Quality Concerns:	Particulate phosphorous, nitrogen/nitrate			
Opportunities:	To provide an enhanced wetlands environment			
Constraints:	Importation of growth medium (soil).			
Recommended On Stream BMPs:	Creation of a wetland system fed by a highly sinuous single thalweg channel (E5c).			

Huffaker Hills

Description:

The Huffaker Hills reach begins at Mira Loma Drive and proceeds upstream to a point approximately 700 feet south of the access road along the north shore of Alexander Lake.

Geographic Location:



Moderate Priority

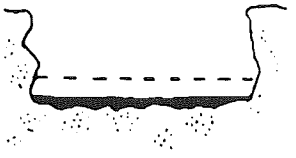
Priority:

This reach would have a moderate priority based on particulate pollution and chemical constituents.

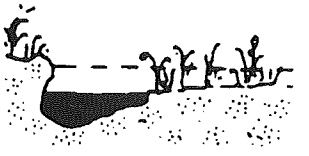
Stream Type:

It is a relatively low sinuosity reach averaging 1.13 and moderately incised with F and G type channels dominating. Bed materials are predominantly sand although some reaches containing abundant gravel in the bed do exist.

Existing:



Recommended:



Recommended BMPs

A preferred approach here would be an active one with full restoration of the planform, profile, and cross-sectional geometry. The new restored channel types should be predominately C5 with some of the steeper gravel bed sections restored to a B4 channel type. The work required would include a reduction in bank height and angle and the construction of revetments along the outside of meander bends. Log and boulder revetments backed by willow plantings would be preferred along the outside of meander bends (although soil boron content concerns still need to be checked). If bank protection with vegetation looks marginal then other revetment materials and riprap may be used as required for protecting bank toes and the outside of meander bends from erosion. Some grade control and flow centering structures (rock vortex weirs) may be needed to initiate riffle and pool formation in the new profile geometry. The proper placement of rock vortex weirs for grade control will be even more important in restoring the steeper B4 channel sections.

Planting/Revegetation

Revegetation of slopes and soils in the Steamboat Creek vicinity is difficult and challenging due to high mineral content of soils in reaches beginning at the Steamboat Geothermal area downstream to the Truckee River. The limitations come from boron, arsenic and other minerals.

Technical Data Huffaker Hills

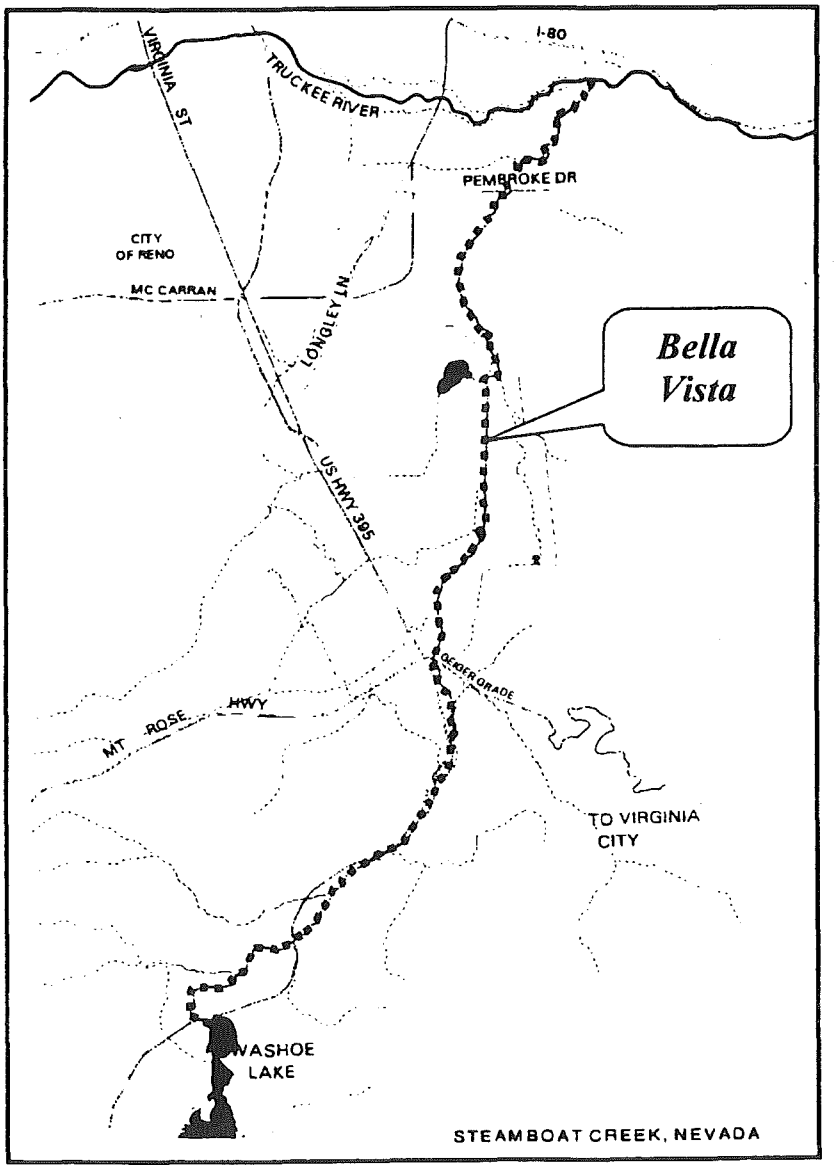
Reach:	Huffaker Hills			
Beginning Station:	202+00	***Ending Station***	286+00	
Downstream End Landmark:	Mira Loma Drive	***Upstream End Landmark:***	Bella Vista Ranch Road	
Stream Types Represented:	F5, G4c	***Dominant Stream Type:***	F5	
Bed Materials Represented:	Sand, Gravel	***Dominant Bed Material:***	Sand	
Bank Erosion Index:	***Range:***	Moderate	***Typical:***	Moderate
Water Surface Gradient:	***Range:***	0 to 0.0179	***Typical:***	0.00289
Estimated Bankfull Flow:	***DS End:***	50 cfs	***US End:***	35 cfs
Major Tributaries Entering:	None			
Major Diversions Exiting:	None			
Overall Stability Assessment:	***Bed:***	Fair	***Banks:***	Fair
Potential for Future Changes To:		***Flow Regime:***	Moderate	
		Sediment Supply:	Moderate	
		Land Use:	Moderate	
Water Quality Concerns:	Particulate phosphorous			
Opportunities:				
Constraints:	Soil boron levels			
Recommended On Stream BMPs:	Full restoration of plan form, profile, and cross sectional geometry, with bank angle reduction and revetments along the outside of meander bends.			

Bella Vista

Description

The Bella Vista reach begins approximately 700 feet south of the access road along the north shore of Alexander Lake and proceeds upstream to a point just northeast of the proposed White's Creek Meadows Subdivision. The majority of this reach is a straight irrigation ditch traversing north/south across the Bella Vista Ranch. Its most obvious characteristic of the planform is its extremely low sinuosity (an average of 1.01).

Geographic Location:



High Priority

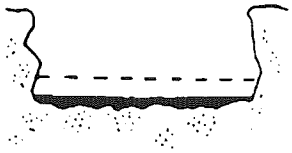
Priority:

This reach would have a moderate to high priority based on particulate pollution and chemical constituents.

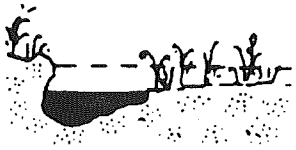
Stream Type:

F and G type channels dominate although the stream type has little meaning in this reach as it is entirely artificial. The natural alignment of Steamboat Creek which existed prior to construction of the irrigation ditch occupied the bottom of the valley floor some 1,000 to 3,000 feet further to the east. It would appear that it was originally a low-gradient anastomosed channel which connected a series of wetlands. An anastomosed system contains multiple channels similar to a braided system. However, in the anastomosed system the individual channels are separated by relatively stable islands and wetlands instead of unstable mid-channel bars, the channel sections transport less sediment and are less susceptible to avulsion The original wetlands still exist but in a highly degraded state.

Existing:



Recommended:



Recommended BMPs

There are two major restoration alternatives which could be considered in this reach. The first alternative would involve performing restoration activities at the site of the modern day channel (i.e., the irrigation ditch). The second alternative would involve relocating Steamboat Creek to occupy its pre-existing channel alignment through the wetlands to the east.

Alternative No. 1 would require the extensive application of an active approach with full restoration of the planform, profile, and cross-sectional geometry for providing a more stable, albeit artificial, system. The one limitation with respect to Alternative No. 1 is that no matter what action is taken in the existing channel alignment, you will not actually be "restoring" any pre-existing natural condition. The alignment will always be perched above the natural valley floor and will have to be regulated and maintained in that position. Any efforts to revegetate the banks with riparian vegetation will likely be handicapped, not only by soil boron levels, but by deep groundwater conditions which may recede to even greater depths once agricultural irrigation activities have terminated. Therefore, riparian vegetation in the banks may actually have to be supported by irrigation indefinitely. An appropriate restoration geometry would be a C5 channel. As before, revetment construction would be required with log and boulder revetments backed by willow plantings preferred, although soil boron content may inhibit revegetation. If bank protection with vegetation looks marginal, then other revetment materials and riprap may be used as required for protecting bank toes and the outside of meander bends from erosion. Some grade control and flow-centering structures (rock vortex weirs) may be needed to initiate riffle and pool formation in the new profile geometry.

Alternative No. 2 would involve principally a passive approach with the only active intervention required being the turning of the main stem Steamboat Creek flows back into the original channel and the active treatment of

trouble spots. However, it should be noted that Alternative No. 2 and the rewetting of pre-existing degraded wetlands could greatly hinder future development in the area by occupying considerably more surface area, aggravating a mosquito/pest problem, and dramatically increasing the surface area impacted during extreme floods. There are also major regulatory hurdles involved in relocating the current alignment of Steamboat Creek (particularly with respect to Corps of Engineers 404 Permitting). Although 404 permits can be regulatory hurdles, preliminary feedback from the Army Corps of Engineers indicate that the environmental enhancement would make the permitting processing easier. Other hurdles include changing the Southeast Truckee Meadows Flood Control Master Plan, the Southeast Truckee Meadows Land Use Plan, and working with Bella Vista Ranch about stream modifications on their property.

A number of proposals for future change exist which would potentially impact this reach. These include (1) the construction of a detention basin at the extreme downstream end of the reach (the Huffaker Hills detention basin), (2) modifications to the distributary channels of White's Creek, (3) construction of a flood-flow diversion structure at the beginning of the next reach upstream (the White's Creek Meadows reach).

The proposed detention basin at Huffaker Hills will be part of a U.S. Army Corps of Engineers flood control project. The Corps' study, described in an *Interim Project Status Report* dated April 1991, describes three alternatives. Alternative No. 1 was the no-action alternative characterizing the pre-project conditions. Alternative No. 2 proposed a flood detention basin covering the University Farms area. Alternative No. 3 proposed the construction of a sediment detention basin in the Huffaker Hills area. The *Interim Project Status Report* recommends the adoption of Alternative No. 3. The project should also involve low-flow channels with training levees or flood walls along Steamboat Creek from the Huffaker Hills outlet to the Rosewood Golf Course. In addition, some levee construction and channelization would be constructed around the University Farm area on Boynton Slough and on Steamboat Creek from the Truckee River to the upstream end of backwater levees. Construction of the sediment detention basin on the main stem of Steamboat Creek at this location would significantly alter the sediment load resulting in a significant reduction in sediment load downstream of the detention basin possibly aggravating the potential for further incision and bank erosion for some distance downstream of the detention basin site.

White's Creek originates in the Carson Range and flows to the east into Steamboat Creek. Approximately two miles upstream of Virginia Street, the natural water course diverges into four smaller channels. Two of the channels enter Steamboat Creek south of the White's Creek Meadows Subdivision and two of the channels flow in a northeasterly direction toward the Double Diamond Ranch. Construction of U.S. 395/I-580 has impacted the White's Creek floodplain by concentrating the flows in larger concrete box culverts under the freeway. The existing flood conveyance before construction of the freeway was shallow sheet-flow over broad, poorly-defined floodplains in the areas where the proposed subdivisions of White's Creek Meadows and the Double Diamond Ranch will be constructed. Current plans under construction consist of a series of channels and detention basins which will enhance and preserve wetlands and mitigate the effects of channelization on peak flows. Two alternatives have been proposed to reroute White's Creek. The first alternative would divert the flow from White's Creek branches 3 and 4 to a trapezoidal channel running along the south boundary of White's Creek Meadows Subdivision. This alternative will capture and convey the flows in the box culverts under the highway. Excess peak flows created by this channelization would be diverted from Steamboat Creek to a detention/wetlands enhancement area. The second alternative involves construction of a channel intercepting branches 1 and 2 from White's Creek and conveying branches 3 and 4 along the eastern property boundary of the Double Diamond Ranch development where it joins a channel diversion from Thomas Creek. The combined flows will flow through a channel along the north edge of the South Meadows Parkway to a proposed detention basin bordering Steamboat Creek. Flows from the developed Double Diamond Ranch property would be diverted to this proposed channel.

The third impact is the above-described diversion structure in Steamboat Creek located at the south edge of the White's Creeks Meadows Subdivision (the beginning of the next reach upstream or the White's Creek Meadows reach). Flows above 2700 cfs would be diverted to the eastern section of the Damonte Ranch through a series of detention basins which will be incorporated into the wetlands and open space areas. The proposed diversion structure on Steamboat Creek would consist of an earthen dam with four 108-inch CMP culverts. The culverts would pass low-flows below 2700 cfs down Steamboat Creek channel. During higher flow events the excess flow would be diverted to the first of two detention basins. The design inflow to the first basin is 5,000 cfs and the design outflow is 4,688 csf. From the first basin the flow would travel over a broad floodplain to the second basin which reduces the flow to a reported 4,460 cfs. The flow exiting the second detention basin is conveyed in the original Steamboat Creek channel northward across the Bella Vista Ranch joining the main stem of Steamboat Creek again in the Huffaker Hills area.

Obviously all of these potential modifications would have significant impact on the flow regime in the Bella Vista reach of the Steamboat Creek channel. Of concern is the capacity of the channel to continue to transport existing sediment loads and bed material through the reach in a potentially diminished flow regime. If proposed detention structures reduce sediment loads sufficient to keep pace with a diminished magnitude and duration of bankfull channel discharge, then the impacts may be relatively small. If the change has created a significant imbalance between bankful discharge and sediment load, then significant aggradation or channel filling could occur if the balance shifts toward an increased relative sediment load, or significant scour and incision could result should the balance shift toward a depleted sediment load. Our current evaluation of the potential changes would favor the tendency toward channel aggradation as the most probable outcome of proposed future changes.

Given the highly artificial and high-maintenance character of the existing channel system in the Bella Vista reach, the future character of the channel could be modified to accommodate these changes in future development of the area without degrading the character of the channel any further or increasing channel maintenance requirements substantially above current levels.

Planting/Revegetation

Revegetation of slopes and soils in the Steamboat Creek vicinity is difficult and challenging due to high mineral content of soils in reaches beginning at the Steamboat Geothermal area downstream to the Truckee River. The limitations come from boron, arsenic and other minerals.

Technical Data Bella Vista

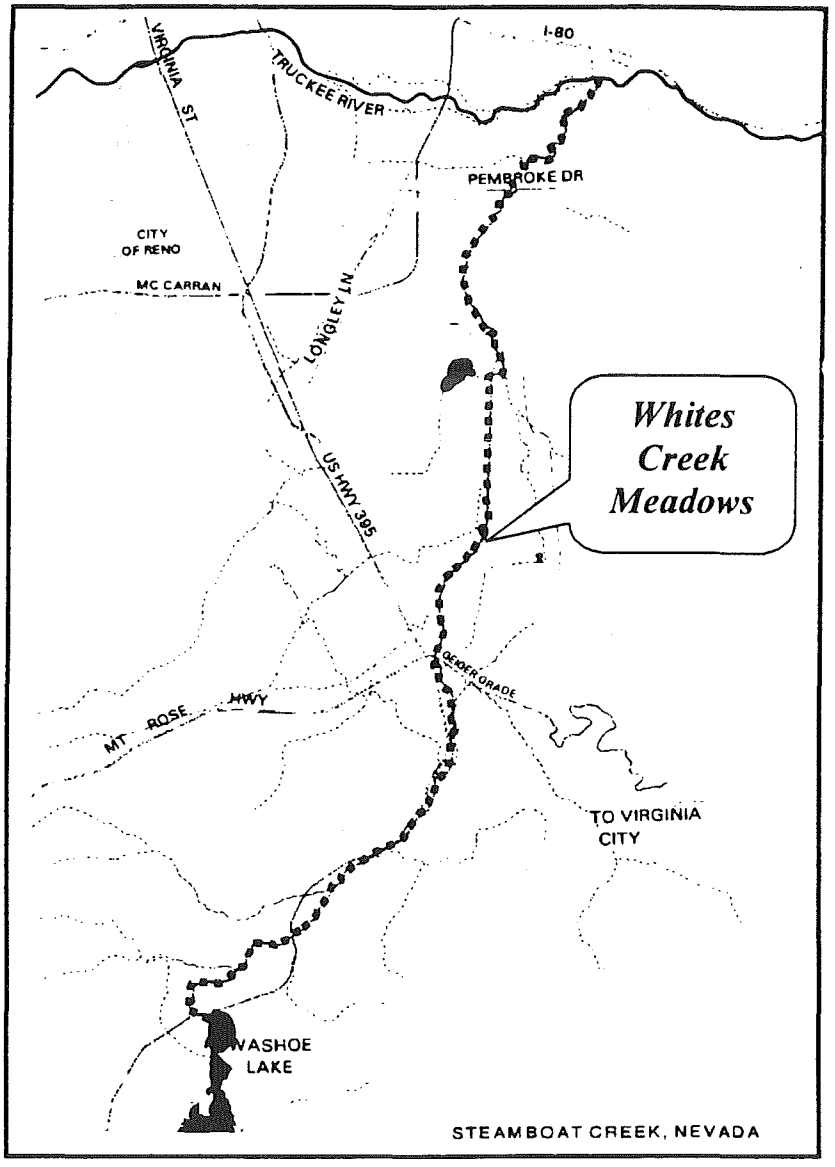
Reach:	Bella Vista			
Beginning Station:	286+00	***Ending Station***	422+00	
Downstream End Landmark:	Bella Vista Ranch Road	***Upstream End Landmark:***	2 miles South of Bella Vista Ranch Road	
Stream Types Represented:	F4, F5, G5c	***Dominant Stream Type:***	F5	
Bed Materials Represented:	Sand, Gravel	***Dominant Bed Material:***	Sand	
Bank Erosion Index:	***Range:***	Moderate to High	***Typical:***	High
Water Surface Gradient:	***Range:***	0 to 0.0124	***Typical:***	0.00299
Estimated Bankfull Flow:	***DS End:***	35 cfs	***US End:***	35 cfs
Major Tributaries Entering:	Thomas Creek, Irrigation return flows			
Major Diversions Exiting:	None			
Overall Stability Assessment:	***Bed:***	Fair	***Banks:***	Fair
Potential for Future Changes To:	***Flow Regime:***		High	
	Sediment Supply:		High	
	Land Use:		High	
Water Quality Concerns:	Particulate phosphorous, nitrogen/nitrate, boron, arsenic, chloride, and TDS			
Opportunities:				
Constraints:	Maintenance of an artificial channel alignment on the valley floor. Soil boron levels.			
Recommended On Stream BMPs:	Full restoration of plan form, profile, and cross sectional geometry, with bank angle reduction and revetments along the outside of meander bends.			

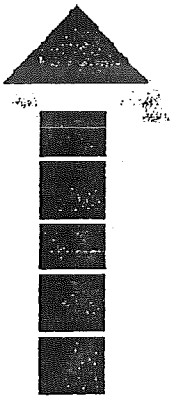
White's Creek Meadows

Description

The White's Creek Meadows reach begins at the upstream end of the straight irrigation ditch that was the end of the Bella Vista reach, and proceeds upstream in a southwesterly direction to the south boundary of the White's Creek Meadows Subdivision. This is a reach in transition. It has characteristics typical of a stream that is well into the channel metamorphosis process and naturally converting from a deeply incised and degraded condition back toward a more stable channel configuration.

Geographic Location:





High Priority

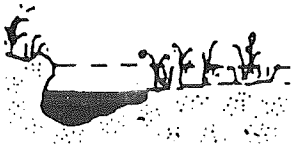
Priority

This reach would be perceived to have a high priority based on impacts to chemical constituents, the impending impacts from development, and the need to preserve and enhance the momentum of the healing process.

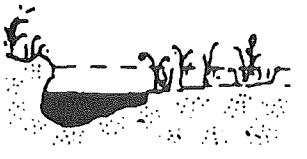
Stream Type:

The pre-existing stream type in the area was, in all likelihood, a C5 channel. Channel degradation and incision possibly occurred as early as the late 1800s. The destabilization caused a conversion from the C5 channel type to a F5 channel type. Degradation of the channel was probably the result of changes in the flow regime associated with irrigation and/or grazing management practices. Whatever the reason, the reach has experienced significant incision and entrenchment in the past. However, lateral bank migration has now proceeded far enough that it has created an adequate meander belt-width for the modern day stream to begin working a new C5 channel on the floor of the widened trench. The stream is regaining its sinuosity by building new active point bars and creating an active floodplain, just like it had before the disturbance, only now at a lower level. Sinuosity in this reach has increased from the 1.01 to 1.04 range typically observed in the Bella Vista reach, to a mean sinuosity of 1.25. Local sinuosity within the reach is as high as 1.5, although the downstream portions of the reach still contain an abundance of channels which classify as F5 systems.

Existing:



Recommended:



Recommended BMPs

The upper portion of the reach already has transitioned to the point where the existing classifications are again C5. Given sufficient time and space this reach would probably fully recover on its own to a more stable C5 channel configuration. Therefore, a passive approach to restoration can be highly recommended in this reach. Immediate action which would help facilitate recovery would be the exclusion of livestock from the stream corridor by fencing and the provision of an alternative means of livestock watering. In the future, when the area is converted from agricultural to residential and commercial uses, an adequate stream buffer zone can be created with restricted land-use activities in the various buffer zones.

Although the proposed passive approaches would permit continued recovery over time, the recovery process could be accelerated and beneficial water quality impacts obtained more quickly with the local application of active instream BMPs at specific problem sites. Techniques having application would include local reductions in bank height and angle at sites where severe bank erosion persists, construction of revetments along the outside of the aggressively eroding meander bends, and the augmentation of the naturally occurring revegetation of the floodplain and banks.

As mentioned previously in the description of the Bella Vista reach, this portion of Steamboat Creek could be

impacted by proposed changes to the flow regime. The most significant impacts would be the construction of a flood diversion structure at the extreme upstream end of the reach and a detention structure in the southeast corner of the proposed White's Creek Meadows Subdivision. Since the proposed flood diversion will affect flows only above a discharge level of 2700 cfs, it should have minimal impact on bankfull channel-maintenance flows and flow durations. However, the proposed diversion structure (four 108-inch CMP culverts on the main stem of Steamboat Creek) could have local impacts on the channel bed and banks. These impacts could include contraction scour immediately downstream of the culverts and headward aggradation immediately upstream of the culverts (particularly during the passage of larger flood events). Since the actual design of the proposed flow diversion structure was not available for review, it is unclear what the potential magnitude of the impact might be of the proposed detention basin on the existing sediment load.

The White's Creek Meadows development is a 519 lot single-family subdivision situated on a 172.5 acre portion of the original Damonte Ranch immediately south of and adjacent to the Double Diamond Subdivision. The Double Diamond Ranch is being planned for residential and commercial development. The commercial portion of the development, called the South Meadows Business Park, is currently under construction while the residential portion of the development remains in the planning stages. Development of the Double Diamond Ranch will significantly alter the floodplain leading to Steamboat Creek, although Steamboat Creek is actually off site to the east of the development. The flows from channels 1 and 2 of Whites Creek as well as the flow from Thomas Creek will be intercepted and conveyed through the "Lumber Jack" channel along the north edge of South Meadows Parkway into a proposed detention basin bordering Steamboat Creek. Flows from the developed areas of the Double Diamond Ranch would be collected in the "Central Channel" and directed into the "Lumber Jack" channel. Current development plans propose the channelization of Steamboat Creek through a trapezoidal earthen channel having a bottom width ranging from 115 to 200 feet. The channel would extend from the proposed diversion at the south edge of White's Creek Meadows Subdivision and end at the proposed detention basin receiving flow from the Lumber Jack channel. Obviously the construction of a large trapezoidal ditch at the site of the existing Steamboat Creek channel would effectively erase all of the natural channel recovery in process. Creation of a multi-stage channel system along this reach, which preserves the channel recovery processes currently under way yet provides an active floodplain capable of safely passing the 100-year design storm event through the developed subdivision, would be recommended as an alternative to be considered in lieu of construction of a simple trapezoidal floodway.

Planting/Revegetation

Revegetation of slopes and soils in the Steamboat Creek vicinity is difficult and challenging due to high mineral content of soils in reaches beginning at the Steamboat Geothermal area downstream to the Truckee River. The limitations come from boron, arsenic and other minerals.

Technical Data Whites Creek Meadows

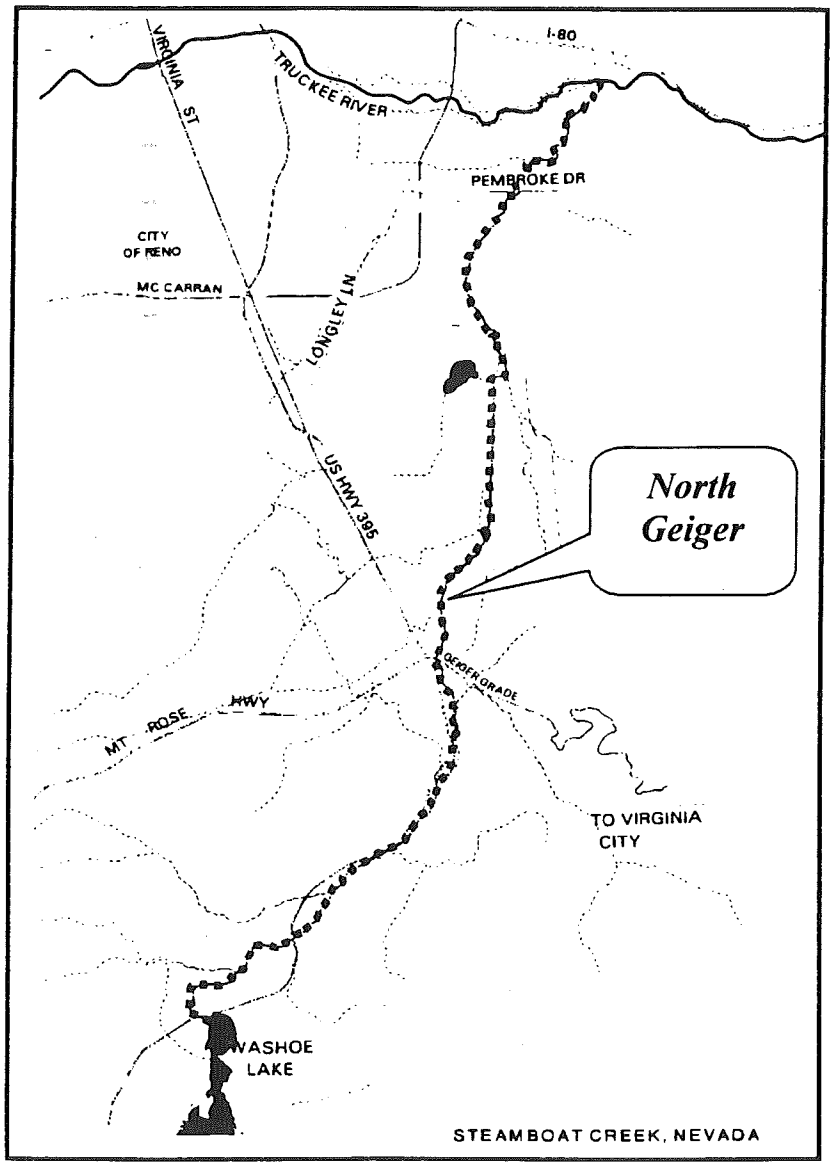
Reach:	Whites Creek Meadows			
Beginning Station:	422+00	***Ending Station***	471+50	
Downstream End Landmark:	2 Miles south of Bella Vista Ranch Road	***Upstream End Landmark:***	1.2 Miles north of SR 341	
Stream Types Represented:	C5, F5	***Dominant Stream Type:***	C5	
Bed Materials Represented:	Sand	***Dominant Bed Material:***	Sand	
Bank Erosion Index:	***Range:***	Moderate to Extreme	***Typical:***	Extreme
Water Surface Gradient:	***Range:***	0 to 0.0136	***Typical:***	0.00456
Estimated Bankfull Flow:	***DS End:***	35 cfs	***US End:***	75 cfs
Major Tributaries Entering:	Whites Creek, Irrigation return flows			
Major Diversions Exiting:	None			
Overall Stability Assessment:	***Bed:***	Fair	***Banks:***	Poor
Potential for Future Changes To:		***Flow Regime:***	Very High	
		Sediment Supply:	High	
		Land Use:	High	
Water Quality Concerns:	Nitrogen/nitrates, boron, arsenic, chloride, and TDS			
Opportunities:				
Constraints:	Soil boron levels.			
Recommended On Stream BMPs:	Fencing out of livestock and development of a stream buffer zone with localized bank angle reduction and treatment of trouble spots.			

North Geiger

Description:

The North Geiger reach begins at the south edge of the proposed White's Creek Meadows Subdivision and proceeds upstream to the crossing at State Highway 341 (Geiger Grade). The reach is similar in character to the White's Creek Meadows reach previously described, however, conversion from a degraded F type channel to a more stable C type channel is even further along in the downstream portions of the reach.

Geographic Location:



High Priority

Priority:

This reach would be perceived to have a high priority based on impacts to chemical constituents, the impending impacts from development, and the need to preserve and enhance the momentum of the healing process.

Stream Type:

The dominant channel types in the northern half of the reach consist of C5 and B5 channels. Measured classification of channel type in the southern half of the reach is not available. However, visual inspection of the channel just downstream at the crossing at Geiger Grade reveals a return to a degraded F type channel. The reasons for this are unclear.

Existing:

Recommended:

Recommended BMPs

In the northern portion of the reach a passive approach identical to that described for the White's Creek Meadows reach would be appropriate. Although the proposed passive approaches would permit continued recovery over time, the recovery process could be accelerated and beneficial water quality impacts obtained more quickly with the local application of active instream BMPs at specific problem sites. Techniques having application would include local reductions in bank height and angle at sites where severe bank erosion persists, construction of revetments along the outside of the aggressively eroding meander bends, and the augmentation of the naturally occurring revegetation of the floodplain and banks.

In the southern portion of the reach, a more active approach would be appropriate involving preferably a full restoration of the planform, profile, and cross-sectional geometry. However, if this should prove not to be possible, then at least the development of a multi-stage channel along the current alignment should be applied. Either procedure will involve reductions in bank height and angle and an appropriate reduction in the width-depth ratio (restoring the cross-section to characteristics appropriate to a C5 channel with a working, active floodplain). It should be noted that this reach contains some natural grade control with the channel bed impinging upon erosion resistant rock outcrops. It would be important to key any changes in channel geometry, and in particular the profile geometry, to these existing grade controls.

Planting/Revegetation

Revegetation of slopes and soils in the Steamboat Creek vicinity is difficult and challenging due to high mineral content of soils in reaches beginning at the Steamboat Geothermal area downstream to the Truckee River. The limitations come from boron, arsenic and other minerals.

Technical Data North Geiger

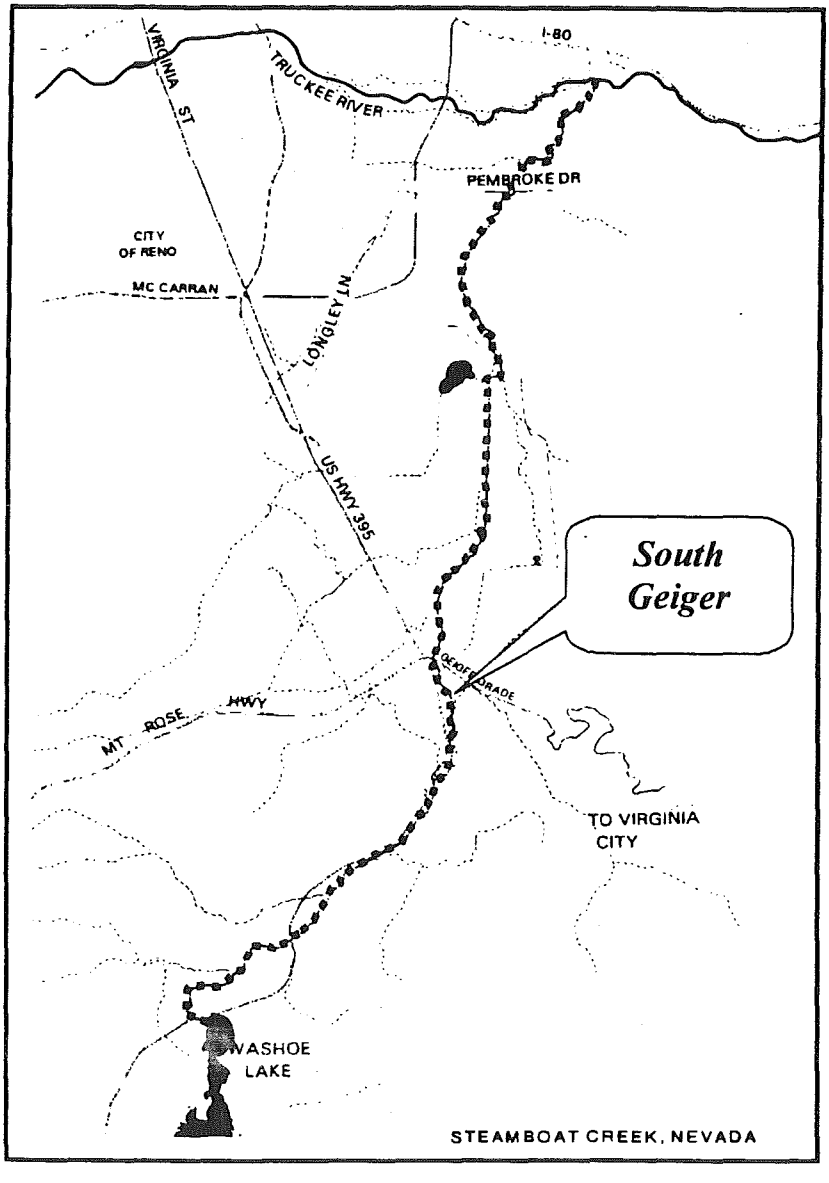
Reach:	North Geiger			
Beginning Station:	471+50	***Ending Station***	541+00	
Downstream End Landmark:	1.2 Miles North of SR 341	***Upstream End Landmark:***	SR 341	
Stream Types Represented:	C5, B5c	***Dominant Stream Type:***	C5	
Bed Materials Represented:	Sand	***Dominant Bed Material:***	Sand	
Bank Erosion Index:	***Range:***	Moderate to Very High	***Typical:***	Moderate
Water Surface Gradient:	***Range:***	0 to 0.0160	***Typical:***	0.00651
Estimated Bankfull Flow:	***DS End:***	75 cfs	***US End:***	40 cfs
Major Tributaries Entering:	None			
Major Diversions Exiting:	None			
Overall Stability Assessment:	***Bed:***	Fair	***Banks:***	Fair
Potential for Future Changes To:		***Flow Regime:***	Moderate	
		Sediment Supply:	Moderate	
		Land Use:	High	
Water Quality Concerns:	Boron, arsenic, chloride, and TDS			
Opportunities:				
Constraints:	Soil boron levels.			
Recommended On Stream BMPs:	Fencing out of livestock and development of a stream buffer zone with localized bank angle reduction and treatment of trouble spots.			

South Geiger

Description:

The Steamboat Station reach begins at the crossing on State Highway 341 and proceeds upstream to the crossing at Towne Drive.

Geographic Location:



High to Moderate Priority

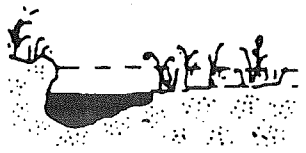
Priority:

This reach would have high to moderate priority based on impacts to chemical constituents, water temperature impacts, and opportunities presented by impending development.

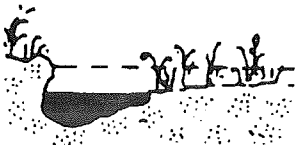
Stream Type:

The reach is dominated by channels that classify as C5 although marginally so. Some sections of the reach still do classify as F5 channels. The reach is affected by extreme changes in flow regime. The reach contains the diversion structure for the Crane Ditch, and the diversion for the Chandler Ditch is in the next reach upstream. At present, during the summer months, nearly all of the flow in the Steamboat Creek channel is diverted eastward through these ditch systems for agricultural use. Therefore, commonly in the summer months there will be no surface flow whatsoever with only a few disconnected, stagnant pools remaining in the low-flow channel. The lack of summer flows has allowed vegetation encroachment in portions of what would otherwise be the active channel bed. The flow channel is frequently choked by cattails. The flow regime in this reach could conceivably continue to change over time as existing agricultural areas downstream are converted to more urbanized residential and commercial use.

Existing:



Recommended:



Recommended BMPs

Another dominant influence in this reach will be the construction of a proposed development called Steamboat Station. Steamboat Station is a 99-acre multi-use commercial development which will contain a 340 room hotel; 4 restaurants, a 19,000 square foot convention center, 80,000 square feet of gaming area, and over 10,000 square feet retail space. With the strong influence of poor water quality from the Hot Springs areas immediately upstream, habitat remains a non-issue in this reach. Therefore, an active approach is recommended which focuses on approvement of water quality and the aesthetic characteristics of the stream channel without regard to habitat. Designers should concentrate on development of a meandering C5 channel and landscaping rather than habitat restoration. A multi-stage channel cross-section could be developed providing for the concentration of available flow in low flow channel systems and provision of a working active floodplain that could safely accommodate a wide variety of discharge levels in an aesthetically pleasing channel environment. Creative use of rock and timber could provide erosion protection in the bed and banks and produce a landscaped stream corridor compatible with the highly commercialized use.

Contact UNR Cooperative Extension's Small Ranch Program coordinator at 784-4848 for assistance in this area.

Planting/Revegetation

Revegetation of slopes and soils in the Steamboat Creek vicinity is difficult and challenging due to high mineral content of soils in reaches beginning at the Steamboat Geothermal area downstream to the Truckee River. The limitations come from boron, arsenic and other minerals.

Technical Data South Geiger

Reach:	South Geiger			
Beginning Station:	541+00	***Ending Station***	610+00	
Downstream End Landmark:	SR 341	***Upstream End Landmark:***	Towne Road	
Stream Types Represented:	C5, F5	***Dominant Stream Type:***	C5	
Bed Materials Represented:	Sand	***Dominant Bed Material:***	Sand	
Bank Erosion Index:	***Range:***	Moderate to High	***Typical:***	Moderate
Water Surface Gradient:	***Range:***	0 to 0.0611	***Typical:***	0.00476
Estimated Bankfull Flow:	***DS End:***	40 cfs	***US End:***	120 cfs
Major Tributaries Entering:	None			
Major Diversions Exiting:	Crane Ditch			
Overall Stability Assessment:	***Bed:***	Fair	***Banks:***	Fair
Potential for Future Changes To:		***Flow Regime:***	High	
		Sediment Supply:	Moderate	
		Land Use:	Moderate	
Water Quality Concerns:	Boron, arsenic, chloride, and TDS			
Opportunities:	Develop a stream restoration effort compatible with proposed commercial development activity			
Constraints:	Extremely variable flow regime and lack of summer base flow. Soil boron levels.			
Recommended On Stream BMPs:	Develop a multistage channel within the existing alignment landscaped to suit proposed commercial use with reduction of bank angle and revetments as required.			

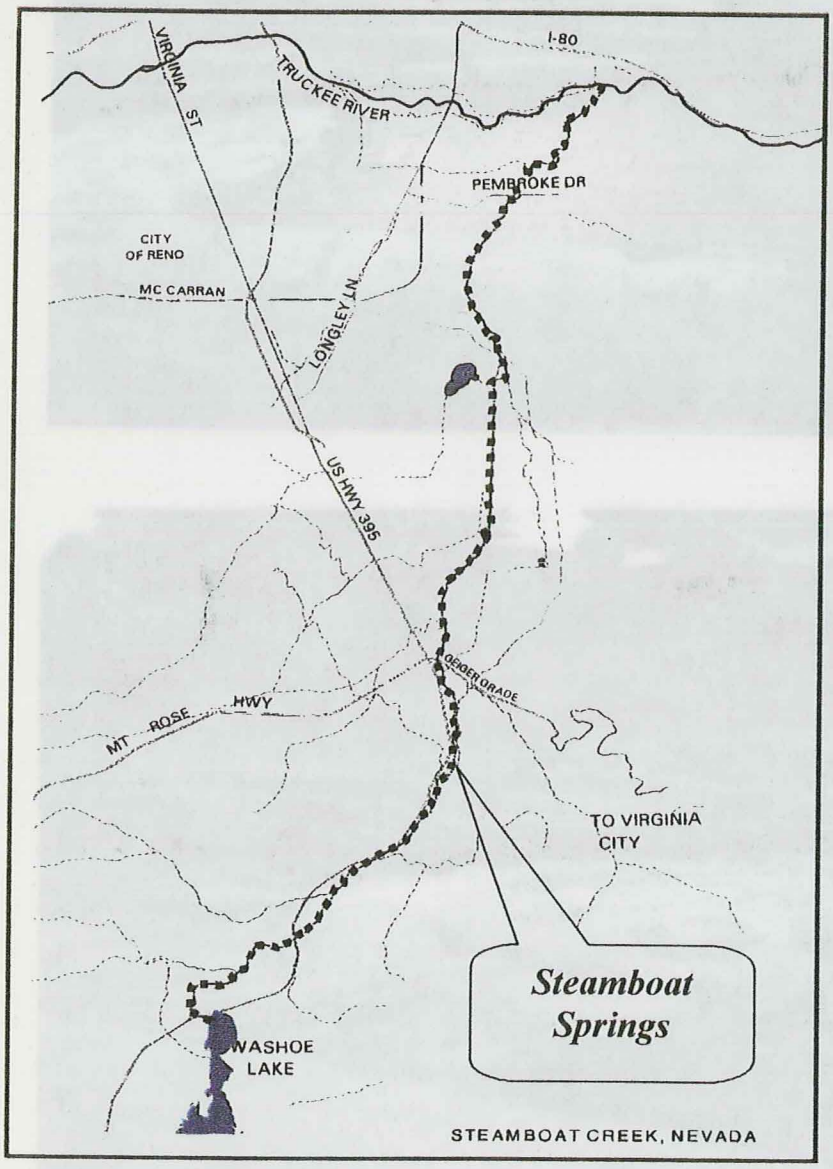
Figure 24. Photo Example of Potential Creative Rock Terrace Treatment at South Geiger

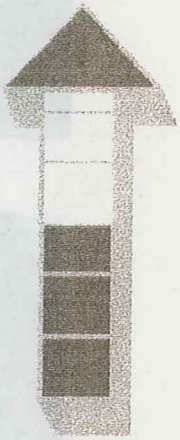
Steamboat Springs

Description:

The Steamboat Springs reach begins at the crossing Towne Drive and proceeds upstream to a point just above the intersection of Highway 395 and Cheyenne Drive.

Geographic Location:





Moderate Priority

Priority:

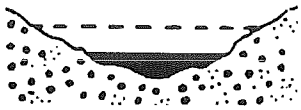
This reach would have a moderate priority based on impacts to chemical constituents.

Stream Type:

It is predominantly a B type channel consisting of a sand bed in the upper portion of the reach and a gravel bed from about Rhodes Road on downstream. Portions of the lower part of this reach are non-fluvial (i.e., the channel impinges upon bedrock in both the bed and banks). Therefore, this section of the channel is likely to represent key grade control that establishes a base level for much of the Steamboat Creek channel lying above the Steamboat Springs reach. It is in the Steamboat Springs reach where the vast majority of the geothermal spring sites discharge into the Steamboat Creek channel. Similar to the Steamboat Station reach, the Steamboat Springs reach contains perhaps the most highly regulated and complex flow regime anywhere in the Steamboat Creek channel. In the upper portion of the reach, flows from Bailey Canyon enter along with some return flow from the upstream diversion of Big Ditch. The Steamboat Ditch also enters the main stem of Steamboat Creek in this reach. During irrigation season, the Steamboat Ditch can discharge as much as 100 cfs into this portion of the reach. However, only a short distance downstream from the discharge point of Steamboat Ditch is the diversion point for the Chandler Ditch. Also in this reach *and those to the south,* the channel traverses a multitude of small property owners (making a large-scale coordinated restoration effort difficult).

Existing:

Recommended:



Recommended BMPs

A predominantly non-structural passive approach is recommended for this reach and from this point on south to Washoe Lake. This reach and those to the south are ideal areas to stress pollution prevention BMPs as presented by the Small Ranch Water Quality Program. Upstream of Rhodes Road, water quality and bank soil conditions will have improved to the point where revegetation efforts would be met with much greater success than at points downstream. Therefore, in addition to the passive restriction of activities and encroachments into the stream channel, local application of active in-stream BMPs including reduction of bank height and angle, and restoration of riparian areas, could be used with success.

Contact UNR Cooperative Extension's Small Ranch Program coordinator at 784-4848 for assistance in this area.

Planting/Revegetation

Revegetation of slopes and soils in the Steamboat Creek vicinity is difficult and challenging due to high mineral content of soils in reaches beginning at the Steamboat Geothermal area downstream to the Truckee River. The limitations come from boron, arsenic and other minerals.

Technical Data Steamboat Springs

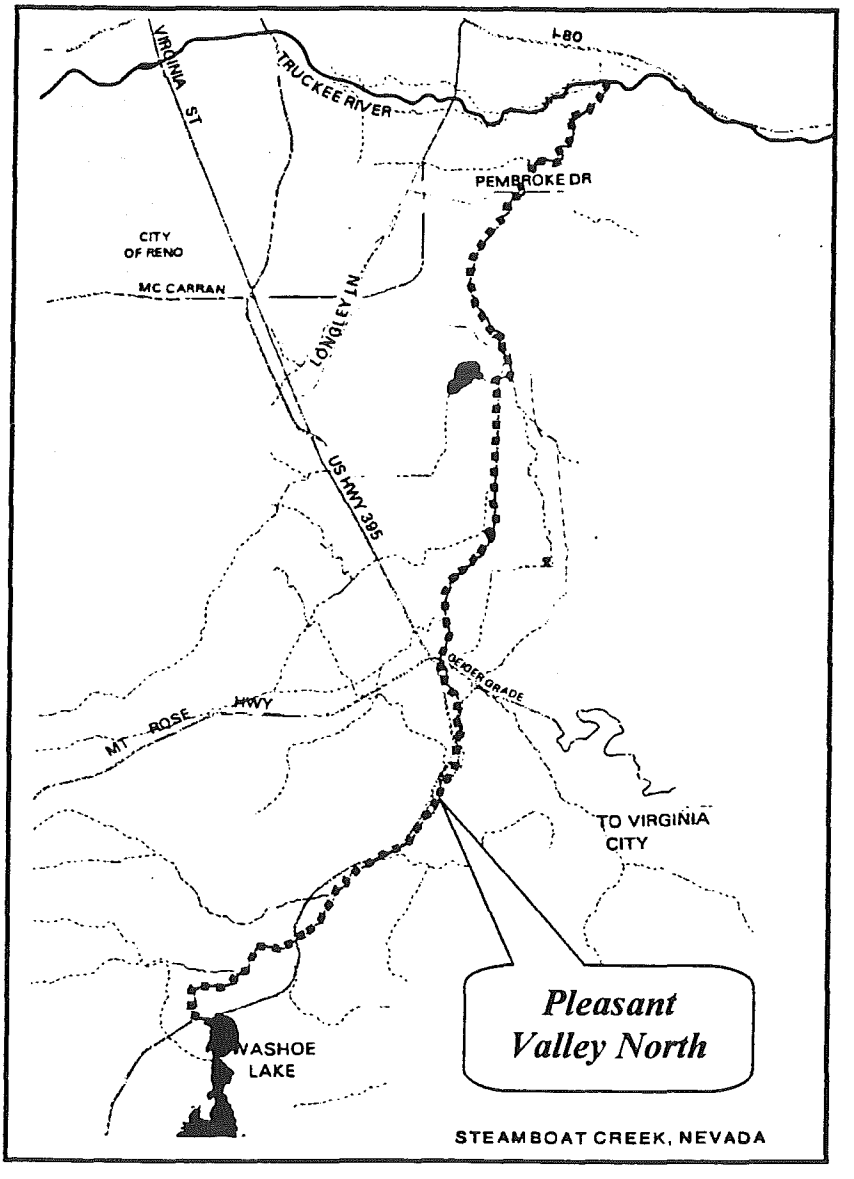
Reach:	Steamboat Springs			
Beginning Station:	610+00	***Ending Station***	690+00	
Downstream End Landmark:	Towne Road	***Upstream End Landmark:***	700's of Cheyenne Drive	
Stream Types Represented:	B4c, B5c	***Dominant Stream Type:***	B5c	
Bed Materials Represented:	Sand, Gravel	***Dominant Bed Material:***	Sand	
Bank Erosion Index:	***Range:***	Low to High	***Typical:***	High
Water Surface Gradient:	***Range:***	0 to 0.0288	***Typical:***	0.00323
Estimated Bankfull Flow:	***DS End:***	120 cfs	***US End:***	100 cfs
Major Tributaries Entering:	Bailey Canyon, Big Ditch, Steamboat Ditch			
Major Diversions Exiting:	Chandler Ditch			
Overall Stability Assessment:	***Bed:***	Good	***Banks:***	Poor
Potential for Future Changes To:		***Flow Regime:***	High	
		Sediment Supply:	Low	
		Land Use:	Low	
Water Quality Concerns:	Boron, arsenic, chloride, and TDS			
Opportunities:				
Constraints:	Soil boron levels in the lower reach.			
Recommended On Stream BMPs:	Development of a stream buffer zone with localized bank angle reduction and treatment of trouble spots.			

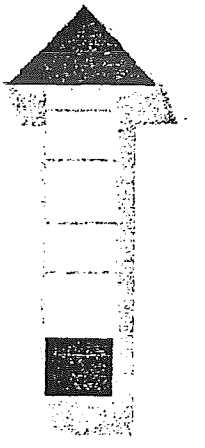
Pleasant Valley North

Description:

The Pleasant Valley North reach extends from just upstream of the intersection of Highway 395 and Cheyenne Drive, upstream to the point of diversion of the Big Ditch (approximately 1500 feet upstream of the crossing at Andrew Lane). This reach is similar in character to the Steamboat Springs reach in that the flows are highly regulated by the diversion into Big Ditch at its upstream end, and the channel traverses a multitude of small property owners. The existing channel is somewhat more degraded in this reach than in the upper portions of the Steamboat Springs reach.

Geographic Location:





Low Priority

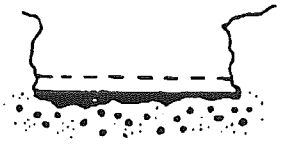
Priority:

This reach would have a low priority due to limited water quality impacts and the degree of difficulty in implementations.

Stream Type:

Channel types alternate between F5 channels B4 channels. The main stem of Steamboat Creek in this reach contains a number of small diversions and check dams. Headward aggradation (channel filling) with sand behind these structures is responsible for many of the conversions to a degraded F type channel.

Existing:



Recommended:

Recommended BMPs

Although a passive approach remains appropriate in this reach, including the fencing out of livestock, and the restriction of access and encroachments of the channel, a somewhat higher level of application of active in-stream BMPs would be appropriate for restoration. Full restoration of planform, profile, and cross-section is probably impractical due to space constraints and the multitude of impacts on individual property owners. However, the development of a multi-stage channel within the existing alignment would be desirable in the highly degraded F type channel reaches. BMPs would include development of a multi-stage channel with active floodplain involving a reduction of bank height and angle, construction of log and boulder revetments at the outside of meander bends, and restoration of riparian vegetation in banks to provide long-term, self-maintaining erosion protection.

Contact UNR Cooperative Extension's Small Ranch Program coordinator at 784-4848 for assistance in this area.

Technical Data Pleasant Valley North

Technical Data Pleasant Valley North

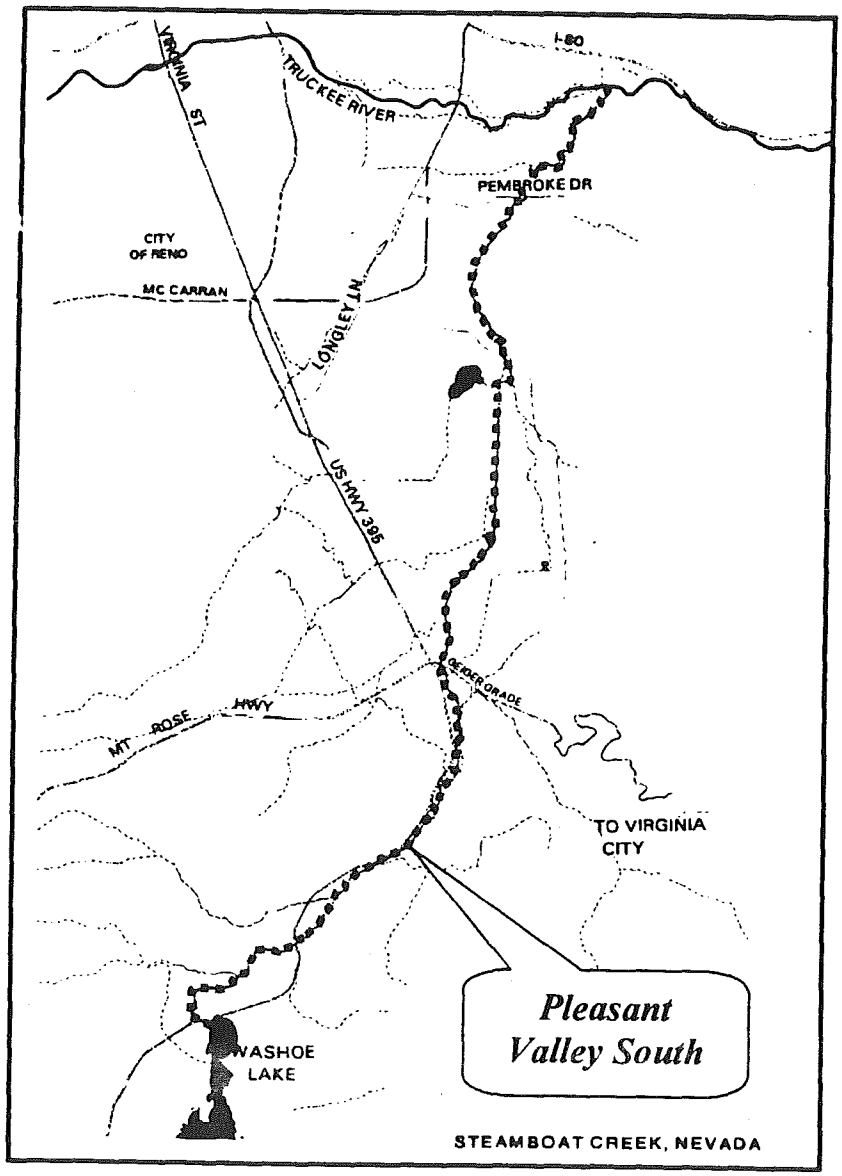
Reach:	Pleasant Valley North			
Beginning Station:	610+00	***Ending Station***	740+00	
Downstream End Landmark:	700s of Cheyenne Drive	***Upstream End Landmark:***	1500' Southwest of Andrew Lane	
Stream Types Represented:	F4, F5, B4c	***Dominant Stream Type:***	F4	
Bed Materials Represented:	Sand, Gravel	***Dominant Bed Material:***	Gravel	
Bank Erosion Index:	***Range:***	Low to High	***Typical:***	Moderate
Water Surface Gradient:	***Range:***	0 to 0.12	***Typical:***	0.0136
Estimated Bankfull Flow:	***DS End:***	100 cfs	***US End:***	75 cfs
Major Tributaries Entering:				
Major Diversions Exiting:				
Overall Stability Assessment:	***Bed:***	Fair	***Banks:***	Fair
Potential for Future Changes To:	***Flow Regime:***		Low	
	Sediment Supply:		Low	
	Land Use:		Low	
Water Quality Concerns:				
Opportunities:				
Constraints:	Potential impacts to multiple individual property owners.			
Recommended On Stream BMPs:	Fencing livestock out of the stream corridor and development of a stream buffer zone. Development of multistage channel with bank angle reduction and revegetation in highly degraded sections.			

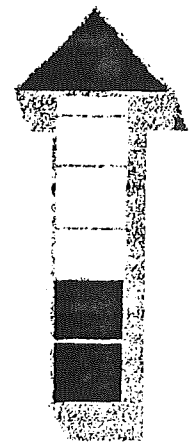
Pleasant Valley South

Description:

The Pleasant Valley South reach begins at the diversion structure for Big Ditch and proceeds upstream to a point just below Laramie Drive.

Geographic Location:





Low to Moderate Priority

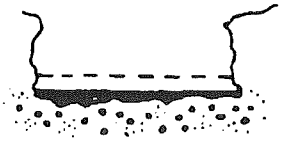
Priority:

This reach would have a low to moderate priority based on limited water quality impacts and the degree of difficulty in implementation.

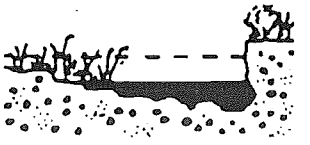
Stream Type:

The reach contains a series of alternating C and F type channels. It has a gravel bed consisting of glacial outwash from Galena Creek which enters Steamboat Creek near the upper end of the reach. This reach appears to have been substantially affected by a threshold event which was the February 1986 flood on Steamboat Creek. The magnitude of this flood event, in combination with man made changes along the channel (primarily channel straightening and removal of riparian stream bank vegetation), resulted in significant erosion and, at some locations, channel incision which has increased width/depth ratios, deepened and over steepened banks, producing F type channels along much of the Steamboat Creek alignment. The crossing of such a threshold begins a cycle of channel metamorphosis and at many locations the channel is already attempting to restore a more stable configuration.

Existing:



Recommended:



Recommended BMPs

An active approach would be strongly recommended in this reach where active in-stream BMPs can be applied to improve channel stability and artificially accelerate the recovery process, shortening the time required to achieve a stable configuration. Where possible, full restoration of the planform, profile, and cross-sectional geometry should be applied. If this is not possible, then at least the development of a multi-stage cross-section with low-flow channel and active floodplain should be developed within the existing alignment in some of the more highly degraded sections of the channel. Restoration to a C4 channel type would be appropriate. Active BMPs would include reduction in bank height and angle, construction of revetments at the outside of meander bends, and restoration of riparian vegetation in the banks in order to provide long-term erosion protection. Once active restoration efforts have been completed, passive approaches could be applied to protect the restored reach from future degradation. This would include the fencing out of livestock and development of a restricted stream buffer zone.

Contact UNR Cooperative Extension's Small Ranch Program coordinator at 784-4848 for assistance in this area.

Technical Data Pleasant Valley South

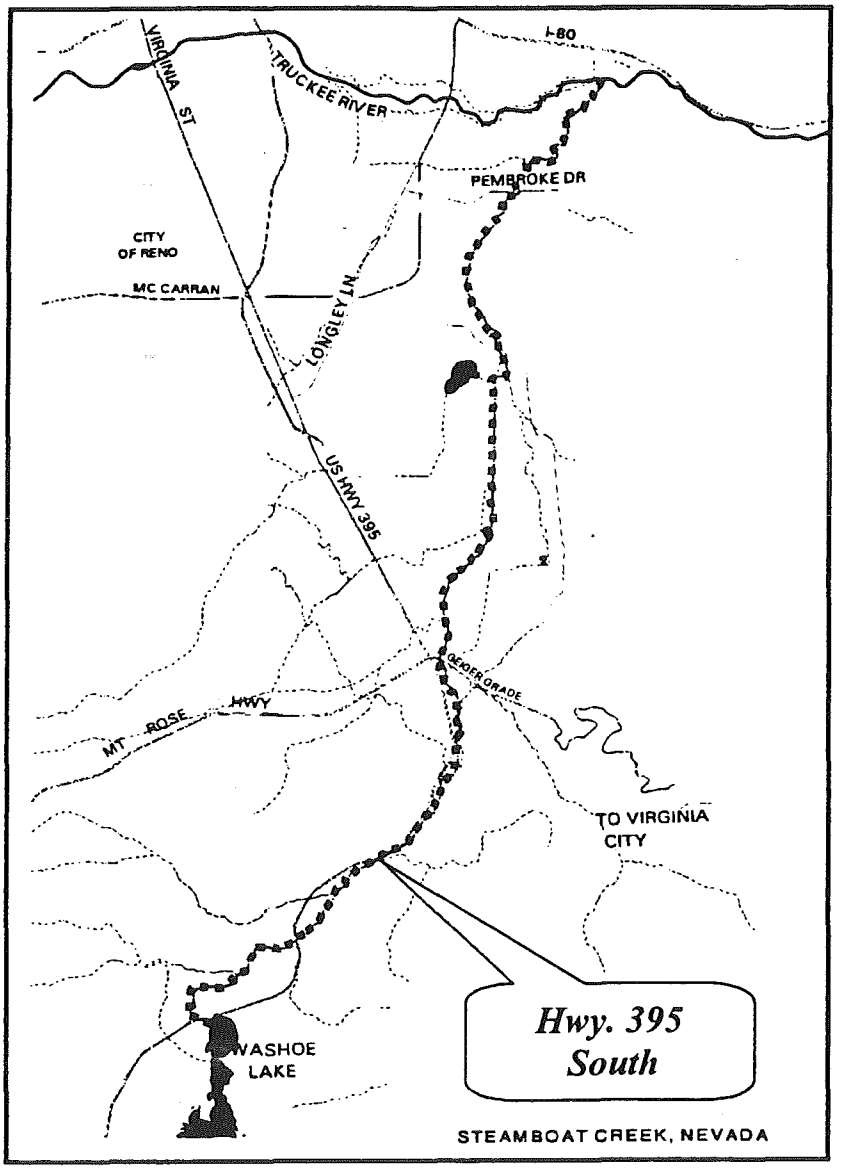
Reach:	Pleasant Valley South			
Beginning Station:	720+50	***Ending Station***	802+00	
Downstream End Landmark:	1500' SW of Andrew Lane	***Upstream End Landmark:***	250' N. of Laramie Drive	
Stream Types Represented:	C4, F4	***Dominant Stream Type:***	F4	
Bed Materials Represented:	Gravel	***Dominant Bed Material:***	Gravel	
Bank Erosion Index:	***Range:***	Low to Very High	***Typical:***	Moderate
Water Surface Gradient:	***Range:***	0 to 0.0771	***Typical:***	0.0116
Estimated Bankfull Flow:	***DS End:***	75 cfs	***US End:***	50 cfs
Major Tributaries Entering:	Galena Creek			
Major Diversions Exiting:	Big Ditch			
Overall Stability Assessment:	***Bed:***	Good	***Banks:***	Fair
Potential for Future Changes To:	***Flow Regime:***	Low		
	Sediment Supply:	Low		
	Land Use:	Low		
Water Quality Concerns:				
Opportunities:				
Constraints:				
Recommended On Stream BMPs:	Full restoration of planform, profile, and cross sectional geometry, with bank angle reduction, revegetation, and revetments along the outside of meander bends. Development of a multistage channel with bank angle reduction and revegetation where the above is not possible.			

395 South

Description:

The 395 South reach extends from just downstream of Laramie Drive upstream to a point approximately 2,000 feet upstream of the crossing at State Highway 395.

Geographic Location:



Low Priority

Priority

This reach would have a low priority due to limited water quality impacts and the degree of difficulty in implementations.

Stream Type:

In this reach, Steamboat Creek leaves the steep fan of glacial outwash below Brown's Creek and starts across the more gentle surface of the Steamboat Creek fan where the water surface slope falls to under 2 percent and the stream profile becomes a riffle and pool structure. The upper portion of the reach is dominated by F type channels which are created largely by the influence of what is in effect a 5-foot high check-dam structure near the crossing of Highway 395. Above 395, the channel would appear to be undergoing active aggradation increasing its width-depth ratio with resulting bank erosion, while below Highway 395, the channel is undergoing bank erosion and scour. The lower portion of the reach consists of alternating sections of B and F type channels with a coarse gravel bed. The inability of the channel to incise into the gravel bed at this location acts as grade control and helps establish a base level for the reach. However, this also puts more erosive pressure on bank areas and has produced localized areas of high-bank erosion which are related more to the localized vegetation conditions, hydraulic conditions, and the nature of the bank materials (not bed materials). These conditions can and do create localized areas of scour. Development pressure is heavy along this section of Steamboat Creek and has resulted in a straighter, low sinuosity alignment. Were it not for the coarse nature of the bed materials present, this reach would likely have experienced an even greater instability in response to the development pressure.

Existing:

Recommended:

Recommended BMPs

An active approach is recommended for this reach. However, due to space constraints and the multitude of small individual property owners, full restoration of the planform, profile, and cross-section is probably impractical. Therefore, the development of a multi-stage channel with low flow channel and active working floodplain should be developed in the existing alignment. Active in-stream BMPs would include reductions in bank height and angle, construction of revetments at the outside of meander bends, and restoration of riparian vegetation in the banks for long-term erosion control.

Contact UNR Cooperative Extension's Small Ranch Program coordinator at 784-4848 for assistance in this area.

395 South

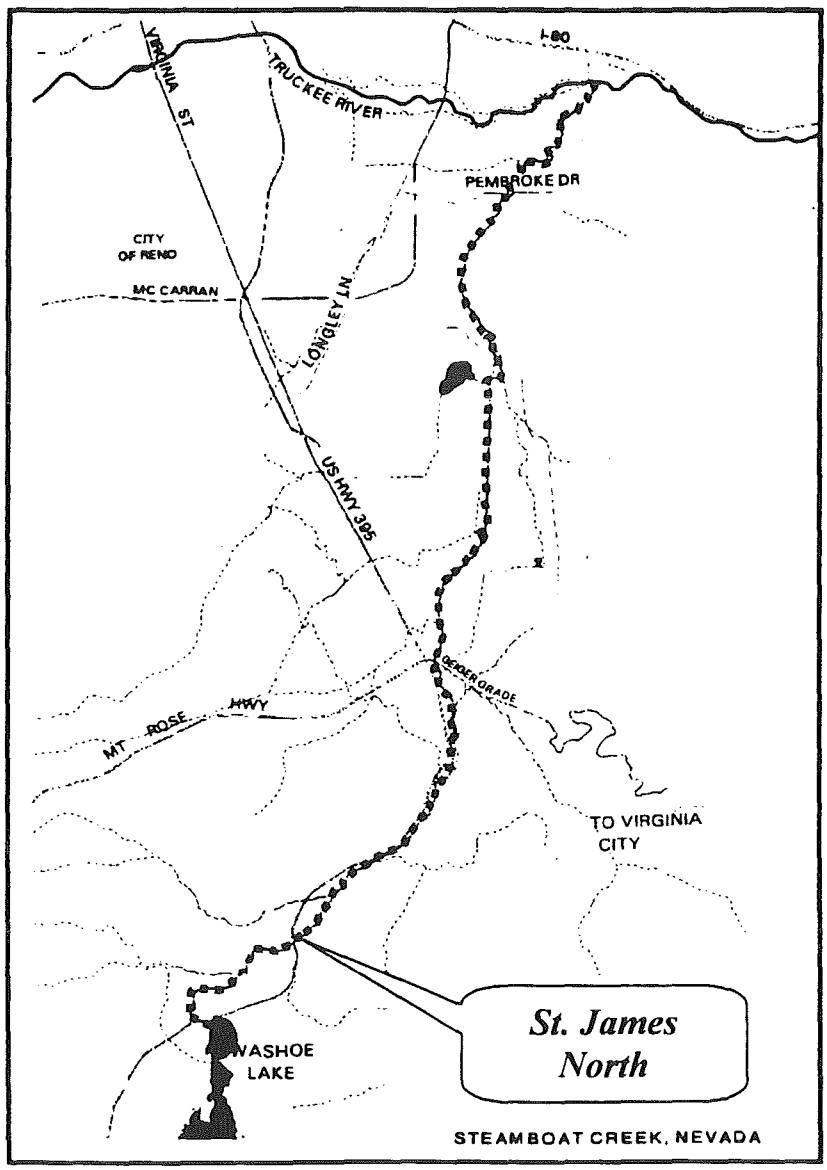
Reach:	395 South			
Beginning Station:	802+00	***Ending Station***	868+00	
Downstream End Landmark:	250' N of Laramie Drive	***Upstream End Landmark:***	0.5 mi. W of 395	
Stream Types Represented:	F4, B4c	***Dominant Stream Type:***	F4	
Bed Materials Represented:	Gravel	***Dominant Bed Material:***	Gravel	
Bank Erosion Index:	***Range:***	Moderate to High	***Typical:***	Moderate
Water Surface Gradient:	***Range:***	0 to 0.0440	***Typical:***	0.0129
Estimated Bankfull Flow:	***DS End:***	50 cfs	***US End:***	70 cfs
Major Tributaries Entering:	None			
Major Diversions Exiting:	None			
Overall Stability Assessment:	***Bed:***	Good	***Banks:***	Fair
Potential for Future Changes To:		***Flow Regime:***	Low	
		Sediment Supply:	High	
		Land Use:	High	
Water Quality Concerns:	Mercury contamination			
Opportunities:				
Constraints:	Potential impacts to multiple individual property owners.			
Recommended On Stream BMPs:	Development of a multistage channel with bank angle reduction and revegetation.			

St. James North

Description:

The St. James North reach extends from a point approximately 2,000 feet upstream from the crossing at State Highway 395 upstream to the confluence with Brown's Creek. The St. James North reach and the next reach upstream (St. James South) represent the most pristine existing conditions observed along Steamboat Creek. These two reaches have the highest potential for effective habitat restoration (including aquatic habitat) and the development of a local fishery. However, water quality concerns in this portion of Steamboat Creek include the presence of mercury contamination in bed and bank materials and therefore, the wisdom of creating a local fishery, given the existing water quality conditions, must be given serious consideration.

Geographic Location:

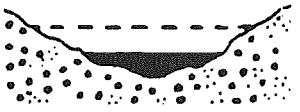


High Priority

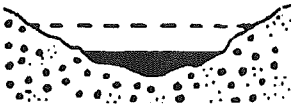
Priority

This reach would be perceived to have a high priority based on water quality impacts from metals, the character of resources to be protected, the relative ease of implementation, and the opportunities presented by the impending development.

Existing:



Recommended:



Stream Type:

In the St. James North reach, Steamboat Creek descends the surface of a steep debris flow fan containing an abundance of older cobble and boulder-sized glacial outwash materials. The predominant material size, however, continues to be gravel. All of the stream types in this reach are B type streams. The upper portion of the reach is sufficiently steep (i.e., 6 to 8 percent) to support cascades. The lower portion of the reach has a step-pool type of profile. The upper portion of the reach begins at the overflow of a large pond (Pleasant Valley Pond). The distributary nature of the pond and the complex surface of the landslide debris immediately below it has created a series of multiple thalweg channels in the upper portion of the reach. However, this is not a classic braided "D" type stream. Rather it is a series of separate B type channels separated by islands which ultimately merge some two-thirds of the distance through the reach. In the lower portion of the reach the single thalweg B type channel traverses the surface of a very young fan formed of coarse flood deposits. Channel grades reduce to the 3 to 4 percent range and the cascade type profile yields to a step-pool structure. The steep grade combined with the increased discharge below the Brown's Creek tributary create a significant local sediment transport capacity. Even the coarse bed materials dissipate further down the reach on the flatter alluvial fan surface. Therefore, this reach would appear to be actively aggrading in the lower portions on the surface of the alluvial fan. The tendency to aggrade and deposit sediment would be particularly acute during the passage of large flood events as these large floods will spread out across the surface of the fan and the reduced depth causes them to deposit sediment. However, the current principal channel down the surface of the fan would appear to be relatively stable due to the predominance of large cobble and boulder-sized glacial outwash materials in both the bed and banks. Channel avulsions are certainly possible on the surface of the fan, but they will require very large flood events in order to erode this extremely coarse surface.

An avulsion did occur on the surface of the fan during the January 1997 flood, moving the channel in a westerly direction and causing local erosion at the point of the avulsion. Only a short distance down the fan, flows spread out, forming shallow braids with minimal incision. Unless the flow is restored to the original channel at some point, then significant flood events will continue to cause substantial erosion and sediment delivery to downstream reaches in an effort to form a new entrenched channel system.

Recommended BMPs

This reach is contained entirely within a proposed development complex called the St. James Resort and Conference Center. This development proposes an 18-hole golf course, a hotel, hotel-villas, tennis courts, and a 500-car parking lot covering approximately 570 acres which surround the Steamboat Creek channel and its

confluence with Brown's Creek. As mentioned previously, the upstream end of this reach begins at the outlet for a large pond or lake. It is proposed to replace the existing dam with a new dam designed to maintain the existing lake level while increasing the surface area. According to descriptions in development plans, the dam spillway and debris control structures will prevent siltation and debris deposition downstream of the dam. Approximately 50 acres of riparian wetlands are located downstream from the dam spillway. Disturbance to Steamboat Creek and the wetland areas is proposed to be minimized. However, disturbance may include slope stabilization of dam abutments and the construction of debris control structures along Brown's Creek.

Other off-stream BMPs proposed in the development include an unspecified number of small detention ponds with 12-inch-diameter pipe drains designed to reduce peak storm flows, catch basins that catch runoff from areas less than 2 acres, and retention ponds to settle out sediments and pollutants from parking lots. Storm drain outfalls are to have headwalls to prevent excessive erosion and open-channels are to be lined with riprap or other type of erosion control features. Streams and other surface water features are proposed to be protected from sediment buildup by these and other BMPs.

A passive approach is recommended for the St. James North reach. This would include the establishment of a functioning stream buffer zone that restricts uses and encroachments in the stream corridor. It is anticipated that there will be little need for application of active BMPs in the stream channel although local trouble spots may still be treated as required. Given the development plans as described, this passive approach to stream restoration in the reach would appear to be compatible with the proposed development. Again, this is one of the few reaches along Steamboat Creek where we can recommend potential application of in-stream BMPs for fisheries habitat enhancement. However, we reiterate the warning that extreme caution must be used in the application of such in-stream BMPs due to the potential for adverse hydraulic impacts. Structures must be carefully sited and potential upstream and downstream impacts fully evaluated.

Technical Data St. James North

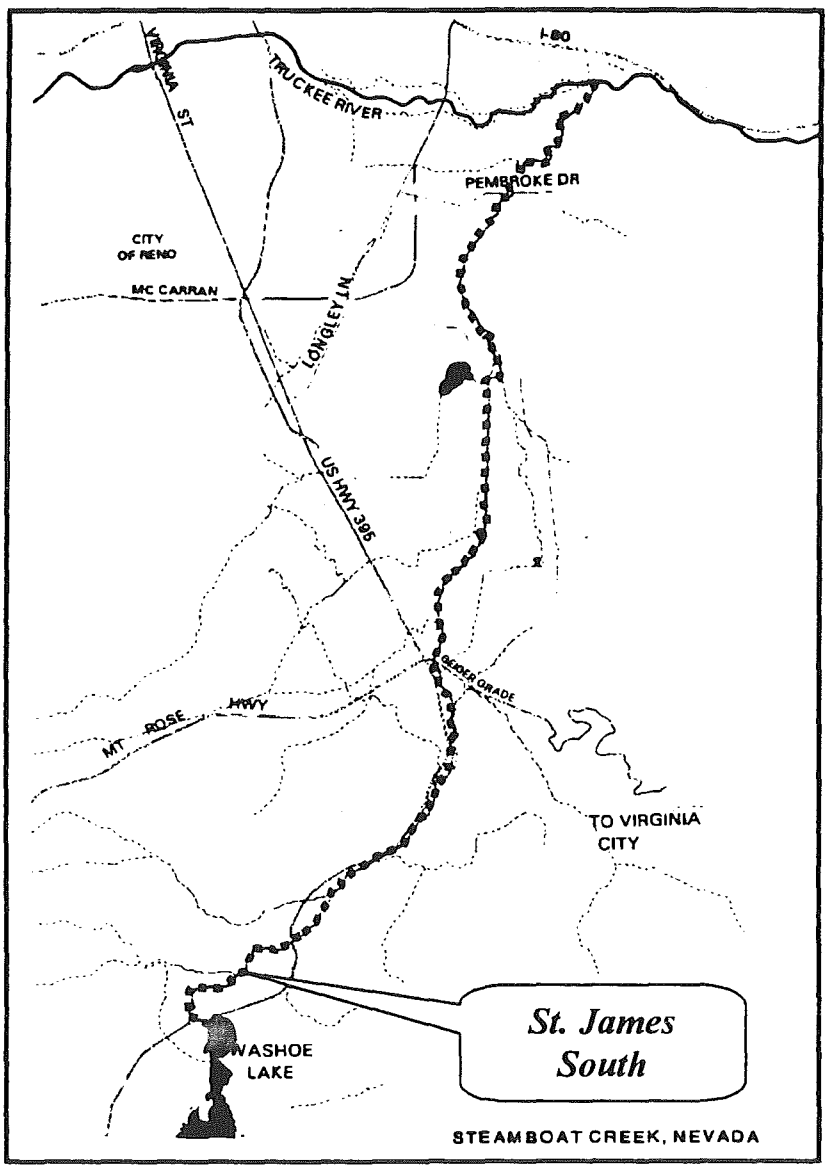
Reach:	St. James North				
Beginning Station:	868+00		***Ending Station***	905+00	
Downstream End Landmark:	0.5 mi. W of 395		***Upstream End Landmark:***	Brown's Creek	
Stream Types Represented:	B3, B4a		***Dominant Stream Type:***	B4a	
Bed Materials Represented:	Gravel, Cobble		***Dominant Bed Material:***	Gravel	
Bank Erosion Index:	***Range:***	Low to High	***Typical:***	Moderate	
Water Surface Gradient:	***Range:***	0 to 0.166	***Typical:***	0.041	
Estimated Bankfull Flow:	***DS End:***	70 cfs	***US End:***	70 cfs	
Major Tributaries Entering:	Brown's Creek				
Major Diversions Exiting:	None				
Overall Stability Assessment:	***Bed:***	Good	***Banks:***	Good	
Potential for Future Changes To:		***Flow Regime:***	Low		
		Sediment Supply:	High		
		Land Use:	High		
Water Quality Concerns:	Mercury contamination.				
Opportunities:					
Constraints:	Mercury contamination.				
Recommended On Stream BMPs:	Development of a stream buffer zone with localized treatment of trouble spots.				

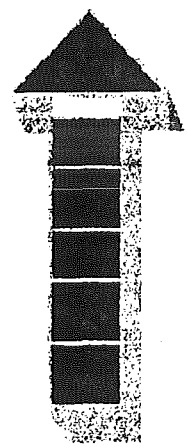
St. James South

Description

The St. James South reach extends from the confluence of Brown's Creek upstream to a point approximately 2,000 feet downstream of the outlet of Little Washoe Lake. As mentioned previously, the lower portion of this reach is a lake, the downstream terminus of which has been impacted by past landslide/debris flow activity across the Steamboat channel caused by Brown's Creek.

Geographic Location:





High Priority

Priority

This reach would be perceived to have a high priority based on water quality impacts from metals, the character of resources to be protected, the relative ease of implementation, and the opportunities presented by the impending development.

Stream Type:

This reach has a high degree of confinement with steep slopes and high rock outcrops on both sides creating colluvial slopes that exert a high degree of constraint on the planform of the channel. This creates a low sinuosity B type channel as the predominant stream type with occasional windows containing a C type channel (where adequate width is available for a meandering thalweg and floodplain). Existing riparian vegetation density in the channel banks is high (predominantly mature coyote willow), which in combination with the B type channel produces a very stable channel environment with only rare occasional sections of high-bank erosion. Gravel-sized materials predominate in the channel bed although cobble and boulder-sizes can exceed 35 percent by weight. These large material sizes are associated with glacial outwash from the former Pleistocene climate. The bed material is sufficiently coarse that there is no significant potential sediment transport of the bed materials at bankfull stage. However, sand-sized sediment will be delivered into the reach from areas upstream as well as additional sediment delivered directly into the channel from the steep slopes adjoining the reach. Sediment transport relative to this finer grain-sand-size sediment is steadily increasing in a downstream direction which means there is no significant potential for aggradation in the upper part of the reach. This in combination with the erosion resistant bed and erosion resistant, well-vegetated banks make the upper portion of this reach quite stable.

An exception to this general trend of stability is in the lower portion of the reach where a high degree of beaver activity has left a string of beaver dams along the channel immediately above where it discharges into the lake. These beaver dams have caused local aggradation and an associated series of channel avulsions around the beaver dams. The sudden channel changes below the beaver dams has caused highly localized, but severe, bank erosion and scour. Unfortunately, these same sediments in the banks in this area contain elevated levels of silver and mercury. These contaminants are believed to be associated with tailings deposition in Washoe Lake during the Comstock mining activity in the mid to late 1800s. These kinds of contaminants are often carried by adsorption on sediment particles. However, presently the lake (Pleasant Valley Pond) intercepts, stores, and effectively removes virtually all of the suspended and bedload sediment transport load from the reach.

Existing:

Recommended:

Recommended BMPs

A passive approach is also recommended in the St. James South reach which would include the establishment of an effective stream buffer zone restricting usage and encroachment in the stream corridor. Need for the application of active in-stream BMPs are anticipated to be small although some treatment of problem spots experiencing active bank erosion may be appropriate using log and boulder revetments and the restoration of riparian vegetation for long-term erosion protection of the banks.

Technical Data St. James South

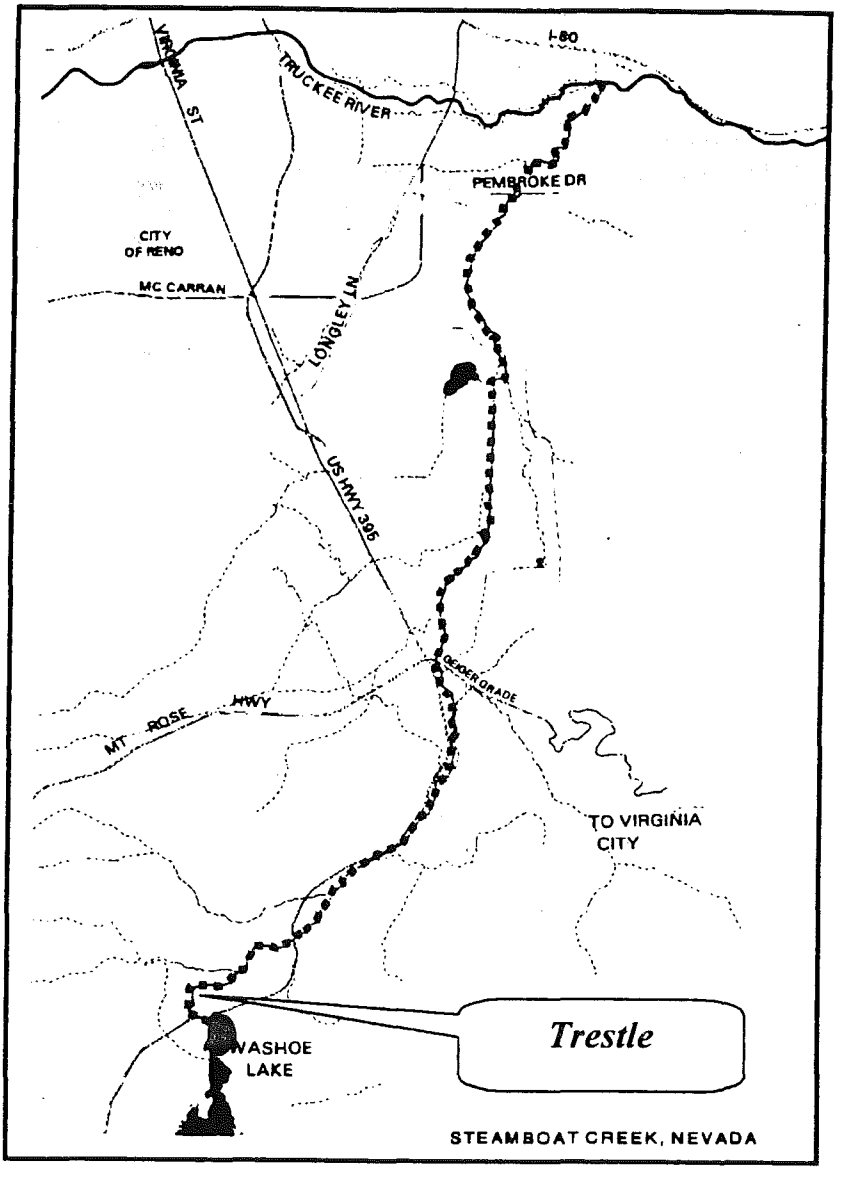
Reach:	St. James South			
Beginning Station:	905+00	***Ending Station***	945+00	
Downstream End Landmark:	Brown's Creek	***Upstream End Landmark:***	0.5 mi. N of Little Washoe Lake	
Stream Types Represented:	B4c, C4	***Dominant Stream Type:***	B4c	
Bed Materials Represented:	Gravel	***Dominant Bed Material:***	Gravel	
Bank Erosion Index:	***Range:***	Low to High	***Typical:***	Moderate
Water Surface Gradient:	***Range:***	0 to 0.354	***Typical:***	0.0752
Estimated Bankfull Flow:	***DS End:***	70 cfs	***US End:***	30 cfs
Major Tributaries Entering:	None			
Major Diversions Exiting:	None			
Overall Stability Assessment:	***Bed:***	Good	***Banks:***	Good
Potential for Future Changes To:		***Flow Regime:***	Low	
		Sediment Supply:	High	
		Land Use:	High	
Water Quality Concerns:	Mercury contamination.			
Opportunities:	Significant habitat enhancement potential including aquatic habitat and development of a local fishery.			
Constraints:	Mercury contamination.			
Recommended On Stream BMPs:	Development of a stream buffer zone with localized bank angle reduction and treatment of trouble spots.			

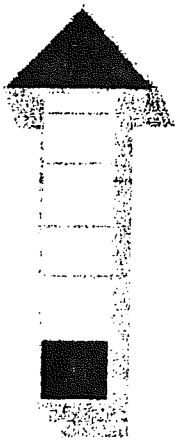
Trestle

Description:

The Trestle reach begins at a point approximately 2,000 feet downstream of the outlet at Little Washoe Lake and proceeds upstream to the outlet.

Geographic Location:





Low Priority

Priority

This reach would have a low priority due to limited water quality impacts and the degree of difficulty in implementation.

Stream Type:

This reach is a man-made trapezoidal channel with a cross-section which fits the F channel type and a sand bed. Its geometry is entirely independent of flow conditions and the bankfull discharge itself is relatively small through the reach (only 18 cfs). The channel is a man-made ditch associated with construction of the old railroad grade through the area.

Recommended BMPs

Although vegetation densities are relatively low in the banks, this combined with a very small bankfull discharge still give this small reach a relatively low potential for any detrimental impact. Major changes to channel geometry in the reach would be impractical and therefore a passive approach would be recommended. We could also recommend attempts to restore a higher density of riparian vegetation along the banks which will further minimize erosion potential.

Technical Data Trestle

Reach:	Trestle			
Beginning Station:	945+00	***Ending Station***	963+00	
Downstream End Landmark:	0.5 mi. N of LW Lake	***Upstream End Landmark:***	Little Washoe Lake outfall	
Stream Types Represented:	F5	***Dominant Stream Type:***	F5	
Bed Materials Represented:	Sand	***Dominant Bed Material:***	Sand	
Bank Erosion Index:	***Range:***	Moderate to High	***Typical:***	Moderate
Water Surface Gradient:	***Range:***	0 to 0.0211	***Typical:***	0.00571
Estimated Bankfull Flow:	***DS End:***	30 cfs	***US End:***	20 cfs
Major Tributaries Entering:	Little Washoe Lake discharge			
Major Diversions Exiting:	None			
Overall Stability Assessment:	***Bed:***	Fair	***Banks:***	Fair
Potential for Future Changes To:		***Flow Regime:***	Low	
		Sediment Supply:	Low	
		Land Use:	Low	
Water Quality Concerns:	Mercury contamination.			
Opportunities:				
Constraints:				
Recommended On Stream BMPs:	Development of a stream buffer zone and enhancement of riparian vegetation densities.			

6. POLICY AND IMPLEMENTATION GUIDELINES

- Action Plan
- Conservation Easements
- Permit Requirements
- Funding Opportunities

6. POLICY AND IMPLEMENTATION GUIDELINES

RECOMMENDED POLICIES

1. Government/Agency Implementation and Monitoring of Plan

   1.1 The recommended Best Management Practices (BMPs) are requested to be followed in all stream work activities by new developments. These recommendations will be requested at time of issuance of agency (Washoe County, Reno, and Sparks) use and building permits.

   1.2 Agencies (Washoe County, Reno, Sparks) will contact Washoe-Storey Conservation District for project review for compliance with all development applications or building permits which encompass Steamboat Creek work.

   1.3 Existing developments not required to obtain a use permit are encouraged to follow the recommendations of this plan.

2. Army Corps of Engineers

   2.1 The Army Corps of Engineers shall review all construction activities within Steamboat Creek for compliance to the BMPs of this plan.

3. Mitigation

   3.1 Wetland/ACOE mitigation for work which may be undertaken on Steamboat Creek must stay within the Steamboat Creek 100 year floodplain.

4. Design Professionals

   4.1 Design professionals including geomorphologists in combination with civil engineers must be used in the development of the technical designs for work in Steamboat Creek. Design professionals should be skilled in the following areas:

   Geomorphology
   Hydrology
   Hydraulics
   Nonpoint source pollution
   Civil engineering design
   Botanists/Reclamation Professionals
   Landscape Architects

   4.2 Technical designers are encouraged to contact Washoe-Storey Conservation District to review recommended BMPs prior to completion of technical designs.

5. Washoe Tribe

   5.1 The Washoe Tribe will be connected prior to construction within the Steamboat Creek to arrange an on-site visit to consider possible native cultural sites in the event of disturbance to sites.

6. Encourage a Multi-use Approach.

   6.1 The public and developers are encouraged to plan in and around the stream and its tributaries for multiple-uses incorporating stream restoration

7. Conservation Easement/Dedication of Land

   7.1 Conservation easements should be considered for all Steamboat Creek restoration projects along the entire length of the Creek. Alternatively, large projects may consider the dedication of the Creek corridor to Washoe County or the City of Reno.

AVAILABLE DATA

The following are projects with verified wetland delineations along Steamboat Creek:

- Double Diamond Ranch
- White's Creek Meadows Subdivision
- St. James Resort
- Damonte Ranch

CONSERVATION EASEMENTS

Conservation easements should be considered for all Steamboat Creek restoration projects along the entire length of the Creek. An alternative to conservation easements for the large projects would be dedication of the Creek corridor to Washoe County or the City of Reno.

The purpose of the conservation easement would be to restrict use of the Creek corridor from adjacent land uses. The benefits to the land owner for this restricted use could be:

- reduction in property taxes,
- reduction in federal income taxes, and
- reduction in personal estate taxes

The following Best Management Practices, as described in this restoration plan, could qualify for conservation easements:

- pond systems,
- wetland systems,
- non-structural on-stream approaches, and
- structural on-stream approaches.

The following implementation strategies are excerpts from the Upper Carson River Watershed Management Plan prepared by the Nevada Division of Environmental Protection, Bureau of Water Quality Planning.

PERMIT REQUIREMENTS

Introduction

The purpose of this section is to highlight each of the agencies from which a permit or other type of authorization may be needed for the various projects and activities necessary to implement this plan. The level of detail will vary from one agency to another and from one permit to another, depending on the likelihood a permit will be necessary for an implementation project, and on the amount of information available at the time this section was drafted. This is in no way intended to be an exhaustive summary of all permits or authorizations issued by the agencies listed. In particular, permits or authorizations for grazing, mineral extraction (except sand and gravel), commercial timber harvesting, and highway construction are beyond the scope of this section. In addition, water appropriation is not addressed.

Federal Agencies

- Army Corps of Engineers

SECTION 404 PERMITTING STRATEGIES

On October 3, 1996, Jeff Codega Planning/Design, Inc. and WESTEC, Inc. presented the U.S. Army Corps of Engineers (Corps) 404 permitting options for restoration of Steamboat Creek to the Steamboat Creek Restoration Steering Committee (Steering Committee) of the Washoe-Storey Conservation District (District) .

The three permitting options available to the Steering Committee include:
- letting the individual restoration project proponents apply for their own permit,
- the District assumes the lead for a general permit for Steamboat Creek restoration activities,
- or, the District assumes the lead for a nationwide permit for Steamboat Creek Restoration.

If each restoration project proponent applies to the Corps for its own permit, the Corps would evaluate the project on its own merits and permit the project with any combination of nationwide and individual permits applicable to the proposed project. The project would not necessarily have to follow the Steamboat Creek Restoration Plan.

The District could apply to the Corps for a general permit for specific restoration activities identified in the restoration plan. The application would be processed as though it was for an individual permit. This includes a 30 day public review period. At the end of the public review, the Corps would determine which activities in the restoration plan would be allowed under the general permit. This alternative would than allow specific restoration projects to be authorized by the Corps which follow the restoration plan. Besides the processing time, the Corps may not authorize all the types of activities identified in the Steamboat Creek Restoration Plan.

The third alternative is that the District apply for the nationwide 27 permit. This permit is specifically for wetland and riparian restoration and creation. This permit requires that a restoration agreement be made between the District and the U.S. Fish and Wildlife Service or the Natural Resource Conservation Service (NRCS). The

District would incorporate the Steamboat Creek Restoration Plan as part of the agreement. It would be best that the agreement be with the NRCS, since the NRCS is represented on the Steering Committee and the District. This process takes less time than the general permit and would allow all the types of restoration activities identified in the Steamboat Creek Restoration Plan be authorized by the Corps. In addition, the Steering Committee passed a resolution that the District's Board of Directors pursue a restoration agreement with the NRCS.

Section 404 of the Federal Clean Water Act requires the Army Corps of Engineers (Corps) to issue a **Section 404 Permit** to deposit dredged or fill material into any waters of the U.S. This means any material which is excavated and redeposited, such as side-cast, as a result of land clearing, ditching, channelization or other excavation. In addition, this includes any new material, such as rip-rap or concrete, used for such activities as bank stabilization or road crossings. The definition of "waters of the U.S." is very broad and includes lakes, streams, rivers, wetlands, playa lakes and even some dry ephemeral stream channels. Work on irrigation ditches and privately-owned reservoirs generally does not require a 404 Permit. There are three categories of permits:

1. **Regional General Permits** are issued for similar types of activities which cause only minor impacts. This type of permit is pre-written and has no associated application fee. For example, before installing a culvert in a river bank or other water of the U.S., the Nevada Department of Transportation would contact the Corps and request to do the work under its General Permit 0006 (GP0006). GP0006 allows the placement of fill for the construction of bridges and culverts, provided certain conditions are met. The Corps may grant or deny the request, but they may require a different permit process to be completed. The Corps has the authority to require an Individual Permit for any project, even if it meets all the general permit conditions. It is important to check with the Corps before starting a job to be sure the general permit will cover the project.

2. **Nationwide Permits** are similar to Regional General Permits except they are issued for similar activities across the entire country, not just within certain regions. As with Regional General Permits, the Corps retains the authority to require an Individual Permit. Nationwide Permits do not require payment of an application fee.

3. **Individual Permits** are normally issued for large projects, projects that will have significant impacts, or activities which are not covered by Nationwide or Regional General Permits. Before an Individual Permit can be issued for work within the Truckee River Watershed, Section 401 Water Quality Certification must be granted by the Nevada Division of Environmental Protection. Individual Permits also require payment of a $10 fee for private (noncommercial), or a $100 fee for commercial or industrial projects.

A following section contains a more detailed description of jurisdiction, authority, permit types, selected examples and application forms. The **Army Corps of Engineers** can be contacted at their Reno Field office at **(702) 784-5304.**

♦ Bureau of Land Management (BLM)

The BLM manages rights-of-way along with grazing, fish and wildlife habitat, mineral production, recreation and timber production on lands under their jurisdiction. Land uses that typically require a right-of-way include water related systems (dams, reservoirs, ditches, canals, pipelines, tunnels), transportation systems (roads, trails, tunnels) and energy, communication and other transmission, distribution and reception systems (oil and gas pipelines, electrical, telephone and television lines). A non-refundable application fee is required when an application is submitted, although State and local government agencies are exempt from the fees. Additional

fees for monitoring and rental may also be required. To inquire whether or not a project requires a right-of-way, or to obtain application forms, a fee schedule or other information, contact the BLM's **Carson City District Office at (702) 885-6000.**

♦ Bureau of Indian Affairs (BIA)

The BIA has authority over tribal management, real estate, leases, contracts and agreements, fiscal management, loan programs, surveying and mapping, tribal policies, housing, education and training, and social programs. Any watershed project which involves Washoe Tribal lands requires application and approval from both the Washoe Tribe and the BIA. For additional information, contact the **BIA Western Area Office, 1677 Hot Springs Rd., Carson City, Nevada at (702) 887-3551.**

♦ U.S. Fish and Wildlife Service (FWS)

The FWS administers the Endangered Species Act and influences decisions on fish and wildlife habitat through its role as a commenting agency on Federal and State permit applications. The FWS must be consulted on federally permitted projects involving modification of any body of water in the U.S., as required by the Fish and Wildlife Coordination Act. Permit reviews by the FWS are coordinated by the Army Corps of Engineers or other permit- issuing agency. The FWS can be contacted at **(702) 861-6300** for additional information.

♦ U.S. Environmental Protection Agency (EPA)

Along with its various duties related to the Federal Clean Water Act, the EPA jointly implements Section 404 of the Act with the Army Corps of Engineers. The EPA reviews Corps permit applications to determine compliance with EPA Section 404 (b)(1) Guidelines and has final authority over permit issuance. The EPA can also make jurisdictional determinations and enforce Section 404 violations.

Nevada Agencies

♦ Nevada Division of Environmental Protection

- Rolling Stock Permits

The Nevada Division of Environmental Protection has authority to prevent and control sources of water pollution. That authority is found in chapter 445A of the Nevada Revised Statutes and Chapter 445A of the Nevada Administrative Code. One of the many possible pollution sources is excavation equipment used for construction, maintenance or repair work within a river or stream channel. NDEP issues a permit called a **Temporary Authorization to Discharge** to control any potential water pollution that might result from the operation of equipment in any Nevada river or creek. NDEP uses the term "rolling stock" for all track- or tire-driven equipment and so the permits are known as **Rolling Stock Permits**. The Division's main concerns are that:

1. the equipment is clean before it enters the channel,
2. there are no leaks (fuel, oil, hydraulic fluid, coolant, etc.),
3. a minimum amount of sediment is washed down stream,

4. any damaged riparian vegetation is restored.

To apply for a permit, contact the NDEP **Bureau of Water Pollution Control, Permits Branch at (702) 687-4670, extension 3137**. In general, a complete application must include the following items.

1. Completed EPA Form.
2. Location: Latitude, Longitude and Township, Range, Section and Quarter Section.
3. Location map (USGS 7.5' Topographic Quad or similar scale). The map needs to show enough detail so that a person unfamiliar with the area can find their way to the site.
4. Plan drawing with dimensions of the location or typical drawings if multiple locations are to be worked, also typical cross sections if possible.
5. Written description of work to be performed at each location including:
   a. equipment to be used,
   b. yards or tons of sediment, gravel, rip rap, etc. to be removed, deposited or moved,
   c. how and where removed sediment will be disposed of or reused,
   d. best management practices to be used for sediment control during excavation/ construction and restoration.
6. Expected start and completion dates (maximum permit term is 6 months).
7. Proposed photo monitoring plan (before and after photos).
8. Confirmation of completion (how the Division will be informed when the job is finished).
9. Copy of Section 404 clearance from the Army Corps of Engineers.
10. $250 fee.

Once the NDEP permit writer has reviewed all the information, he or she will write a draft permit for review by the applicant. If the applicant has no problems with the draft, the final permit will be issued. If there is a problem, it can usually be worked out over the phone. The permit process from application to issuance can take as little as two weeks, but sometimes as long as two or three months, depending on the complexity of the project and the permit writer's work load. In general, apply early and allow a month or two to receive the permit. If an emergency exists, the Division will strive to meet the applicant's needs.

The permit is a 10 to 12 page document divided into three parts. Part one includes limitations, monitoring and reporting requirements and other associated conditions. Part two is on management requirements and part three covers other requirements. In general, part one is most important. It will state when and where work is permitted, what record keeping and reporting must be done, and other conditions and requirements. There may be paragraphs in sections two and/or three that do not apply to a particular project. This is because the standard permit format must apply to a variety of projects, from discharge of treated municipal or industrial wastewater to operating a backhoe in a riverbed. It is important, however, to read and understand the entire permit. There are conditions and requirements in all three sections that will apply to every project.

- Stormwater Permits

Federal law requires the State of Nevada to issue permits for certain industries and activities for the control of pollution that might be washed off the site by stormwater. In general, agriculture is exempt, however the following activities, even on a farm or ranch, require a Stormwater Permit:

1. Construction which disturbs more than five acres,
2. Sand and gravel operations,
3. Batch plants.

To find out if a permit is needed, the **NDEP Bureau of Water Pollution Control, Stormwater Permit Program** can be contacted at **(702) 687-4670, extension 3137.** To apply, a **Notice of Intent** must submitted along with a $200 filing fee. A **Stormwater Pollution Prevention Plan** must also be submitted.

- Section 401 Water Quality Certification (for 404 permits)

As part of the Section 404 permitting process, the Nevada Division of Environmental Protection issues **Section 401 Water Quality Certification** in certain cases. The Army Corps of Engineers (the issuing agency) has developed Nationwide Permits and General Permits in addition to Individual 404 Permits. The Nevada Division of Environmental Protection has pre-certified activities authorized under all Nationwide and General Permits **EXCEPT for the Truckee and Carson River Systems.** Any 404 activities in those two river systems require individual water quality certification, which is issued by NDEP's **Bureau of Water Quality Planning (687-4670 ext. 3088).** In addition to Nationwide and General Permits on the Truckee and Carson, all individual 404 permits anywhere in the State require water quality certification from NDEP.

To apply, the applicant must contact the NDEP's Bureau of Water Quality Planning and request certification. Certain information must be submitted, most of which is included in the Corps of Engineers 404 application. One of the conditions of certification is that the applicant must apply for and receive an NDEP Rolling Stock Permit if one is applicable to the project.

♦ Nevada Division of Water Resources

The Nevada Division of Water Resources issues permits for dam safety. Any person who intends to construct, reconstruct or alter a dam that has a crest height of 20 feet or higher, as measured from the downstream toe to the crest, or has a crest height less than 20 feet but will impound 20 acre-feet or more of movable material, must acquire a dam safety permit prior to construction. This does not pertain to United States Bureau of Reclamation or to the United States Army Corps of Engineers projects. Any dam that doesn't meet the "20/20" criteria must still file a completed application form with the State Engineer's office prior to construction. The filling fee is not applicable unless a permit is required. The Division of Water Resources and the State Engineer's office can be reached at **(702) 687-4380.**

♦ Nevada Division of State Lands

The Nevada Division of State Lands holds title to lands underlying certain water bodies in Nevada, namely the Carson, Colorado, Truckee and Virgin Rivers, and Tahoe, Walker and Washoe Lakes. The property boundary is the high water mark (technically the ordinary and permanent high water mark), except at Lake Tahoe where the boundary is a line at elevation 6223 feet. The Division of State Lands can help with locating the exact position of the property boundary. The Division must authorize all use of State owned lands (except land held by the University System, the Department of Transportation and the Legislature.) Activities and features that require authorization include bank stabilization, bridges, dams, dredging, floating structures, out-fall structures, sand and gravel bar removal, utility crossings and water intake and discharge pipelines. A more complete list is included in the following section.

A complete application for a Division of State Lands authorization includes the following items.

1. Completed application form.

2. Legal description of land.

3. Five sets of complete drawings and site plans.

4. Maps and other supporting documents, if applicable.

5. Proof of financial responsibility, if applicable.

6. A permit fee may be required with the application.

The Division of State Lands will review the application for completeness and send copies to reviewing agencies for comments. Public notice and comment may also be required before the Division acts on approval or denial. Normal processing time is four to six months. Emergency authorizations may be granted over the phone if the situation is severe. An after-the-fact application must be submitted for work completed under a verbal emergency authorization.

The following section contains a more detailed description of jurisdiction and authority in addition to application forms and example permits. **The Division of State Lands** can be contacted at **(702) 687-4363.**

♦ Nevada Division of Forestry (NDF)

State law allows the NDF to issue a **Stream Zone Variance** for work near streams in forested areas on non-Federal lands. The definition of "stream" in the law is sufficiently broad to include channels with only intermittent flow. In addition to Stream Zone Variances, the NDF issues **Burn Permits** for the disposal of slash and other debris, **Timber Harvesting Permits** upon submittal and approval of a completed Timber Harvesting Plan and **Timberland Conversion Certificates** for areas where timber resources are proposed for conversion. The NDF also conducts **Threatened and Endangered Species reviews** for Federally-funded watershed projects on private property. For more information, contact the NDF at **(702) 687-4350.**

♦ State Historic Preservation Office (SHPO)

Federal law requires that every Federal agency "take into account" how each of their undertakings could affect historic properties. Federal undertakings include construction, rehabilitation and repair projects including Emergency Watershed Protection projects, demolition, licenses, 404 and other Federal permits, loans, loan guarantees, Section 319(h) and other Federal grants, Federal property transfers and many other types of Federal involvement. An historic property is any property listed, or eligible for listing in the National Register of Historic Places. A property is eligible for listing if it is 50 years old and is associated with one of the following: 1) historic events or trends, 2) historic individuals, 3) historic architecture or engineering, or 4) if it has significant historic data potential.

The Federal agency (or the State or local agency responsible for a Federal program) is responsible for notifying the **Nevada State Historic Preservation Office** of any plans for projects or activities mentioned above. That office can be contacted at **(702) 687-5138 or 687-6362** for more information.

Local Agencies in Nevada

- Washoe County & City of Reno

Washoe County

The following permits may be required by Washoe County prior to proposed stream restoration activities:
- Special Use Permit
- Grading and Excavation Permit
- Dust Control Plan

The Washoe County Department of Development Review issues Special Use Permits. A Special Use Permit is required (Washoe County Development Code Section 110.302.45) should the proposed stream restoration activity result in greater than 25,000 square feet of disturbance per parcel, if more than 1,000 cubic yards of earth will be imported and placed as fill below the flood hazard area or limited flooding area, if more than 5,000 cubic yards of earth will be imported and placed as fill, if more than 1,000 cubic yards of earth will be excavated from the property, or if a permanent earthen structure will be established over 4.5 feet high. **The Washoe County Department of Development Review** can be contacted at **702-328-6100** for additional information.

The Washoe County Building Department issues Grading and Excavation Permits. A Grading and Excavation Permit is required if the project involves the grading of more than 50 cubic yards of material. The applicant seeking a permit must submit a grading plan to the Building Department along with the application fee. The grading plan presents a plan view of the proposed excavation area and cross sections showing how much material is to be excavated. The fee to submit an application for a Grading and Excavation Permit varies and is based upon the number of cubic yards of material to be graded. **The Washoe County Building Department** can be contacted at **702-328-2020** for additional information.

The Washoe County District Health Department, Air Quality Management Division issues Dust Control Plan. A Dust Control Plan is required prior to any disturbance within the County. An application for a Dust Control Plan may be obtained from the Air Quality Management Division. The application includes information such as the applicant and address, amount of material to be excavated, and methods of dust control. Projects disturbing 1.00 to 4.99 acres is $60.00; 5.00 or more acres of disturbance is $110.00. The Washoe County District Health Department, **Air Quality Management Division** can be contacted at **702-784-7200** for additional information.

City of Reno

The following permits may be required by the City of Reno prior to proposed stream restoration activities:
- Special Use Permit
- Grading Permit

The City of Reno, Community Development Department issues both Special Use Permits and Grading Permits. A Special Use Permit would be required if the proposed restoration would result in the placement of 10 feet or more of fill material or cutting 20 feet or more. A Grading Permit is required for all grading activities, no matter how small or large an area is to grade. Grading plans must be submitted to the Community Development Department including a plan view and cross-section of proposed grading. These plans must be stamped by a

Nevada licensed civil engineer. Fees are variable and depend on the City of Reno's evaluation upon permit application submittal. If the Applicants proposed restoration is in conformance with the Steamboat Creek Restoration Plan, no further compliance with the City of Reno's Major Drainageways Plan or Wetland and Stream Environment Policy is needed. When inquiring about a grading permit, Applicants should also contact the appropriate planner at the city of Reno to assure compliance with both the Major Drainageways Plan and Wetland Stream Environment Policy.
The **Community Development Department** can be reached at **702-334-2062** for additional information.

PURSUING SUPPORT

Having developed a project idea and seeking state and local funds, it helps to be affiliated with a government agency in some cases, such as a Conservation District. Seeking regular appropriations from state and local governments is one of the ways to carry out long term local programs. Programs that receive the best support are:

1. Protecting soils from erosion
2. Cleaning up ditches
3. Improving watersheds
4. Flood prevention
5. Water quality improvements
6. Steam restoration
7. Wetland restoration
8. Planting trees
9. Education outreach

Organizing a Finance Committee

As part of your fund-raising strategy, it is a good idea to establish a finance committee. It should be comprised of local experts, such as bankers, business people, professional fund-raisers, civic leaders and others experienced in raising money for worthy community enterprises. By organizing a finance committee, you can put these people and their ideas to work for your program.

Along with designing fund-raising projects, a finance committee can work on a statement of overall financial needs. If everyone understands the relationship between the funding requests and the programs that the funding will support, then fund-raising efforts will go more smoothly.

Organizing a Marketing Plan for a Project

In order to be considered as a potential grant recipient it is a good idea to develop a marketing plan. Marketing sells your project as what your customers are asking for in the way of services or a needed project. There are seven steps to marketing which are:

1. <u>IDENTIFY CRITICAL ISSUES</u>

   A conservation issue is any topic related to local natural resources, for example:

a. Improving water quality or a watershed

b. Developing partnerships

c. Improving local coordination

d. Providing education outreach

e. Gaining public support.

The best way to identify issues is to involve all potential interests and partners in developing a list of local issues. When the list is developed, it is also important to list next to the issue what needs to be done to address each issue.

2. DEVELOP ALLIANCES

This phase identifies other organizations that might assist you with your critical issues and be willing to contribute resources. By involving others, you will develop partnerships and alliances. To involve others:

a. Talk with your community opinion leaders and get them involved.

b. Find our their views about your issues.

c. Talk to community groups which have political influence. Learn what they support and key on areas of common interest for their support.

d. Create a list of key contacts. When you get your alliances developed or know what you want, you need to identify what role each group will play. This can be done by making a list of who the group is, what they can provide and how the alliance will benefit them.

3. DEFINE CUSTOMERS

After identifying the issues and who will be your partners, it is time to zero in on who will benefit from your project or program. A customer is any individual or group that can benefit from the services offered. The next step is to complete a list of potential customers. The list should identify who the customer is, the issue and the benefit to them.

4. IDENTIFY CUSTOMER NEEDS

In this phase, customers tell you about their needs based on the issues that have been identified. When gathering information on customer needs use the rules of thumb below:

a. Take ample time to collect customer information.

b. Use time wisely to collect required information.

c. Use common sense and focus on needs, not wants.

d. Look ahead and ask what the customer thinks the future will bring.

Information gathering methods are listed below:

a. Personnel interviews

b. Focus groups

c. Surveys

d. Personnel observations

e. Direct mail

f. Printed mail

g. Advisory Committee

h. Key informants

5. DEVELOP ACTION GOALS

Now that you have gathered and analyzed the information on your customer needs it is time to set action goals. An action goal states what you want to achieve and how you will define success in your marketing efforts. To do this, write goals that are specific.

A goal is expressed in explicit detailed terms, not general ones. The goal must be measurable to determine the success of your marketing effort. Measurements can be:

a. Physical

b. Psychological

c. Awareness

d. Participation

e. Adoption

When developing action goals, set your sights high. Consider all actions that will give you the best possible results. Also consider what outside factors (good and bad) could affect your ability to reach your goal. Another very important consideration in developing goals is looking at what resources you have such as staff, partners, volunteers and budget. The last step in goal setting is to refine your list to realistic goals which can be done during your group consensus process.

6. DEVELOP AND ACTIVATE A MARKETING PLAN

Now it is time to take the issues and goals identified and put them in a marketing plan. The marketing plan will take each critical issue and develop a strategy on how to address and accomplish each issue. Below is an example of a marketing plan.

MARKETING PLAN

Critical Issue: Develop a watershed plan for Steamboat Creek

Customer: Land owners/managers along Steamboat Creek

Customer Needs: Reduce soil erosion and nutrient load entering the river system

Identify Partners and Alliance Members: Land owners and managers, Conservation District, Forest Service, Bureau of Land Management, Natural Resource Conservation Service, State Division of Wildlife, State Water Quality Bureau, U.S. Army Corps of Engineers, County Commission, media outlets and others.

Broad Strategy You Will Use to Meet the Customer Needs: Form a team of interested people at the state, federal and local level to cooperatively develop a stream management plan.

Action Goals:

* Reduce erosion on 2,000 acres of land
* Stabilize 15 miles of river corridor
* Reduce nutrient load by 25%
* Gain community support

ACTIVITY	WHO	COST	START	STOP
Develop an awareness campaign to gain support for the Steamboat Creek Restoration Plan	CD, NRCS, County, etc.	$500.00	1995	1998

The best way to kick off an awareness campaign is to hold a special event. It could be a fund raiser to help offset some of the costs of addressing the critical issue. Special events take the message to the community and get local support while promoting a conservation spirit. Be sure to include the local media in promoting your awareness campaign special event. Special events can be:

* A community work day on the project site
* Barbecue
* Float trips
* Car washes
* Celebrity dinners
* Auctions
* Fish fry
* Harvest dinner
* Nature hike
* Raffles
* River run
* Bike ride
* Wine tasting
* Yard sale

The way to measure the success of the awareness campaign is to look at the number of people who participated, funds raised, amount of media coverage, and movement of people joining the Steamboat Creek team.

7. EVALUATE YOUR MARKETING EFFORT

At some time during your marketing campaign you need to evaluate your efforts. Questions that should be asked are:

a. Did you meet your action goals?
b. What worked well?
c. What didn't work?
d. What would you do differently next time?
e. What should you do again?
f. Were your customers satisfied and their needs met?

At sometime during the above seven steps when you feel you have support for your project, it is time to write a grant proposal. To access grant funding sources, each of which has their own proposal format and requirements, an effective proposal will need to address the following five areas:

Abstract - A short description of who you are, the problem you wish to address, your solution and the benefit of implementing the proposal.

Budget - How much will each line item in the proposed budget cost, and what exactly will the money be used for?

Need Statement/Description Of the Problem - What problem is this proposal going to address? Why is it important that it be approved?

Description of Key Activities, Timeline and Responsible Person - What is the project going to do to address the problem? When will each activity be performed? Who will perform each activity?

Evaluation - How will you demonstrate that each activity has been completed? How will you demonstrate that the problem has been successfully addressed?

Remember that most requests for proposals are very competitive. Not all proposals can be funded, and sometimes even a very good proposal can't be funded.

Often there are specific reasons why other proposals succeeded and yours didn't. Find out why your proposal wasn't funded. Use this information to strengthen your planning process and proposal writing skills.

Plan to Resubmit Your Proposal, If Possible - The lessons learned from being turned down will assist in being approved next time. Also, some organizations establish a preference for approving proposals from applicants who haven't had a proposal approved in the past.

FUNDING OPPORTUNITIES

Introduction

Grant Funding and other grant money is available from a wide variety of sources. Funds are available from federal, state and local agencies and private foundations and businesses. Federal and state grants commonly address water quality, forestry, habitat restoration, research and education to mention a few. There are also private sector grants that are less restrictive but must match the goals or address the needs of the grantor.

Where to Look for Funding Information

Local libraries are an excellent starting place to seek grant information sources. They will most likely have or be able to get directories on federal, foundation and corporation grant programs. You can also contact the following federal and state offices for potential grant sources:

1. USDA Natural Resource Conservation Service
2. Consolidated Farm Service Agency
3. U.S. Army Corps of Engineers
4. U.S. Fish and Wildlife Service
5. U.S. Forest Service
6. Extension Service
7. U.S. Department of Energy
8. U.S. Environmental Protection Agency
9. Bureau of Land Management
10. Nevada Division of Environmental Protection
    Bureau of Water Quality & Bureau of Water Pollution Control
11. Nevada Division of Conservation Districts
12. Nevada Division of Forestry

Also, don't overlook the potential of obtaining grants from local businesses, organizations, and clubs, many of whom have vested interests in projects beneficial to the community. A brief example of some potential grant sources are:

1. Local sports clubs
2. Local chapters of national organizations
    a. Audubon Society
    b. Ducks Unlimited
    c. Trout Unlimited
3. Nevada Farm Bureau (Nevada Agriculture Foundation)
4. Water Conservancy Districts
5. Mining companies
6. Business organizations
    a. Rotary
    b. Other service clubs

Other sources of grant funds:

1. The Foundation Center is an independent national service organization established to be an authoritative source of information on private philanthropic giving. It has a nationwide network of funding sources for public use. Call 1-(800)-424-9833 to find the nearest location of a potential funding source.

2. The Environmental Grantmaker Association can provide information on grants available from various private foundations that give to resource projects. Call (212)-373-4260.

3. The Environmental Grantmaking Foundation Directory is designed as a resource for the environmental community; grant makers, grant seekers, and others who want to learn more about the field of environmental funding.

There are 600 grant maker's profiles in the directory that have combined assets of more than $70 billion (excluding corporation assets). They collectively give more than $425 million in environmental grants each year. They consist mainly of independent grant makers, but also include more than a dozen U.S. community grant makers, several U.S. company-sponsored grant makers, and a few Canadian grant makers. Some have sizeable and well-established environmental programs; others have modest or nascent ones. Still others have no program as such but typically award a cluster of environmental grants each year. To get information on the directory call 1-(800)-724-1857.

Federal & State Agency Programs

The following list identifies current assistance programs available to address watershed issues and projects. Contact the appropriate agency for current information.

Federal

- Agricultural Conservation Program (ACP)

Farm Service Agency (FSA) & Natural Resources Conservation Service (NRCS)

ACP was initiated to reduce soil loss and agricultural contributions to water pollution from both runoff and direct discharge. The program provides cost-share funds for approved practices that provide long-term and community-wide benefits. The practices eligible for cost-share are determined by each county's Agricultural Conservation Committee and may include: establishing permanent vegetative cover, restoring shallow water areas or developing new ones and installing water control structures.

- Water Bank Program (WBP)

Farm Service Bureau (FSA) & Natural Resources Conservation Service (NRCS)

Congress established the WBP in 1970 to preserve and improve wetlands as habitat for migratory waterfowl and other wildlife, to conserve surface waters, to reduce runoff and soil erosion, to contribute to flood control, to improve water quality, to increase subsurface moisture and to enhance the natural beauty of the landscape. Landowners can enter into a ten-year renewable agreement with the FSA to manage the land so that habitat

values will be maintained or improved. The FSA makes payments to landowners on an annual, per acre basis to help offset management costs. Agreements are renewable.

- Wetland Protection Development Grants (Clean Water Act) Section 104 (b)(3) (WPDG)

The United States Environmental Protection Agency, created in 1990, has a grant program that was designed to assist states in developing wetlands protection programs. Grants are provided to state agencies for priority wetlands planning activities such as wetland watershed protection approach demonstration projects, state wetlands conservation plan development, refinement or implementation, state/tribal section 404 assumption assistance, streamlining state/tribal regulatory programs, and assessing and monitoring the ecological integrity of wetlands.

- Wetland Reserve Program (WRP)

Farm Service Agency (FSA), Natural Resources Conservation Service(NRCS) & US Fish & Wildlife Service (FWS)

The WRP is a conservation easement and habitat restoration program focused primarily on wetlands in agricultural production. The purposes of the program are to restore the hydrology and vegetation of converted wetlands (wetlands brought into agricultural production prior to December 23, 1985) or wetlands farmed under natural conditions; to protect the functions and values of wetlands for wildlife habitat; and to improve water quality, floodwater retention, and ground water recharge capacity of wetlands. The program offers cash payment to landowners for placing permanent conservation easements on their wetland property, as well as cost-share assistance for restoration work.

- Wildlife Habitat Incentive Program (WHIP)

Natural Resource Conservation Service (NRCS)

A Wildlife Habitat Incentive Program is authorized to promote implementation of various management practices to improve wildlife habitat. $50 million in total funding is provided from Conservation Reserve Program funds.

- Partners for Wildlife

US Fish & Wildlife Service (USFWS)

Partners for Wildlife offers technical and cost-share assistance to landowners who wish to restore wildlife habitat, including degraded or converted wetlands. USFWS can provide technical assistance on project design and location, and 50 percent of the implementation costs through formal cooperative agreements or informal advice. Projects can include revegetation with native plants, creating shallow water areas, and fencing of riparian areas for livestock exclusion. The program was created by the federal Food, Agriculture, Conservation and Trade Act of 1990.

♦ Conservation Reserve Program (CRP):

Farm Service Agency (FSA) & Natural Resources Conservation Service (NRCS)

The goals of the CRP include reducing soil erosion and sedimentation, improving water quality, maintaining fish and wildlife habitat, and providing income support to farmers. The program provides for annual rental payments to farmers who remove from production, for a minimum of ten years, cropland on highly erodible or otherwise environmentally sensitive terrain, such as wetlands. Additionally, certain conservation measures must be carried out for the life of the contract as agreed upon by the participant and the NRCS district conservationist. Up to 50 percent cost-share is available for establishing these conservation practices.

♦ Acquisition Program of the US Fish & Wildlife Service

US Fish & Wildlife Service (USFWS)

The USFWS works with willing sellers to acquire land or interests in land that has significant value for wildlife. Wetlands are a high priority habitat in this program, which is carried out within established boundaries identified by the USFWS and approved by Congress. USFWS usually acquires either conservation easements or full title to the land.

♦ Debt Restructuring Program:

Farmers Home Administration (FmHA) & US Fish & Wildlife Service (USFWS)

The FmHA allows for reduction of borrower debt in exchange for permanent conservation easements on valuable habitat, including wetlands. The program applies only to FmHA loans. Wetlands placed in easements by farmers for FmHA debt reduction may be managed by the USFWS.

♦ Forest Stewardship Program (FSP) & Stewardship Incentive Program (SIP)

Nevada Division of Forestry (NDF), & Farm Service Agency (FSA)

The FSP and SIP are companion programs created by the Federal Food, Agriculture, Conservation and Trade Act of 1990 to provide technical and financial assistance to landowners who want to protect and enhance their forest lands and associated wetlands. Both programs involve the development of a Forest Stewardship Plan designed to accommodate the needs of both the landowner and the natural resources on the property. The FSP offers technical assistance for developing the plan, while the SIP provides cost-share assistance for both preparing and implementing the plan.

♦ Nevada State Revolving Fund

Nevada Division of Environmental Protection, Bureau of Water Pollution Control

Provides loans at or below market rate and other forms of financial assistance to municipalities and other entities to assist in financing the construction of wastewater treatment works or projects to control nonpoint sources of

water pollution.

The types of financial assistance available include:

1 loans at or below market rate
2 loan guarantees
3 purchasing bond insurance to guarantee debt service retirement
4 refinancing existing debt obligations under certain conditions.

♦ Loans and Grants for Capitol Improvements to Community Water Systems

Nevada Division of Water Planning

The AB 197 (loan) and AB 198 (grant) programs provide financial assistance to water purveyors to pay for capital improvements made necessary by the state health regulations and the federal Safe Drinking Water Act. The loan program is available to any community water systems while the grant program is restricted to publicly owned community water systems.

The types of projects that are eligible include:

1. water treatment facilities, and necessary intake structures, pumping plants and transmission lines;
2. replacement of leaking distribution lines;
3. elimination of deadened distribution lines;
4. spring rehabilitation;
5. new well and pump installation to replace poor quality sources; and
6. storage tank rehabilitation

Foundation Opportunities

Below is a list of several foundations and the types of projects they support.

The Dean Witter Foundation
57 Post Street, Suite 510
San Francisco, California 94104
(415) 981-2966

Environmental Awards

The Foundation occasionally makes small grants, usually on a matching basis, to support specific wildlife research and conservation projects, primarily in northern California.

Recent Grants

1992 grants included support for land conservation, coastal issues, habitat and species preservation, water management, waste and recycling, and public education.

Bank America Foundation
Department 3246
P.O. Box 37000
San Francisco, California 94137
(415) 953-3175

Environmental Awards

Program and interests: Each year some funding is allocated for a grassroots program to encourage direct involvement and volunteer activities inside the Bank of America as well as to support worthwhile environmental organizations at the local level.

Recent Grants

1993 grants included support for land and wildlife conservation, parks, fisheries, marine mammals, recycling, horticulture, public and youth education.

ARCO Foundation
515 South Flower Street
Los Angeles, California 90071
(213) 486-3158

Environmental Awards

Program and interests: "The ARCO Foundation invests in efforts to conserve and sustain the natural environment, supporting projects in which experts analyze and communicate the price both business and the community must pay for safeguarding that environment. Foundation investments also encourage organizations to develop and advocate responsible environmental positions and to balance the mandate for economic growth with the mandate to preserve and enhance environmental quality."

Priority is given to:

1. Balanced environmental organizations that support regional land use and natural resource policies;

2. Environmental education that:

    a. Develops curriculum and programs in which the relationship between the economic cost and the public benefit of environmental decisions is articulated; and

    b. Increases the number of young people involved in community service to improve the environment.

3. Land preservation initiatives that:

    a. Preserve ecologically unique land for open space with public access; and

    b. Assist in the ecological restoration of unique locations that have been environmentally damaged.

4. Conflict-resolution efforts that expedite mediation of sensitive environmental decisions;

5. Conservation of wildlife and protection of endangered species;

6. Recycling by community-based organizations as a means of reducing solid waste and creating jobs; and

7. Pollution prevention by identifying pollution-minimization opportunities and encouraging their adoption.

Ruth Mott Fund
1726 Genesse Towers
Flint, Michigan 48502
(313) 232-3180

Environmental Awards

Program and interests: "The Fund seeks to foster public understanding and involvement in protecting our public resources. This includes the health of natural resources on public lands, the air we breathe, and the water we drink. The Fund is concerned particularly with the affect that private or public actions have on public resources."

"The Ruth Mott fund values organizations which are democratic and whose membership reflects the diversity of their community. While recognizing that organizations employ a range of strategies in regard to public resource issues, the Fund will give special attention to efforts to organize local citizens around issues of national significance. The Fund encourages efforts of local groups to work together and with regional or national organizations on projects that promote public education, involvement and advocacy."

Threshold Foundation
1388 Sutter Street, 10th Floor
San Francisco, California 94109
(415) 771-4308

Environmental Awards

Program and interests: Threshold seeks projects that "deepen the understanding of interrelatedness, and that offer strategic relief to the suffering of our planet and its inhabitants." Specific topics of interest are:

1. Overpopulation;
2. Pollution of water, air and oceans;
3. Global warming;
4. Toxic and nuclear waste;
5. Biodiversity;
6. Forest preservation;
7. Alternative agriculture; and
8. Creation of ecologically sustainable culture.

"The Foundation seeks projects which help us live lightly on the Earth, and which recognize and reflect the sacredness of Gaia-the Earth as a living organism. Programs should address these issues through transformational education, corporate responsibility and accountability, regional projects with national/international impact, and other highly leveraged approaches.

The Mary A. Crocker Trust
233 Post Street, 2nd Floor
San Francisco, California 94108
(415) 982-0138

Environmental Awards

Program and interests: The Trust seeks to fund education and advocacy projects that promote solutions to environmental problems and boost public awareness and participation. The Trust has a special interest in:

1. Sustainable agriculture;
2. Waste management and recycling;
3. Water quality;
4. Land use management; and
5. Population.

Recent Grants

1993 grants included support for coastal issues, forest preservation, river protection and youth education.

Heller Charitable and Educational Fund
P.O. Box 336
Kentfield, California 94914
(415) 434-3160

Environmental Awards

Program and interests: Environmental grants are in two areas:

1. Supporting programs of research, litigation or other means of arresting despoliation of the natural environment; and

2. Preserving open space lands for agriculture, wilderness, and recreation through purchase and other means.

Recent Grants

Grants in 1995 included support for land conservation (greenbelt, public lands, national park restoration), coastal issues, river protection, sustainable and organic agriculture, and minority opportunities.

The Carpenter Foundation
711 East Main Street, Suite 18
Medford, Oregon 97501
(503) 772-5851

Environmental Awards

Program and interests: Public interest grants, which include environmental grants, make up about 15 percent

of Foundation funding.

Recent Grants

1993 grants included support for land conservation, watershed protection, and forest preservation.

The James Irvine Foundation
One Market Plaza
Spear Tower, Suite 1715
San Francisco, California 94105
(415) 777-2244

Environmental Awards

Program and interests: The Foundation does not have a specific environmental grant-making program. However, it has been receptive to proposals that link environmental concerns with its interests in access to health care and in economic and human development.

Recent Grants

1993 grants included support for river and watershed protection, toxic and environmental health, recycling, sustainable development, and education.

The Ahmanson Foundation
9215 Wilshire Boulevard
Beverly Hills, California 90210
(310) 278-0770

Recent Grants

1992 grants included support for river protection, land conservation, water reclamation, species protection, and public and teacher education.

Southwestern Bell Foundation
175 East Houston Street, Suite 200
San Antonio, Texas 78205
(201) 351-2208

Recent Grants

1992 grants included support for land conservation, species protection, beautification, botanical gardens, and zoos.

PRIVATE ORGANIZATIONS

American Conservation Assoc.
30 Rockefeller Plaza
Room 5402
New York, New York 10112

Land acquisition and preservation (financial)

Ducks Unlimited, Inc.
One Waterfowl Way
Long Grove, Illinois 60047

Matching Aid to Restore State Habitat (MARSH) (financial)

Forest Trust
P.O. Box 9238
Santa Fe, New Mexico 87504-9238

Land Trust Services (financial)

Foundation for North American Wild Sheep
720 Allen Avenue
Cody, Wyoming 82414

1. Wild Sheep Habitat Program (financial)
2. Funds Available for Wildlife Now (financial and hay)

Game Conservation International
P.O. Box 17444
San Antonio, Texas 78217

Protection of habitat (financial)

Izaak Walton League of America Endowment
P.O. Box 824
Iowa City, Iowa 52240

Land Acquisition Program (financial)

National Association of Conservation Districts
509 Capitol Court NE
Washington, D.C. 20002-4946

Natural Resources Conservation and Development Program (technical and financial)

National Audubon Society
950 Third Avenue
New York, New York 10022

Sanctuary Program (financial)

National Fish and Wildlife Foundation
18th and C Streets, NW
Room 2626
Washington, D.C. 20240

Conservation Programs associated with US Fish and Wildlife Service activities (technical and financial)

National Wild Turkey Federation, Inc.
Wild Turkey Building
P.O. Box 530
Edgefield, South Carolina 29824

Conservation of and transplanting wild turkeys (turkey transport cartons)

The Nature Conservancy
Western Regional Office
785 Market Street, 3rd Floor
San Francisco, California 94103

1. Land Acquisition Program (financial)
2. Sanctuary Program (financial and technical)

One-Shot Antelope
John Emmerich
260 Buena Vista
Lander, Wyoming

Water Developments for Wildlife

Pheasants Forever
P.O. Box 75473
St. Paul, Minnesota 55175

Pheasant Habitat Program (financial and seed)

Rocky Mountain Elk
P.O. Box 8249
Missoula, Montana 59807-8249

1. Elk Habitat Development Program (technical and financial)
2. North American Habitat Fund Land Acquisition and Easement Program (financial)

Trout Unlimited
National Headquarters
501 Church Street, NE
Vienna, Virginia 22180

Trout habitat development programs (financial)

Trust for Public Land
82 Second Street
San Francisco, California 94105

Wetlands for Wildlife
P.O. Box 344
West Bend, Wisconsin 53095

Acquisition Programs (financial)

Amax Foundation
1270 Avenue of the Americas, 8th Floor
New York, New York 10017
(212) 765-3475

Farmland Industries
3315 North Oak Traffic Way
Kansas City, Missouri 64116
(816) 459-6122

Ralston Purina Checkerboard Square
St. Louis, Missouri 63188
(314) 982-3219

Scripps Foundation
Scripps Building, Room 306
525 C Street
San Diego, California 92101

Directory

Federal Agencies

Farm Service Agency
1755 E. Plumb Lane, Suite 202
Reno, Nevada 89502
(702) 784-5131

Natural Resource Conservation Service
5301 Longley Lane
Building F, Suite 201
Reno, Nevada 89511
(702) 784-5863

U.S. Geological Survey
333 West Nye Lane
Carson City, Nevada 89706
(702) 887-7600

U.S. Fish and Wildlife Service/Nevada Fish and Wildlife Office
1340 Financial Blvd., Suite 234
Reno, Nevada 89502
(702) 861-6300

National Park Service
(415) 744-3972

U.S. Army Corps of Engineers
300 Booth Street, Room 2103
Reno, Nevada 89509
(702) 784-5304

Bureau of Reclamation
705 North Plaza Street
Carson City, Nevada 89701
(702) 882-3436

Western Resource Conservation and Development Office
705 North Plaza Street
Carson City, Nevada 89701
(702) 883-2292

U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105-3901
(415)-744-1500

U.S. Department of Energy
Western Power Administration
Bioenergy Program
1627 Cole Boulevard
P.O. Box 3402
Golden, Colorado 80401
(303) 275-1706

SOURCES OF ASSISTANCE

Federal Agencies

U.S. Department of Agriculture (USDA)

- Farm Service Agency (FSA)

  Nevada State FSA Office
  1755 E. Plumb Lane, Suite 202
  Reno, Nevada 89502-3207
  (702) 784-5411

The Agricultural Conservation Program (ACP) administered by the FSA, provides financial and technical assistance to farmers, ranchers and non-industrial landowners who wish to apply soil, water and wildlife habitat conservation BMPs of long-term benefit to their land. The program emphasizes projects which control soil erosion and nutrient runoff from agricultural lands. Program monies are allocated to states and subsequently to county FSA offices. County offices establish annual or long-term (3 to 10 years) cost-share agreements with landowners. Other programs under the auspices of the FSA include: Conservation Reserve Program, Sodbuster, Swampbuster, Conservation Compliance, Water Bank Program and the Rural Clean Water Program. FSA field offices are located strategically to serve all of Nevada.

- U.S.D.A. Rural Development

  State Office
  1390 S. Curry Street
  Carson City, NV 89703
  (702) 887-1222

The U.S.D.A. Rural Development makes grants and loans to individual farmers and ranchers to develop water and soil conservation practices and pollution abatement measures on their lands. Loans are also available to landowner associations for irrigation improvements and other soil and water conservation projects. Loans obtained from Rural Development may be used to supplement USDA cost-share projects developed through Watershed Protection and Flood Prevention and Resource Conservation and Development Programs.

- Natural Resources Conservation Service (NRCS)

  Nevada State Office
  5301 Longley Lane
  Bld. F, #201
  Reno, NV 89511
  (702) 784-5863

  Reno Field Office
  1201 Terminal Way, Suite #222
  Reno, NV 89511
  (702) 784-5408

Western Nevada Resource
Conservation & Development
705 N. Plaza, Room #107
P.O. Box 3543
Carson City, NV. 89702
(702) 463-2265

Conservation technical assistance is the core of the NRCS programs. Technical assistance is provided in the form of on-site development and application of individual conservation plans. NRCS personnel perform site-specific investigations of soil, plant, water and other physical conditions and interpret soil survey data to identify alternative land use and land treatment systems. Assistance also includes design and installation of conservation practices. The primary focus of the program has been to respond to farmers who voluntarily seek technical assistance in development and application of conservation plans. Other programs under the auspices of the NRCS include: Watershed Protection and Flood Prevention (PL 566), Resource Conservation and Development, and River Basins Studies.

U.S. Department of Commerce

- National Oceanic & Atmospheric Administration (NOAA)
  National Weather Service Office
  2350 Raggio Parkway
  Reno, NV 89512
  (702) 673-8100

NOAA maintains meteorological data and mapping for the country. The National Weather Service can also provide data which may be necessary to design certain structural BMPs (i.e. impoundments, detention/retention basins) to meet specific criteria, such as the 100-year storm event.

U.S. Department of Defense (DOD)

- U.S. Army Corps of Engineers (Corps)
  Sacramento District
  1325 J Street
  Sacramento, CA 95814-2992
  (916) 557-5250

  Reno Field Office
  Federal Building
  300 Booth St./Room 2103
  Reno, NV 89507
  (702) 784-5304

The U.S. Army Corps of Engineers (Corps) is directly concerned with all aspects of water-resources development including conservation for municipal and industrial uses, flood zone mapping, flood control, navigation, hydroelectric power, recreation, fish and wildlife enhancement, irrigation, water quality control, waste-water disposal, preservation of esthetic and ecological values, and all other ecological values and related land and water uses. The Corps administers laws pertaining to protection and preservation of navigable waters and is responsible for the issuance of 404 permits and wetland mapping.

- Bureau of Land Management (BLM)

Nevada State Office
1340 Financial Blvd.
Reno, NV 89502
(702) 785-6500

Carson City District
1535 Hot Springs Road, Suite 300
Carson City, NV 89706
(702) 885-6000

The BLM is responsible for administration of nearly 48 million acres of public lands in Nevada. These lands are managed for multiple-use benefits including mining, rangeland, grazing, recreation, fish and wildlife, woodland, etc. They develop Resource Management Plans to stabilize watersheds, to protect soil, water and air resources, and to develop and improve watershed conditions on public lands. The BLM also works with public land users and adjacent landowners to solve resource problems of common concern to both.

- U.S. Geological Survey (USGS)
  District Office
  333 W. Nye Lane
  Carson City, NV 89701
  (702) 887-7600

The mission of the USGS is to provide geologic, topographic, and hydrologic information that contributes to the wise management of the Nation's natural resources and that promote the health, safety, and well-being of the people. This information consists of maps, databases, and descriptions and analyses of the water, energy, and mineral resources, land surface, underlying geologic structure, natural hazards, and dynamic processes of the earth.

- U. S. Fish & Wildlife Service (USFWS)
  1340 Financial Blvd., Suite 234
  Reno, NV 89502
  (702) 861-6300

The mission of the U.S. Fish and Wildlife Service (USFWS) is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. The USFWS' major responsibilities are for migratory birds, endangered species, certain marine mammals, and freshwater and anadromous fish.

- U.S. Bureau of Reclamation *(BOR)*

Lahontan Basin Projects Office
705 N. Plaza
Carson City, NV 89701
(702) 882-3436

The Bureau of Reclamation (BOR) administers a variety of programs that provide financial and technical assistance to irrigation districts for project operation and improvements such as control of sediment, erosion, and nonpoint source pollution on BOR irrigation project lands. Additionally, BOR can provide technical and financial assistance to state and federal agencies for basic water quality investigations, monitoring and planning (especially for irrigation return flow water quality).

- U.S. Environmental Protection Agency (EPA)

  Region IX
  75 Hawthorne Street
  San Francisco, CA 94105
  (415) 744-1500

The EPA was established in 1970 by Presidential Executive Order to bring together various government agencies involved with the control of pollutants. EPA provides numerous grants to states to promote the preservation of natural resources and to regulate potentially adverse environmental impacts. The EPA has primacy over the Nonpoint Source Pollution Program and provides technical assistance and monies for demonstration projects.

State Agencies

The Department of Forestry and Fire Protection was established to protect Californians from fire, respond to emergencies, and protect and enhance the state's forest, range and watershed resources. The Department oversees a variety of programs which can provide both technical assistance and funding resources.

Nevada

Department of Conservation and Natural Resources

- Division of Conservation Districts
  333 West Nye Lane, Room 125
  Carson City, NV 89710
  (702) 687-6977

The Nevada Division of Conservation Districts provides staff services to the State Conservation Commission, which assists, guides, and regulates the operations of Nevada's Conservation Districts. The SDCD maintains a current directory of the state's twenty-seven locally elected conservation district chairmen.

- Division of Forestry (NDF)
  123 West Nye Lane
  Carson City, NV 89710
  (702) 687-4350

The Division of Forestry manages and coordinates all forestry, nursery, endangered plant species, and watershed resource activities on certain public and private lands and is responsible for protecting community and natural resources by fire prevention and protection. NDF also provides planning assistance to private landowners for management and conservation of woodland and riparian areas. Several offices are located throughout the State.

Programs administered by the Division of Forestry, include but are not limited to:

- Forest Practices - The Nevada Forest Practice and Reforestation Act (Nevada Revised Statutes [NRS] 528) establishes minimum standards of forest practice and requires compliance by every timber owner or operator to promote sustained productivity of forests in Nevada and to preserve the natural water supply

in the interests of the economic welfare of the State.

- Water and Soil Conservation - The establishment and preservation of vegetative cover in forests and watersheds is mandated in NRS 472. The purpose of this law is to conserve water and soil and to prevent destructive floods.

  Nevada's Forest Protection Act (NRS 527) provides protection of forested lands, and trees and flora on all lands of the State of Nevada.

- Logging - NRS 528 outlines logging permit and application requirements. The statutes also require: 1) logging plans depicting all roads, landings etc.; 2) the volume of timber to be removed; 3) performance bonds; and, 4) specifies cutting practices.

- Activities near Water - NRS 528 prohibits certain activities near bodies of water. No falling of trees, skidding, rigging or construction of tractor or truck roads or landings, or the operation of vehicles may take place within 200 feet of any lake, reservoir, stream or other body of water unless a variance is first obtained from the State Forester, Administrator of Wildlife and the State Engineer.

- Timberland Conversion Certificate - NRS 528 outlines the requirements to convert timber lands to other uses.

- Environmental Education - Provides environmental education material and training to teacher's workshops as a "learning window" into the environment. Student/classroom programs use Smokey the Bear, Project Learning Tree, and Nature Scope materials.

- Forest Stewardship Program and Stewardship Incentive Program - provides technical assistance and cost-share funding to non-industrial private landowners to assist them with the management of their natural resources.

- Urban and Community Forestry - NRS 528.098 - Urban Forestry is the science of developing, caring for and/or cultivating conservation plant materials in an urban environment to enhance air quality, provide shade, stabilize soils, reduce noise and dust levels, maintain water quality and improve esthetics.

  This program provides technical and cost-share assistance to cities, communities, volunteer groups and citizens.

- Nurseries - To aid agriculture, conserve water resources, renew the timber supply, promote erosion control, beautify urban areas, educate the public, improve natural forests, deserts, wildlife habitation, and in other ways advance the general welfare and bring about benefits resulting from reforestation and the establishment of windbreaks, woodlots, greenbelts, open space, parks and arboretums on lands in the State of Nevada, NRS 528 authorizes the State Division of Forestry to negotiate and enter into cooperative agreements with the U.S. government or other state or local governments for the purpose of securing and establishing nursery sites.

  The purpose of the nursery is to propagate and sell conservation-grade plant material for all of the conservation purposes mentioned above. Plant materials range from harsh desert natives to riparian species. Plant material sales are restricted to landowners living outside of the city limits and owning 1 or more acre of land. This promotes planting for conservation purposes rather than general landscaping.

♦ Nevada Division of State Lands
333 West Nye Lane
Carson City, NV 89710
(702) 687-4363

The Division of State Lands authorizes all uses of state-owned lands, including the beds of navigable bodies of water, with the exception of lands held by the University systems, the Department of Transportation, and the Legislature.

Nevada Revised Statutes 321 and 322 set forth the authority for the leasing of state lands and issuance of easements and rights-of-way and other authorizations. Activities at Lake Tahoe are governed by NAC 445.040 through 445.064: Regulations governing pier construction, deposit of fill, dredging or alteration of Lake Tahoe shoreline.

♦ Nevada Division of Wildlife (NDOW)
1100 Valley Road
P.O. Box 10678
Reno, NV 89520
(702) 688-1500

The Nevada Division of Wildlife (NDOW) was established to preserve, protect, manage and restore the wildlife resources of Nevada. NDOW consists of six divisions and three regions. The Board of Wildlife Commissioners was created to establish policies and regulations for the protection, propagation, restoration, transplanting, introduction and management of wildlife in the State. The goals of NDOW are to: 1) maintain all species of the State's wildlife and their habitats for their intrinsic and ecological values as well as their direct and indirect benefits to man, 2) provide for the diversified recreational use of the State's wildlife resource, 3) provide for an economic contribution from the wildlife resources in the best interests of the people consistent with the long-term welfare of these resources, and 4) provide for scientific, educational and aesthetic uses of the State's wildlife resources.

Environmental pollution, including nonpoint source pollution of water, degrades wildlife habitat and restricts production and propagation and is, therefore, inconsistent with the goals and objectives of NDOW. Bureaus within NDOW can offer technical and educational, and, at times, financial assistance in NPS pollution management programs and projects.

- Game Bureau - The Game Bureau is responsible for management of the State's big game, upland game, fur-bearers, waterfowl and nongame resources. In addition, the Bureau duties include development, operation and maintenance of State-owned or uncontrolled wildlife management areas. The Game Bureau has the potential to assist in NPS pollution management through the acquisition and protection of sensitive wildlife habitat areas which also have beneficial water quality functions (i.e., wetlands and riparian areas), and through monitoring for metal, toxic chemical and other contamination of biota from water pollution.

- Fisheries Bureau - The Fisheries Bureau is responsible for the protection, restoration, transplanting, introduction, and management of the fisheries resources within the State of Nevada. The Bureau provides financial, technical and research assistance for evaluating and resolving problems, including water pollution, affecting the resources.

- Conservation Education Bureau - The objective of the Conservation Education Bureau (CEB) is to disseminate information about the NDOW and its programs, projects and activities through a multi-media approach designed to achieve public understanding of the need for the wise use of wildlife resources. The Bureau encompasses four major programs including Public Affairs, Hunter Education, Boating Safety Education, and Environmental Education. Project WILD, an environmental education program sponsored by the Department, presents teachers with methods for instruction of basic principles of conservation. The program is a potential mechanism for providing assistance to NPS educational programs.

- Habitat Bureau - The Habitat Bureau is responsible for maintenance, protection, and enhancement of Nevada's fish and wildlife resources and habitats. The Bureau provides input relative to fish and wildlife concerns during the development of resource management plans and other action plans in addition to reviewing and evaluating proposed land and water uses that may affect fish and wildlife resources. The Division can offer technical, financial, and data-management assistance in NPS pollution programs.

♦ Division of Water Planning (NDWP)
1550 East College Parkway, Suite 142
Carson City, Nevada 89710
(702) 687-3600

By statute (NRS 540.051), NDWP is to "provide political subdivisions and private enterprises with information, alternatives and recommendations bearing upon regional shortages of water including feasible selections or courses of planning and action for acquiring additional water or for conserving water now available, or both".

NDWP also administers a program under which grants are awarded to help fund improvements to drinking water systems. Grants are limited to those improvements made necessary by state health regulations and the federal State Drinking Water Act.

♦ Division of Water Resources (DWR)
123 West Nye Lane
Carson City, Nevada 89710
(702) 687-4380

The Division of Water Resources is responsible for the appropriation of all surface and ground waters of the State, and regulates the construction of water wells. Nevada statutes exempt wells drilled before March 25, 1939 and those for single family household use up to 1,800 gallons per day. The State Engineer is authorized to designate basins when administration of the basin is required to conserve ground water. Within designated basins, the State Engineer can establish preferred uses and limit withdrawals as needed. The following activities are regulated by the State Engineer through a permit process:

- appropriation of public waters;
- changing existing water rights;
- issuance of temporary changes of existing water rights;
- primary storage and use of secondary waste water;
- construction, reconstruction or alteration of dams;

- recharge, storage and recovery of water projects;
- claims of vested rights;
- subdivision review (permit not required but signature is); and,
- assignment of ownership of water rights (acknowledgment only, no permit required).

The State Engineer also licenses all well drillers and water right surveyors, maintains well logs from the drilling of all wells, and develops and enforces standards for well construction and closure. The goals of Nevada's water law are to protect the health and safety of Nevada's citizens, wildlife and fisheries, to preserve the quality of life, and to protect the existing water rights of beneficial users.

The Division of Water Resources has the following information booklets available:

- Summary of Statutory Procedure in Making Application for a Water Right and Fee Set by Statute.
- Regulations Concerning Preparation of Maps under Applications to Appropriate Water and Proofs of Appropriation.
- Nevada Administrative Code - Regulations for Water Well and Related Drilling.
- Common Methods of Measuring Water as Practiced in Western States.
- Assignments of Water Rights (Guidelines).
- Laws and Permitting Information Pertaining to Dams (1995).

♦ Nevada Division of Environmental Protection (NDEP)
Nevada Division of Environmental Protection
333 West Nye Lane
Carson City, Nevada 89710
(702) 687-4670

The Nevada Division of Environmental Protection (NDEP) is responsible for implementation of statutory and regulatory provisions for the control of air and water (including point and nonpoint source) pollution and solid and hazardous waste management. NDEP has a variety of programs which directly or indirectly address NPS pollution issues and may offer assistance in NPS pollution control programs.

- Bureau of Air Quality - The Bureau of Air Quality has responsibility for the issuance of air quality construction and operating permits. The purpose of the permits is to ensure, through enforceable permit conditions, that adequate air pollution control equipment is used in industrial processes to protect the ambient air quality standards and public health and safety, prevent injury to plant and animal life, prevent damage to property, and preserve visibility, scenic, aesthetic and historic values within the State.
- Bureau of Mining Regulation and Reclamation - The Bureau of Mining Regulation and Reclamation has the responsibility for protecting the environment from adverse impacts associated with mining activities. Permits for the design, construction, operation and closure of mining facilities are issued under the authority of NAC 445.242 through NAC 445.24388. The purpose of the permits is to protect waters of the State from unauthorized discharges from process components. These regulations

do not apply to facilities involved solely in the mining and processing of sand and gravel, cinders, diatomaceous earth, slate, shale, gypsum, clay or crushed stone.
Permits for the reclamation of exploration projects and mining operations are issued under the authority of NAC 519.A. The purpose of these permits is to ensure: 1) the return of the land to a safe, stable condition consistent with the establishment of a productive post-mining use; and 2) the safe abandonment of a facility in a manner which ensures the public safety as well as the encouragement of techniques which minimize the adverse visual effects.

- Bureau of Water Pollution Control - the Bureau of Water Pollution Control is responsible for issuing ground water discharge permits, under the authority of Nevada Revised Statutes, Chapter 445. The purpose of the permit is to prevent groundwater pollution and to protect the environment. Permits are required for any activity such as waste treatment plants, etc., which would or could result in a discharge of pollutants having the potential to adversely impact groundwater.

  This Bureau also issues National Pollution Discharge Elimination System (NPDES) permits. The purpose of these permits is to regulate discharges into surface waters to prevent water pollution, protect the environment, and to preserve the beneficial uses that have been designated for those waters. Stormwater discharge permits are also issued under this program.

  Underground Injection Control (UIC) permits are also obtained from this Bureau. The purpose of the permits is to regulate underground injection in order to prevent groundwater pollution and protect the environment. Examples of activities which require a UIC permit include:

  - Injection of fluids produced in conjunction with oil and gas production;
  - Spent geothermal fluids;
  - Groundwater recharge projects; and
  - Remediation projects if water or another substance is injected.
    Note: Injection of radiological and hazardous wastes are prohibited.

  The Bureau of Water Pollution Control also permits all sewage disposal systems with a capacity of more than 5,000 gallons of effluent per day.

- Bureau of Waste Management - The Bureau of Waste Management issues permits for the operation of landfills under the authority of Nevada Revised Statutes. The purpose of the permits is to ensure proper operation of such systems, to protect public health and the environment.

  The Waste Management Bureau is also authorized to regulate hazardous wastes and to issue Resource Conservation and Recovery Act (RCRA) permits under authority of Nevada Revised Statutes (NRS) 459.400 through 459.600. Hazardous waste regulations and permits ensure proper management of hazardous wastes by generators, transporters, and treatment, storage, and disposal facilities.

- Bureau of Water Quality Planning - The Bureau of Water Quality Planning develops, reviews and revises beneficial uses and water quality standards for surface water, develops the total maximum daily loads of pollutants which can be introduced into a water body to meet in-stream water quality standards, manages the Wellhead Protection Program, the Comprehensive State Ground Water Protection Program, and conducts statewide surface water monitoring. This Bureau also manages the Nonpoint Source program. The focus of the program is to 1) identify categories of NPS pollution which contribute significantly to water quality degradation and are not adequately addressed or

controlled by existing programs; 2) describe a strategy for managing these categories of NPS pollution; and 3) develop a schedule for achieving program goal and objectives.

- Bureau of Federal Facilities - The Bureau of Federal Facilities oversees permitting and remediation activities on lands owned by the Department of Energy and the Department of Defense.

- Bureau of Corrective Actions - The Bureau of Corrective Actions regulates underground storage tanks and provides regulatory oversight on remediation of leaking underground storage tanks (UST/LUST programs), provides oversight for RCRA corrective action cases, provides Certification of Remediation Consultants and UST personnel, and administers the Superfund programs.

Department of Business and Industry

♦ Division of Agriculture
350 Capitol Hill Avenue
P.O. Box 1209
Reno, NV 89504
(702) 688-1180

The Nevada Division of Agriculture (NDOA) has primacy to administer the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in the state. The primary responsibility is to regulate the registration, use, storage, transportation and disposal of canceled and suspended pesticides. A State Management Plan for pesticides is being developed with the goal of protecting groundwater from pollution.

The Nevada Pesticides Act (NRS 586.401) requires that all pesticides used in the state be registered with the Division of Agriculture which publishes an annual list of all registered pesticides by their EPA registration Number.

The NDOA is required to eliminate from use in the state any pesticides that endanger the agricultural or nonagricultural environment. To accomplish this, the Division of Agriculture continuously evaluates all registered pesticides, and those pending registration.

Less hazardous pesticides, but ones that still require careful use so as to avoid injury to man or the environment, are classified by the NDOA as restricted-use pesticides. These pesticides are regulated by the Department and all applicators must pass a test prior to licensing.

♦ Division of Minerals (DOM)
400 W. King Street
Suite 106
Carson City, NV 89710
(702) 687-5050

The Division of Minerals regulates exploration for and production of oil, gas, and geothermal energy. In issuing permits for geothermal production and exploration wells, DOM is required to consult with and adhere to the policies and regulations administered by the Divisions of Environmental Protection, Water Resources, and Wildlife.

The DOM oil and gas regulations mandate that surface and subsurface formations of fresh water will be protected from pollution as a result of drilling or plugging a well or as the result of the escape, release, or injection of oil, gas, or brine from any well. Wells used to inject gas, air, water, or other fluids into a producing formation must be cased in such a way that leaks or damage to oil, gas, or fresh water are prevented.

Department of Transportation (NDOT)

1263 South Stewart St.
Carson City, NV 89710
(702) 687-5440

The role of the State Highway Department is to build and maintain roads throughout Nevada. Water quality problems evolving from highway and right-of-way runoff, maintenance procedures and road de-icing, are resolved by the Nevada Department of Transportation in cooperation with other state and federal agencies such as NRCS, BLM, Nevada Division of Forestry, USFS, NDEP, Bureau of Indian Affairs, and others. All major Nevada Department of Transportation highway construction projects involve an EIS, Clearinghouse review and a water pollution control plan which includes appropriate BMPs. NDOT also is involved in interlocal Stormwater NPDES Permits in Washoe and Clark Counties. District offices are located at Reno, Las Vegas, Elko, Ely, Tonopah, and Winnemucca.

University and Community College System

The following is a synopsis of programs in the University and Community College System which can provide educational and technical information for the general public regarding land use alternatives and treatments. Assistance in the planning, implementation and evaluation of BMPs is also available. As these agencies are quasi-public, the level of gratis assistance must be determined on a case-by-case basis.

The University and Community College System of Nevada has established programs which include:

- Agricultural Experiment Stations - (702) 784-6237
- Cooperative Extension Office of Director - (702) 784-1614
- Desert Research Institute - (702) 673-7300
- Harry Reid Center for Environmental Studies - (702) 739-3094
- Nevada Small Business Development Center - (702) 784-1717
- Nevada Bureau of Mines and Geology - (702) 784-6691
- University of Nevada Library System - (702) 784-6533

The following discussion will only focus on the services provided by the Cooperative Extension Service (CES) as CES has a mandate to work with agriculture, families, small communities, and decisions makers.

The Cooperative Extension Service has a primary role of public education (educational outreach and technology transfer), utilizing the technical expertise of specialists from the University of Nevada, Reno and elsewhere for field assistance when necessary. Assistance is provided through local extension staff who, in turn, work closely with other agencies. Information is provided in BMPs addressing water quality and quantity issues, and other traditional topics including: crop information, economics, seeding recommendations, pesticide use, etc.

Nevada Cooperative Extension areas and office locations are:

Western Area

Reno	784-4848
Incline Village	832-4150

Regional-Local

Washoe-Storey Conservation District

Conservation planning and technical assistance is available to landowners and managers through Nevada's 27 Conservation Districts. The District consists of locally elected boards which provide guidance for the USDA Natural Resource Conservation Service. This relationship provides access to the latest technology and knowledge available in a wide range of environmental disciplines.

Conservation Districts encourage Best Management Practices (BMPs) through public outreach efforts, demonstration projects and student education. Conservation Districts identify problems and provide solutions through voluntary programs.

Additional information on Washoe-Storey Conservation District can be obtained from the Nevada Division of Conservation Districts (702-687-6977) or by calling 322-9934.

Consultants

Consulting firms are based throughout the State, and provide services such as resource inventory and planning, engineering, soils testing, etc. Some businesses marketing irrigation supplies, erosion control products, etc., also have specialists available to assist in planning and implementing conservation projects.

County Health District

The Washoe County Health District is responsible for certain environmental programs. In general, the District performs solid waste, individual septic system inspections, and other public health programs. The District also responds to hazardous waste spills and reports of leaking underground storage tanks. Washoe County also administers the Air Quality Programs. NRS 439.370 through 439.580 enables this district to be formed with the primary mandate to protect public health.

GOVERNMENTAL SERVICES

A variety of agencies have worked together toward the common goal of completing a restoration plan for the Steamboat Creek. It has been everyone's vision to work in a coordinated and complementary manner to overcome existing hurdles in areas such as the permitting process and agency communications. Our hope has always been to improve agency service to the public, while meeting the needs of the watershed's natural resources, local economies and beneficial uses. The following discussion briefly identifies the roles and responsibilities of each of the agencies involved in the Steamboat Creek in an effort to provide the reader with a better understanding of how and where management directives originate and where additional assistance can be obtained.

Federal Agencies

- US Environmental Protection Agency, Region IX (EPA)

The primary sponsor of the project, both through technical assistance and financial support, has been the EPA. EPA is responsible, as directed by the Clean Water Act of 1972 and its amendments, for restoring the quality of the nation's waters. Nonpoint source pollution has been identified as the primary contributor of pollutants to the Truckee River system. EPA works closely with the State of Nevada Division of Environmental Protection in voluntarily controlling nonpoint source pollution through watershed based or community based programs. EPA will continue to play an important role in solving nonpoint source (NPS) issues throughout the watershed.

- USDA Natural Resources Conservation Service (NRCS)

Conservation technical assistance is the core of the NRCS. Technical assistance activities include development of individual conservation plans, design and installation of conservation practices (including BMPs). NRCS performs specific investigations of soil, plant, water and other natural resources to improve conservation technology. NRCS is the technical service arm for Nevada Conservation Districts and will continue to provide invaluable service throughout plan implementation. NRCS can assist local landowners with a number of natural resource issues.

- US Department of Defense, Army Corps of Engineers (Corps)

The Corps is directly responsible for all aspects of water resources including flood control and mapping, navigation, water quality and wetlands, irrigation systems, etc. The Corps operates a permit program, the 404 Permit Program, and is responsible for wetland mapping. Inclusion and participation of the Corps in the Steamboat Creek Restoration Plan is critical for implementing projects or activities proposed to address current NPS issues. The Corps can also provide technical assistance and guidance regarding their program activities.

- USDI Geological Survey, Water Resources Division (USGS)

As a federal agency with water quality and quantity responsibilities, the USGS can assist the watershed stakeholders in a variety of ways including technical assistance, data management, mapping and education.

Their primary responsibility is the maintenance and collection of hydrologic data. USGS will also be a key partner in all future watershed planning and implementation activities.

♦ USDI Fish & Wildlife Service (USFWS)

The primary mission of the USFWS is to provide leadership in achieving a national net gain of fish and wildlife and the natural systems which support them. They provide input to the Corps 404 Permit Program and offer financial assistance through several preservation/restoration programs.

♦ USDA Farm Service Agency(FSA)

The Agricultural Conservation Program (ACP) is administered by the FSA , formerly the Agricultural Stabilization and Conservation Service, and can provide financial and technical assistance to farmers, ranchers and non-industrial landowners who wish to apply soil, water and wildlife habitat conservation BMPs of long- term benefit to their land. FSA programs include Conservation Reserve, Sodbuster, Conservation Compliance, Water Bank and Rural Clean Water. FSA, in conjunction with NRCS and the Conservation Districts, will be an active partner in future watershed plan activities.

♦ USDA Rural Development

The Rural Development Program can provide loans and grants when available to individual farmers and ranchers to develop water and soil conservation practices on their land . Loans are also available to landowner associations to improve irrigation systems and implement soil and water conservation projects. The Rural Development Program has been and will continue to be another source of assistance to watershed stakeholders.

♦ Nevada Division of Environmental Protection (NDEP)

- Bureau of Water Quality Planning (BWQP)

The NDEP, BWQP requires and issues, as part of the 404 permitting process, 401 Water Quality Certification on the Truckee and Carson River Systems. Nevada's Nonpoint Source Pollution Control Program is the responsibility of the BWQP.

- Bureau of Water Pollution Control (BWPC)

NDEP's, BWPC is responsible for water pollution control permit programs including permits which control the type and condition of equipment used for work within surface water channels. This program issues Rolling Stock Permits which must be obtained prior to initiating any activity.

♦ Nevada Division of Conservation Districts (NDCD)

The NDCD oversees the activities of twenty-seven conservation districts throughout the State. NDCD provides technical and financial assistance to the CDS to improve the wise use and conservation of Nevada's natural resources, and sponsors education programs, public outreach, workshops and participation in the development

of Nevada's Best Management Practices Handbook. NDCD will continue to assist the watershed effort on an ongoing basis.

- Washoe Storey Conservation District (WSCD)

The WSCD and all conservation districts are responsible for the conservation and wise use of Nevada's natural resources for their given areas. The WSCD has assumed oversight responsibility for the development of the restoration plan and will be the lead agency for plan implementation in Nevada. WSCD currently employs a staff of one, the Administrative Assistant. The District has taken significant steps in planning future land use and resource management activities to the benefit of all watershed residents.

- Nevada Division of Forestry (NDF)

NDF manages and coordinates all forestry, nursery, endangered plant species and watershed resource activities on certain public and private lands on a statewide basis. Technical assistance regarding the management and conservation of woodland and riparian areas, financial assistance through several conservation programs and wildland fire prevention and protection, are all NDF's responsibility. NDF has many resources which can benefit future watershed implementation projects and overall watershed planning efforts.

- Nevada Division of State Lands (NDSL)

A permit program which authorizes all uses of state-owned lands, including the beds of navigable bodies of water, with the exception of lands held by the University System, the Department of Transportation and the Legislature, is the responsibility of NDSL.

- Nevada Division of Wildlife (NDOW)

One of the focuses of NDOW is environmental pollution which affects water quality, degrades wildlife and fisheries habitat and restricts production and/or propagation of fish wildlife. NDOW can offer technical and educational assistance and, at times, financial assistance with NPS pollution control projects.

- Nevada Division of Water Resources (NDWR)

The appropriation of all surface and ground waters of the State and the regulation of water well construction is the responsibility of NDWR. NDWR also maintains extensive data on water quantity, both surface and ground, and can provide technical assistance. NDWR regulates the design and construction of certain dams and impoundments and works closely with numerous state and federal agencies. NDWR will be involved in ongoing watershed planning and implementation efforts.

- Nevada Cooperative Extension (NCE)

As a division of the University of Nevada System supported by the local community, NCE provides technical assistance and public education to local residents. Areas of expertise include water quantity and quality,

agricultural information, economics, seeding recommendations, pesticide use, and residential landscape maintenance information. The NCE maintains local offices and has been invaluable to the development of the Steamboat Creek Restoration Plan. The NCE will continue to serve watershed residents and provide perhaps the key element of the plan, public education.

South of Geiger Grade, there are many small properties ranging from one to two acres in size, particularly in the Pleasant/Steamboat Valley areas. These properties, some of which were built upon 30 or more years ago, either abut or drain to Steamboat Creek. With a recognition that the actions of all residents will impact water quality in Steamboat Creek, the University of Nevada Cooperative Extension provides a voluntary educational program in managing nonpoint sources of pollution. Assistance is available in determining and implementing best management practices for erosion control, animal waste management, well and septic care and maintenance, and more. Streambank stabilization and creek protection are an integral part of Extension's Small Ranch program. Program events include classes, workshops, work parties in which BMPs are implemented, site visits, reading materials and more. A publication titled "Small Ranch Manual: A Guide for Green Pastures and Clean Water" is available from the Reno office of Cooperative Extension. For more information or for assistance, call Program Coordinator Sue Donaldson at 702-784-4848

- Nevada Division of Water Planning (NDWP)

Long range planning of Nevada's water resources is the responsibility of NDWP. Extensive data is maintained by NDWP and research is conducted in areas of water quantity, river basin modeling, economics and river basin assessments. One of the primary tasks of the Division of Water Planning (as mandated by the Nevada State Legislature) is to develop, implement, and update a statewide water resource management plan and policy initiatives (State Water Plan). NDWP also conducts the Water Education for Teachers (WET) Program throughout the State and provides other key public education and outreach activities.

7. RECOMMENDED RIVERINE CORRIDOR WIDTHS FOR STEAMBOAT CREEK

- Introduction and Background
- Restoration Objectives Formulated by Steering Committee
- Methods and Results
- Summary of Tables

I Introduction and Background

As part of a Steamboat Creek Restoration Plan, Washoe County and the Steamboat Creek Restoration Steering Committee requested that an ecologically functional corridor width for Steamboat Creek be determined. The work completed for this task built on previous work, specifically phase I and II of a fluvial geomorphology study for the Steamboat Creek Restoration Plan. In addition, the stream corridor widths recommended in this report were based on the vision statement and restoration goals formulated by the Steering Committee. Methods used to determine corridor width were purely scientific and did not considering political, legal, property ownership, or financial realities. These evaluations and decisions will be left to County officials and Steering Committee members.

II Restoration Objectives Formulated by Steering Committee

Restoration objectives determined by the Steamboat Creek Restoration Steering Committee, as outlined in the Steamboat Creek Restoration Plan (page 2-2):

1. Improve the water quality of Steamboat Creek.
2. Restore Steamboat Creek to a Sustainable Condition.
3. Re-establish wildlife habitat appropriate for individual stream reaches.
4. Re-establish vegetation appropriate for individual stream reaches.
5. Combine stream restoration with recreation in areas designated for public access.

All corridor width recommendations presented here were specifically developed to meet these restoration objectives.

III Methods and Results

Four representative Steamboat Creek reaches were examined for the purposes of determining a channel belt width:1) University Farms, 2) Bella Vista Ranch, 3) Near Geiger Grade and 4) Pleasant Valley (Figure 1; these reaches correspond to the four study areas depicted in Figure 3 of the restoration plan). Cross-section, water surface slope, and channel bed material size were surveyed in each of these stream reaches. Corridor width recommendations were determined from these surveys, analysis of recent aerial photography, and published literature on influence of riparian corridor width on wildlife use.

Four primary techniques were used to develop corridor width recommendations:

1. Calculate channel belt width using empirical equations: A geomorphological publication titled *River Meanders and Channel Size* (Williams 1986) combined known data sets on channel geometry and developed general empirical equations for belt width and radius of curvature (Fig. 2). The following equations are examples of the relationships that can be used for determining channel belt width:

$$B = 4.3W^{1.12}$$

$$B = 18A^{.086}$$

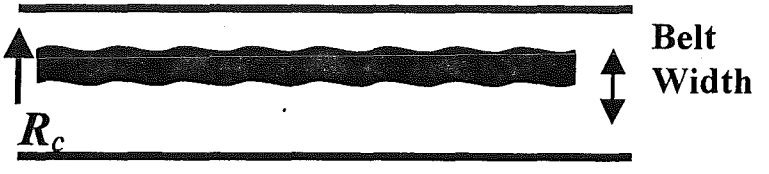
$$B = 148A^{1.52}$$

$$B = 0.61L_m$$

$$B = 0.78L_b$$

$$B = 2.88\ R_c$$

Figure 2: Meander Belt Width and Radius of Curvature



The equations developed by Williams (1986) can be useful in determining riverine corridor width if they are applied with a full understanding of what they represent. The calculated belt width represents a specific measurement which is the expected average distance across a set of meander lobes (Figure 2.). However, the average condition may vary from site to site in that some sites may naturally have slightly larger belt widths, while others may be slightly narrower. Also, Williams (1986) equations probably slightly underestimate the true natural belt width of rivers in an equilibrium state, as he did not distinguish data from channels in equilibrium from those that are in disequilibrium.

Finally, these relationships give us only guidance for the proposed belt width (and other measures of channel geometry), regardless of all other factors that need to be considered, such as wildlife habitat requirements, vegetation establishment requirements, and long-term sustainability of the system. The actual corridor width should be significantly larger to accommodate 1) above average meander lobes of a developing channel, 2) channel migration, 3) sediment deposition, 3) changing watershed conditions, 4) flood plain areas for riparian vegetation establishment, and 5) a dynamic equilibrium condition. Therefore, **the restored channel of Steamboat Creek will likely require a greater belt width over time than the one derived from empirical equations.**

Table 1 summarizes the results of Steamboat Creek belt width calculations based on empirical relationships (Williams 1986).

Table 1. Steamboat Creek Channel Reaches	**Empirical Equations for Channel Belt Width**		
	$B = 4.3\ W^{1.12}$	$B = 18\ A^{0.86}$	$B = 2.88 R_c$
Pleasant Valley Reach	84 ft	74 ft	78 ft
Geiger Grade Reach	135 ft	126 ft	135 ft
Bella Vista Ranch Reach[1]	155 ft[1]	194 ft[1]	156 ft[1]
University Farms Reach	311 ft	585 ft	313 ft

2. Dimension-less critical shear values for incipient bed particle motion: Critical shear values can be used to determine the extent of bed motion during peak flows of varying frequency. We calculated dimension-less critical shear values to evaluate the extent of particle motion during peak flows with a 1.5 year recurrence interval, as this magnitude of flood represents bank full flow in most rivers.

$$\tau^* \qquad \frac{RS}{1.65 d_{50}}$$

τ^* = Dimension-less critical shear at bank-full flow
R = Hydraulic radius
S = Channel energy slope (approximated by water surface slope)
d_{50} = Median particle diameter

Gravel bed stream reaches with high critical shear values (> 0.06) are assumed to be in a state of disequilibrium. To reduce shear stress for a given flow so that it falls into a range closer to the equilibrium, the stream slope must decrease (assuming that no substantial change in bed particle size or hydraulic radius will occur). Stream slopes are directly influenced by sinuosity. Sinuosity is a measure of the amount of meandering in a channel. It is expressed as a ratio of channel distance divided by straight valley distance over the same reach.

If sinuosity increases, stream slope decreases. We determined the stream slope necessary for an equilibrium condition by solving the above equation using a critical shear value of < 0.05. Channel patterns, with increased sinuosity to achieve reduced slopes, were superimposed on the existing condition to determine our recommended channel corridor width (Figure 2, Table 2).

[1] This channel segment is wide and shallow. A restored channel would develop a narrower and deeper channel than the existing one. Therefore, channel widths and depths are adjusted for these calculations.

Table 2 reports 1) calculated existing critical shear, 2) existing sinuosity, 3) projected sinuosity needed to achieve equilibrium, and 4) proposed corridor width for each of the stream segment.

Table 2. Steamboat Creek Channel Reaches	Bank full dimension-less critical shear	Existing sinuosity	Sinuosity required for shear stress reduction	Channel corridor width required to achieve desired sinuosity
Pleasant Valley Reach	0.042	1.5	1.5	300 ft
Geiger Grade Reach	0.21	1.1	2[2]	400 ft
Bella Vista Ranch Reach	0.033	1.0	1.5-1.8	500 ft
University Farms Reach	0.29 (sand)	1.3	1.6 - 2.3[3]	700 ft

3. Relationships developed by Dave Rosgen (1994): While developing other parts of the Steamboat Creek restoration plan, WESTEC consultants routinely used Rosgen's stream classification system and fluvial geomorphological relationships (from Rosgen's (1994) publication titled: *A Classification of Natural Rivers*). To be consistent with their approach, we compared belt widths calculated with empirical equations to those recommended by Rosgen (1994).

WESTEC determined the desired future condition for most of Steamboat Creek channel to be a Rosgen type C 5. Rosgen reports belt widths for C type channels to range from 4 to 20 times the channel bankfull width, with an average of 11.4 (Fig. 3). However, the fact that C-5 type channels have a greater sinuosity than the "average" C channel indicates that a factor greater than 11.4 is appropriate. To accommodate this sinuosity, we will use factor of 15 to calculate belt width.

[2] In this reach, bedrock was exposed in the channel bed. Thus, the dimensions critical shear calculations for gravel bed stream would not appropriate. However the calculations were reported for comparison, and the proposed sinuosity was the authors professional judgement.

[3] This segment of Steamboat Creek channel has a sand bed. Sand bed channels frequently have dimensionless critical shear values more than ten times those values that are typical for initiation of particle motion in channels with coarser bed particles.

Table 3 summarizes the calculated channel belt width based on empirical relationships in comparison with belt widths derived from Rosgen's classification system.

Table 3. Steamboat Creek Channel Reaches	Empirically calculated Channel belt width (average)	Channel corridor width	Rosgen's Belt Width
Pleasant Valley Reach	79 ft	300 ft	225 ft
Geiger Grade Reach	132 ft	400 ft	368 ft
Bella Vista Ranch Reach	168 ft	500 ft	420 ft
University Farms Reach	403 ft	700 ft	780 ft

This comparison shows that Rosgen's recommendations are largely in agreement with the calculated channel belt widths presented in our analysis considering that empirically calculated channel belt widths presented in our analysis considering that empirically calculated channel belt width are generally an underestimate of the true belt width (see discussion above).

4. Template Comparison: Recent aerial photography was examined to locate stream segments that approximate the desired future condition. Channel belt width and river channel corridor width were measured (the measured belt widths correlate well with the empirical derived values). Also, the riparian vegetation corridors were measured. Using these measured values, proportional relationships between channel belt width, river channel corridor width and riparian corridor width were determined (Table 4).

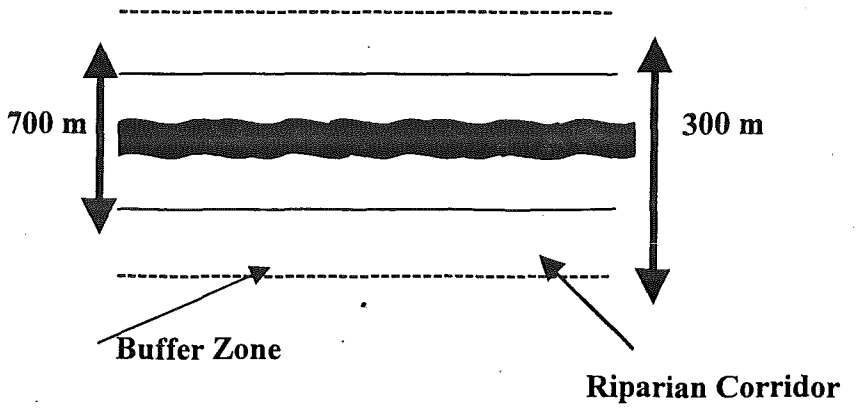
In addition, the riparian vegetation corridors were measured using aerial photography. Using these measurements, proportional relationships between channel belt width, river channel corridor width and riparian corridor width is about 3.3 times the channel belt width and the riparian corridor is about 4.4 times the measures belt width (Table 4). This high ratio results from the additional room needed to accommodate the extensively meandering channel, which required for a stable stream pattern, and the spacious riparian forest associated with this channel type. It is common that in extensively meandering stream types, such as Steamboat Creek, the total river channel corridor width is much greater than channel belt width because of secondary channel meandering.

Table 4. Steamboat Creek Channel Reaches	**Calculated *channel* corridor widths**	**Calculated *riparian* corridor widths**
Pleasant Valley Reach	260 ft	350 ft
Geiger Grade Reach	435 ft	580 ft
Bella Vista Ranch Reach	555 ft	740 ft
University Farms Reach	1330 ft	1770 ft

5. Riparian corridor and upland buffer widths based on wildlife use: To determine the importance of corridor width and buffer zones for wildlife of riparian areas in the semi-arid west, Dr. Elisabeth Ammon (University of Nevada, Reno) reviewed scientific publications and summarized her own research. Recommendations for riparian corridor width for Steamboat Creek were based on these findings.

Minimum Patch Size for Riparian Woodlands
Ohmart (1994) suggested 0.4 ha (1 acre) as a bare minimum for riparian habitat patch size, if any detectable benefits to birds are desired. Results from England et al. (1984) suggest that number of breeding bird species and total species richness form an asymptotic relationship with patch size of riparian habitat. According to their data, minimum patch size of riparian habitat that captures most of the total species richness is 10 ha (25 acres). Therefore, land planning for restored and protected riparian areas along Steamboat Creek should include setting aside larger areas (25 acres) of intact riparian woodlands.

Minimum Width of Buffer Zone in Uplands
Szaro and Jakle (1985) found that, in arid habitats, bird abundance decreased at 200 m (656 ft) from the edge of a riparian corridor, while in xeric-riparian habitats (i.e., desert washes), bird abundances remained high up to 600 m (1969 ft) from the mesic-riparian corridor. The habitats surrounding Steamboat Creek are primarily semi-arid (shrub-steppe) and agricultural. Based on Szaro and Jakle's (1985) results, the recommended buffer zone adjacent to the cottonwood-dominated riparian zone is at least 200 m (656 ft). This buffer zone should, ideally, consist of protected and/or restored native upland habitat, which is in the case of Steamboat Creek, sagebrush-dominated shrub-steppe. However, abandoned agricultural lands would also be valuable for buffer zones, especially if they provide a connection to more remote native upland habitats (i.e., into the undeveloped hills near Steamboat Creek).



Minimum Corridor Width for Riparian Woodlands

A recent study of breeding birds of Diamond Fork Canyon, Utah, showed that both bird abundance and species richness were higher in corridor widths > 200 m (656 ft) than in corridor widths < 100 m (328 ft) (E. Ammon, *unpubl. data*). Similarly, at the Provo River, Utah, species richness was almost twice as high in corridor widths > 300 m (948 ft) than in corridor widths < 100 m (E. Ammon, *unpubl. data*). While available data on minimum riparian corridor width for wildlife benefits are presently sketchy, several lines of evidence suggest that riparian corridors of at least 300 m in width are needed to approach wildlife benefits of a relatively intact system.

General Considerations
Information on area requirements for most riparian wildlife is difficult to generalize across different areas. Therefore, important variables that can influence local area requirements of native wildlife should also be considered in site-specific restoration planning for Steamboat Creek. These considerations should include: (1) the types of riparian and upland habitats present in the site (native habitat types have greater benefits than habitats dominated by exotic species); (2) prevalent types of land use (uses with low impacts to native vegetation are preferred over uses with high impacts to native vegetation); (3) types and degree of existing impacts on riparian habitats (recovery potential of wildlife benefits is closely linked to the recovery potential of riparian vegetation); and (4) presence of domestic animals (livestock and household pets can have substantial impacts on reproductive success of songbirds, among other effects).

Based on the information available at the time of this report, the following basic design is recommended for riparian corridor width and adjacent buffer zone at Steamboat Creek. A larger corridor width than recommended here (i.e., > 700 m (2297 ft)) would, however, result in additional benefits to wildlife, particularly by protecting more reclusive species and providing additional important habitats for nesting, roosting, foraging, and predator evasion.

IV Discussion and Recommendations

To achieve the Steering Committee's goal of re-establishing a channel in a dynamic equilibrium state (i.e., a stable meander pattern), land planners must designate sufficient room for a channel with considerable sinuosity (1.7 to 2.3). The minimum corridor widths that meet this criterion are listed in Table 6 *(Channel corridor width)*.

To achieve the Steering Committee's wildlife objectives, the corridor width should be approximately those listed in Table 5 (*Riparian corridor width).* However, to maximum wildlife benefits, planners should utilize every opportunity to achieve the combined riparian and upland buffer widths listed under *Riparian and Upland Buffer Corridor Width.*

Since it is unlikely that planners could achieve these recommended corridor widths everywhere, they should seek out those opportunities where several benefits are combined. Wildlife will benefit most from having a few broad, continuous forest patches, which are connected to upland habitats, than from having many smaller disconnected forest patches. Public lands along the river corridor can provide an undeveloped upland buffer. Therefore, planners should try to establish the river corridor adjacent to these lands, even if it requires moving the channel. Also, there are minimum areas needed to support a diverse biological community, and the general rule is *more is always better.* Planners should seek opportunities to establish patches of riparian forest areas of at least 25 acres.

Channel segments with widths less than those listed under the heading *Channel corridor width,* and especially segments with corridor widths less those listed under the *Channel belt width* heading, are typically sacrifice zones and will likely need to be armored and planted with trees and shrubs[4].

Table 5. Steamboat Creek Channel Reaches	Channel belt width	Channel corridor width	Channel corridor width	Riparian corridor width	Riparian & Upland Buffer Corridor Width
Pleasant Valley Reach	79 ft	300 ft	260 ft	350 ft	1650 ft
Geiger Grade Reach	132 ft	400 ft	435 ft	580 ft	1880 ft
Bella Vista Ranch Reach	267 ft	550 ft	880 ft	1175 ft	2475 ft
University Farms Reach	403 ft	700 ft	1330 ft	1770 ft	3070 ft

[4]This statement does not apply to channel reaches that are classified as a Rosgen "B" type channel.

V Literature Cited

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Rosgen, D. L. 1994. A classification of natural rivers. Catena 22, 169-199.

Szaro, R. C. , and M. D. Jakle. 1985. Avian use of a desert riparian island and its adjacent scrub habitat. Condor 87: 511-519.

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Summary of Tables

Table 1. Steamboat Creek Channel Reaches	**Empirical Equations for Channel Belt Width**		
	$B = 4.3\ W^{1.12}$	$B = 18\ A^{0.86}$	$B = 2.88R_c$
Pleasant Valley Reach	84 ft	74 ft	78 ft
Geiger Grade Reach	135 ft	126 ft	135 ft
Bella Vista Ranch Reach[1]	155 ft[1]	194 ft[1]	156 ft[1]
University Farms Reach	311 ft	585 ft	313 ft

[1] This channel segment is wide and shallow. A restored channel would develop a narrower and deeper channel that the existing one. Therefore, channel widths and depths were adjusted for the calculations.

Table 2. Steamboat Creek Channel Reaches	Bank full dimension-less critical shear	Existing sinuosity	Sinuosity required for shear stress reduction	Channel corridor width required to achieve desired sinuosity
Pleasant Valley Reach	0.042	1.5	1.5	300 ft
Geiger Grade Reach	0.21	1.1	2[2]	400 ft
Bella Vista Ranch Reach	0.033	1.0	1.5-1.8	500 ft
University Farms Reach	0.29 (sand)	1.3	1.6 - 2.3[3]	700 ft

[2] In this reach, bedrock was exposed in the channel bed. Thus, the dimensionless critical shear calculations for gravel bed stream would nor appropriate. However the calculations were reported for comparison, and the proposed sinuosity was the authors professional judgement.

[3] This segment of Steamboat Creek channel has a sand bed. Sand bed channels frequently have dimensionless critical shear values more than ten times those values that are typical for initiation of particle motion in channels with coarser bed particles.

Table 3. Steamboat Creek Channel Reaches	Empirically calculated Channel belt width (average)	Channel corridor width	Rosgen's Belt Width
Pleasant Valley Reach	79 ft	300 ft	225 ft
Geiger Grade Reach	132 ft	400 ft	368 ft
Bella Vista Ranch Reach	168 ft	500 ft	420 ft
University Farms Reach	403 ft	700 ft	780 ft

Table 4. Steamboat Creek Channel Reaches	**Calculated *channel* corridor widths**	**Calculated *riparian* corridor widths**
Pleasant Valley Reach	260 ft	350 ft
Geiger Grade Reach	435 ft	580 ft
Bella Vista Ranch Reach	555 ft	740 ft
University Farms Reach	1330 ft	1770 ft

Table 5. Steamboat Creek Channel Reaches	Channel belt width	Channel corridor width	Channel corridor width	Riparian corridor width	Riparian & Upland Buffer Corridor Width
Pleasant Valley Reach	79 ft	300 ft	260 ft	350 ft	1650 ft
Geiger Grade Reach	132 ft	400 ft	435 ft	580 ft	1880 ft
Bella Vista Ranch Reach	267 ft	550 ft	880 ft	1175 ft	2475 ft
University Farms Reach	403 ft	700 ft	1330 ft	1770 ft	3070 ft

8. APPENDIX

- Definition of Terms
- Graph of Bankfull Discharge vs. Station
- Arguments for Stream Buffers
- Best Management Practices
- Federal Water Master List of Water Rights in the Steamboat Creek Vicinity
- Army Corps of Engineers Information

APPENDIX

Definition of Terms

Graph of Bankfull Discharge vs. Station

Arguments for Steam Buffers

Best Management Practices

Federal Water Master List of Water Rights in the Steamboat Creek Vicinity

Army corps of Engineers Information

1. Application for Department of the Army Permit
2. Information Sheet on the U.S. Army corps of Engineers permitting Program under section 404 of the Clean Water Act.
3. U.S. Army Corps of Engineers regulatory Jurisdiction.
4. Nationwide Permit 27 - Wetland & Riparian Restoration & Creation Activities (Sections 10 and 404).

DEFINITION OF TERMS

The discussions to be found in this report will necessarily involve information of a highly technical nature. Although we have made every attempt to keep the discussions in the body of the report at as comfortable a level as possible, capable of being understood by the average person, it will necessarily involve some terminology that will be unfamiliar to the average person and even to many in the practicing sciences. This section will provide a brief description of some of the more important terminology, which will enhance the ability of the reader to understand the information being presented in this report.

Aggradation — The tendency of a channel to "fill-in" or drop its sediment load at a given location. Aggradation occurs when the sediment transport capacity downstream of the location is less than the upstream sediment transport capacity downstream of the location is less than the upstream sediment transport capacity feeding sediment into that location.

Alluvial Fan — A geomorphic feature commonly found at the downstream terminus of a basin in which sediment is being deposited and flows are becoming divergent (i.e., rather than flows being concentrated to a single stream, flows on the surface of an alluvial fan will often be distributed to multiple channels).

Avulsion — An event in which a stream channel rapidly changes course or direction.

Bankfull Discharge — The bankfull discharge is another name for mean dominate discharge. It is given this name because it is also the discharge, which commonly will just almost fill the active channel in a stable stream environment without spreading out onto the active flood plain. For all perennial streams and most ephemeral streams the bankfull discharge corresponds to a flow with a return interval on the order of 1.5 years (i.e., and annual exceedence probability on the order of 67 percent).

Bankfull Depth — The depth of flowing water in the channel which corresponds to the bankfull discharge.

Bankfull Width — The surface width of flowing water in the channel which corresponds to the bankfull depth and bankfull discharge.

Basin	A basin is a more or less bowl-shaped topographical feature on the surface of the earth which causes water falling on the surface to be collected, concentrated, and delivered to a drainage network or stream which will remove both water and sediment from the basin.
Bedload	That portion of the sediment which at any given discharge is too large and heavy to be picked up completely off the bottom by the flowing water. Bedload is moved along the floor of the channel by sliding, rolling, and saltation (i.e., the tipping of a large rock into a scour hole eroded beneath its downstream edge).
Bed Material Load	Discussions of "sediment transport" typically exclude the wash load component which is best correlated with sediment yield. The bed material load is simply the sum of the bedload and suspended load.
Degradation	This is another term for "erosion" or the tendency of a channel to cut into and remove sediment within its channel. Degradation occurs when the sediment transport capacity downstream of the given location exceeds the sediment transport capacity feeding sediment into that location.
Discharge	A measure of the volume of water (and/or sediment) passing a fixed point over time. It is usually expressed as a rate with units of volume over time. The measure of discharge most commonly used in this report is cubic feet per second or cfs.
Entrenchment	A measure of the degree to which a stream channel is incised (i.e., down cut into the surface of the flood plain) or vertically confined. It is technically defined as the ratio of the flood prone width (i.e., the width of the channel at a level of twice the bankfull depth) and the bankfull width.
Fluvial Geomorphology	The forms and processes associated with rivers and drainage basins; topics include basin hydrology, drainage networks, river hydraulics, sediment transport processes, channel morphology, channel change, and human impacts on fluvial systems.
Mean Annual Discharge	This is the arithmetic average of all the average daily discharge rates over the entire year. Application of the mean annual discharge rate over the time span of a full year produces an estimate of the "mean annual yield" or the total volume of surface water produced by the basin over the full water year.

Mean Dominate Discharge

Water flowing in a natural channel has the ability to move soil and rock particles in its bed and on its banks. The amount of materials being moved by the flow increases with increasing discharge. Low levels of discharge occur very frequently, however, the higher of flood level discharge occur only rarely. The mean dominate discharge is that discharge level at which the greatest total volume of sediment is moved over the course of a water year. Since the shape of the channel is determined by the ability of the stream to move sediment this is a very important discharge, sometimes referred to as the "channel forming discharge."

Quasi Equilibrium

A stream is said to be in a state of "quasi equilibrium" when it exists in a state in which it is "comfortable" with minimal tendencies to aggrade, degrade, or migrate laterally. In terms of sediment load coming in from upstream is in balance with the sediment load being transported downstream.

Return Interval

The return interval is the inverse of the annual exceedence probability for a given flood or discharge. In other words, for a flood which has a 1 percent chance of being exceeded each year the return interval would be 1 divided by 0.01 or 100 years.

Sediment Transport

A measure of the ability of a surface stream to move soil and rock particles of various sizes (i.e., sediment) downstream under the influence of flowing water.

Sediment Yield

This is a measure of the total volume of sediment being mobilized by precipitation within a basin. A discussed above, the overwhelming majority of this volume is the fine-grained "wash load". Sediment yield is commonly estimated using the Universal Soil Loss equation (USLE) developed by the Soil Conservation Service (SCS). This procedure was initially developed in agriculture areas in the Midwest in order to predict soil loss on cultivated fields. It has been adapted to other areas (including the mountainous areas of the semi-arid west) but is cannot be viewed to five quantitatively accurate estimates of soil loss. It is useful only in making comparisons between areas and assessing the impact of changes within a given basin.

Sinuosity

A measure of the tendency of a stream channel to follow a circuitous, curvilinear path rather than a straight line. It is technically defined as the length of the stream channel divided by the length of the valley.

Suspended Load

The portion of the sediment load which is transported entirely within the water flow and is completely surrounded by water but which moves intermittently by settling back to rest on the bed of the stream.

Wash Load

This is the finest fraction of the sediment moved by water flow (typically silts and clays only). These particles are sufficiently small that unlike suspended load, they will not settle out of flowing water. Their removal requires still or impounded water in a lake or reservoir. Because of these properties, the wash load fraction of the total sediment budget has little to do with the flow of regime and more to do with the basin characteristics and "sediment yield".

PRELIMINARY ESTIMATES OF DESIGN BANKFULL DISCHARGE BY REACH

REACH NAME	BANKFULL DISCHARGE (cfs)
Truckee Terrace	170
Rosewood	110
High Meadow	130
Huffaker Hills	50
Bella Vista	35
Whites Creek	35
North Geiger	75
South Geiger	40
Steamboat Springs	120
Pleasant Valley N	100
Pleasant Valley S	75
395 South	50
St. James North	70
St. James South	50
Trestle	25

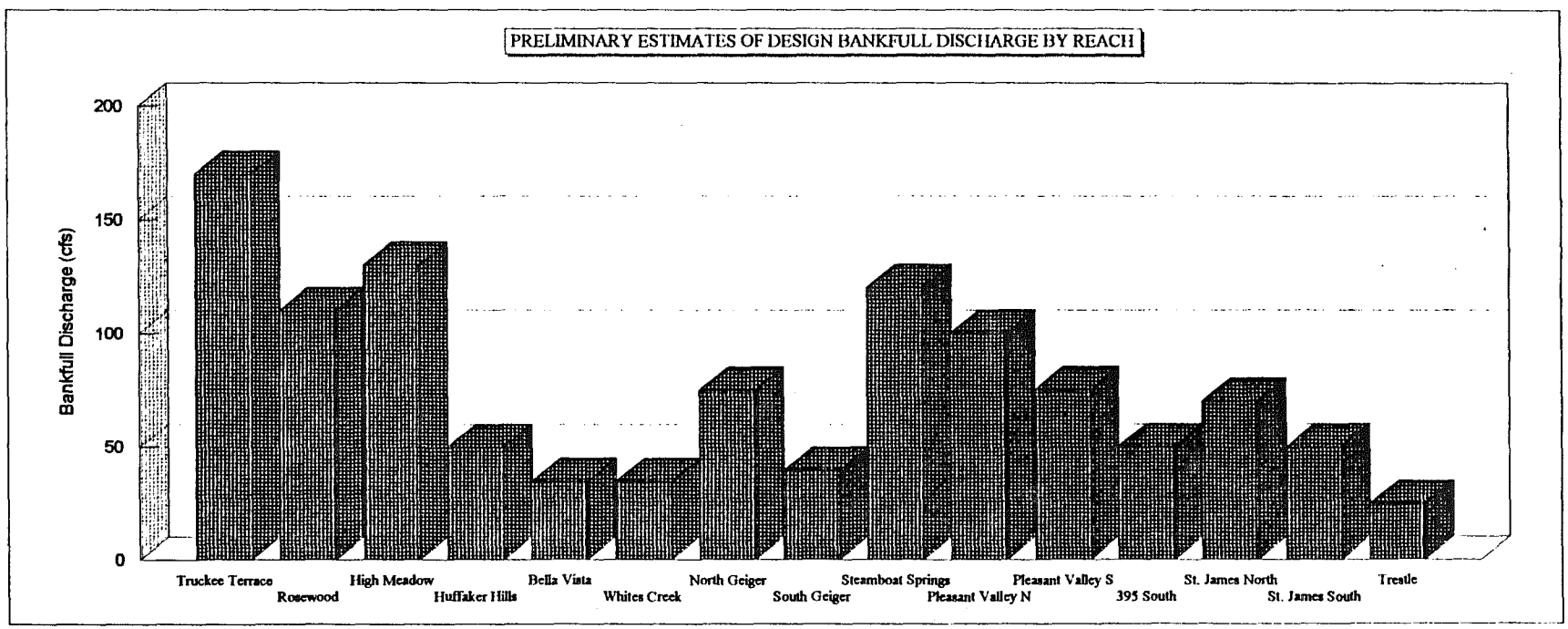


Table 3
20 Arguments for Stream Buffers

1. Reduces watershed imperviousness by 5%
2. Creates distance between impervious cover and the stream
3. Reduces small drainage problems and complaints
4. Allows stream to move laterally over time
5. Provides effective flood control insurance
6. Protect stream bank erosion
7. Increases property values in adjacent community
8. Increases pollutant removal of the BMP system
9. Provides green space in a community
10. Provides food, cover and habitat structure to the stream
11. Prevents stream warming
12. Supports wetland protection efforts
13. Prevents soil erosion from steep slopes
14. Preserves wildlife habitat
15. Creates wildlife travel corridors
16. Protects amphibian habitat
17. Discourages the creation of barriers to fish migration
18. Discourages excessive storm drain enclosures or channel hardening
19. Integrates urban best management practices in the landscape
20. Allows for future restoration/reforestation of the stream

Results of Local Government buffer Survey:
(Heraty, 1992) 36 programs across USA

- 90% of buffers in private ownership
- 90% has a neutral or positive impact on property values
- Only 30% of all buffer programs had significant complaints
- 25% of buffer programs have been recently strengthened
- 48% of buffer programs had "weak" or no notification methods
- Only 50% of buffer programs require delineation of buffers on grading plans and /or E&S plans
- 60 % of property owners are unaware of boundaries and uses of buffers
- 67% of buffer programs did not record buffers on any official map
- Few buffer programs make forests their vegetative target (predevelopment cover or no target at all)
- 26% of respondents indicated buffers were often impaired during construction.

A Suggested Stream buffer Model

1. Each buffer should have three zones:
   - Inner core (streamside)
   - Middle zone (floodplain plus)
   - Outer Zone (setback)

2. The width, vegetative target and allowable use within each zone are different.

3. The width of the middle zone expands to include:
   - 100-year floodplain
   - Steep slopes (4 feet per 1% increase in slope)
   - Any adjacent wetlands or critical habitats
   - Extra width for third order or higher streams

4. The stream is defined in terms that can be clearly delineated in the field and on a mapping unit-where it begins.

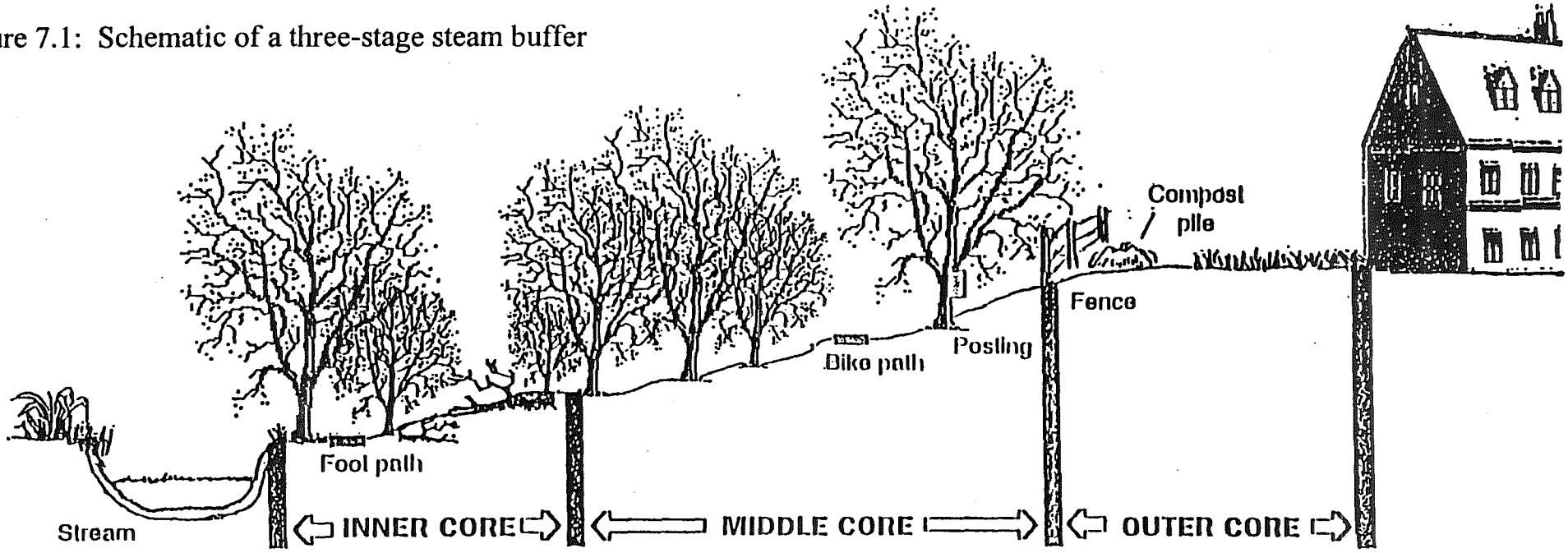
5. Developer may be compensated with extra density outside the buffer, if buffer consumers too much land.

6. The number and kind of buffer crossings are clearly defined.

7. The stream buffer is one element of the total BMP system for the site.

8. Buffer is mapped, posted and managed.

Figure 7.1: Schematic of a three-stage steam buffer



Width	25 feet, plus wetlands and critical habitats	25 to 50 feet, depending on stream order, slope, and 100 year floodplain	25 foot minimum setback to structure
Vegetative Target	Undisturbed forest Reforest if grass	Managed forest, some clearing allowable	Forest or turf
Allowable Uses	*Very Restricted* e.g., flood control, utility right of ways, footpaths, etc.	*Restricted* e.g., some recreational uses, some stormwater BMPs, bike paths, tree removal by permit	*Unrestricted* e.g., residential uses including lawn, garden, compost, yard wastes, most stormwater BMPs

Pollutant removal frequently cited as justification for urban stream buffers (61% of local governments).

There is little evidence that buffers actually remove urban pollutants in stormwater.

Best performance is for systems with level spreader and 150 feet of mowed Grass. (Yu et al, 1990)

Most sites will require a structural best management practice (BMP) for long-term pollutant removal.

Not all BMPs are always compatible with stream buffer objectives (or forest targets).

Stormwater ponds and wetlands, unless: located at head of buffer, or in middle zone, and landscaping of their required buffers.

Small BMPs need to be better integrated into buffer systems

- swales
- biofilters
- infiltration

Techniques to Maintain Integrity of Buffers:

I. Planning Stage

1. Require buffer limits to be present on all clearing/grading and erosion control plans.

2. Record buffer boundaries on official maps.

3. Clearly establish acceptable/unacceptable buffer uses.

4. Establish clear vegetative targets for each buffer zone.

5. Provide incentives for owners to protect buffers through conservation easements rather than deed restrictions.

II. Construction Stage

1. Preconstruction stakeout of buffers to define limit of disturbance (LOD).

2. Set LOD based on the drip line of the forested buffer.

3. Conduct preconstruction meeting to familiarize contractors with LOD and buffer limits.

4. Mark LOD with silt fence barrier, signs and other methods to exclude construction equipment and stockpiling.

III. Post Development Stage

1. Mark buffer boundaries with permanent signs describing allowable uses.

2. Educate property owners and homeowner association regularly.

3. Conduct annual bufferwalks to inspect the buffer network.

4. Reforest buffer areas that are grassed or in turf.

Table 7.2: Types of disturbance to urban wetland buffers in King and Snomish Counties, Washington
(N=21). (Adapted from Cooke, 1991)

Category Of Disturbance	*Percent of Buffer Disturbed*
Dumping of Yard Wastes	76
Conversion of Natural Vegetation into Lawn or Turf	100
Tree Removal	50
Evidence of Fertilizer Impact	55
Evidence of Stormwater Short-Circuiting Buffer	28
Increased Dominance of Invasive/Exotic plants	67
Evidence that Buffer had been Maintained	5
Trails Established in Buffer	29
Buffers Exhibiting Signs of Alternation	95
Severely Altered buffers (Not Protection Adjacent Wetland)	43

Table 7.1: Acceptable and Unacceptable Uses Within Stream and Wetland Buffers *source: Heraty, 1992)*

Use	Allowed (%)	Denied (%)
Foot Paths	60	8
Utility Line Crossings	52	5
Water Dependent Uses	45	10
Bike Paths	30	15
Stormwater BMPs	28	10
Home Additions (Decks/Gazebos)	10	55
Maintenance for Flood Control	Often Allowed	Often Allowed
Pumphouses	Restricted	Restricted
Sewage Treatment Plant	Restricted	Restricted
Golf Courses	Restricted	Restricted
Campgrounds	Restricted	Restricted
Timber Harvesting	Restricted	Restricted
Hydropower	Restricted	Restricted
Roads/bridges	Restricted	Restricted
Athletic Fields	Restricted	Restricted
Playground Equipment	Restricted	Restricted
Compost/Yard Wastes	Unrestricted	Unrestricted
Landscaping	Unrestricted	Unrestricted
No Uses permitted (30%)		
No Uses Denied (15%)		

Percentages of Buffer programs that specifically allow or deny a given use. The "Restricted" and "Unrestricted" entries refer to other stream buffer uses that are not commonly addressed in local ordinances.

Module 4

Review for Urban Best Management Practices

Source Controls

Pond Systems (6)

Wetland Systems (4)

Infiltration Systems (5)

Filtering Systems (7)

Urban BMP Systems

A. Pond Systems

B. Wetland Systems

C. Infiltration Systems

D. Filtering Systems

Pond Systems

#1. Conventional Dry Pond
#2. Dry Extended Detention (ED) Pond
#3. Micropool ED Pond
#4. Wet Pond
#5. Wet ED Pond
#6. Multiple Pond Systems

Wetland Systems

#7. Shallow marsh Systems
#8. ED Wetland Systems
#9. Pocket Wetland
#10. Pond/Marsh Systems

Infiltration Systems

#11. Dry-Wall
#12. Conventional Infiltration Trench
#13. Enhanced Infiltration Trench
#14. Infiltration Basin
#15. Porous Pavement

Filtering Systems

#16. Sand Filter
#17. Peat San Filter/Compost Filter
#18. Grassed Swale
#19. Biofilter
#20. Bioretention
#21. Urban Filter strip
#22. Oil/Girt Separator (Water Quality Inlet)

Indicators shown in the following BMP Summaries are as follows:

DA: Drainage Area

Pollutant Removal: Achievable with best Design

Longevity: Failure Rate of BMP

Notes: Physical and Environmental Constraints and Maintenance

No. 1: Conventional Dry Stormwater Pond

DA: 5 to 400 Acres

Pollutant Removal: TSS = 10% TP = 0 TN = 0

Longevity: Excellent (20+Years)

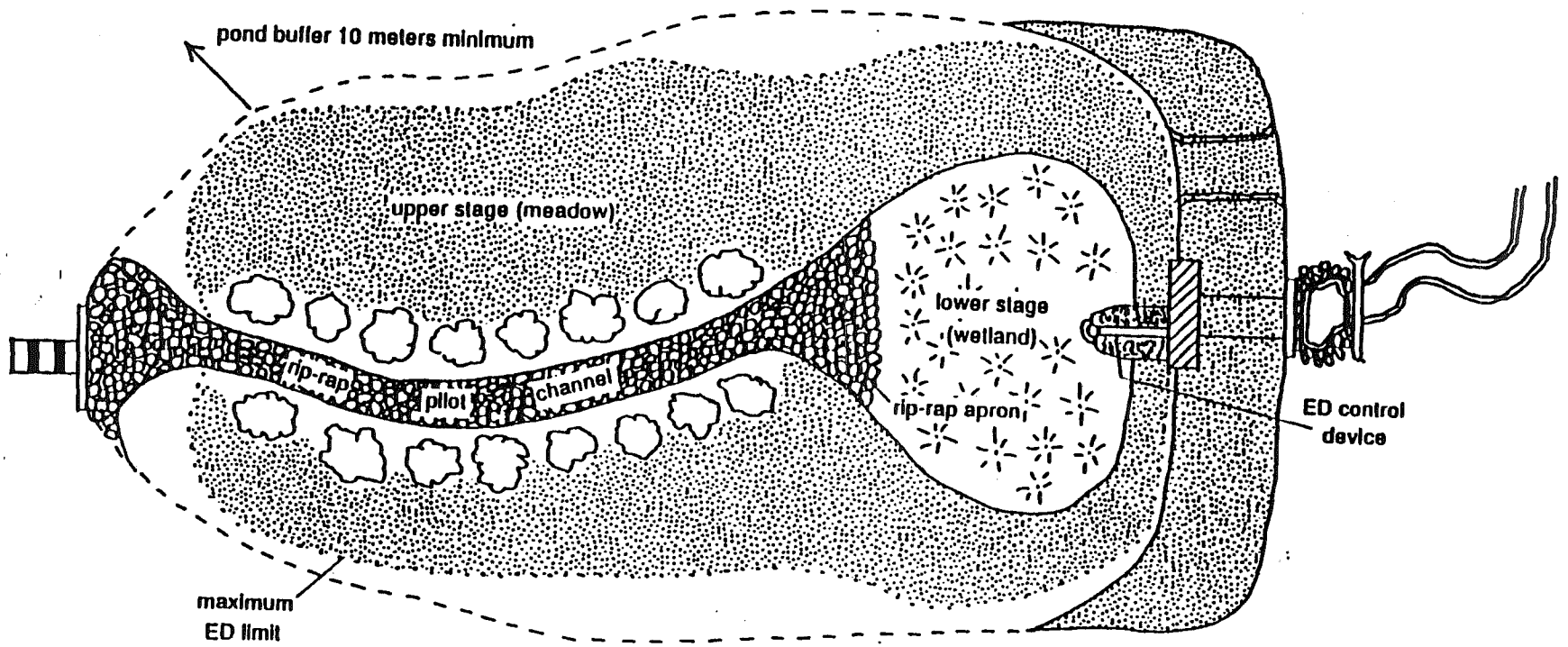
Key Design Factors:

- Performance cannot be significantly improved

Notes:

- Very limited downstream channel protection
- Very limited pollutant removal
- Low maintenance

POND DESIGN NO. 1 DRY ED POND SYSTEM



STORAGE ALLOCATION:

ED storage (24 hours) = 75 mm/impha
upper stage = 45 mm/impha
lower stage = 30 mm/impha

No. 2: Dry Detention Pond

DA: 10 to 400 Acres

Pollutant Removal: TSS = 30% TP = 10% TN = 10; extremely variable

Longevity: Excellent (20+ Years), but prone to chronic clogging

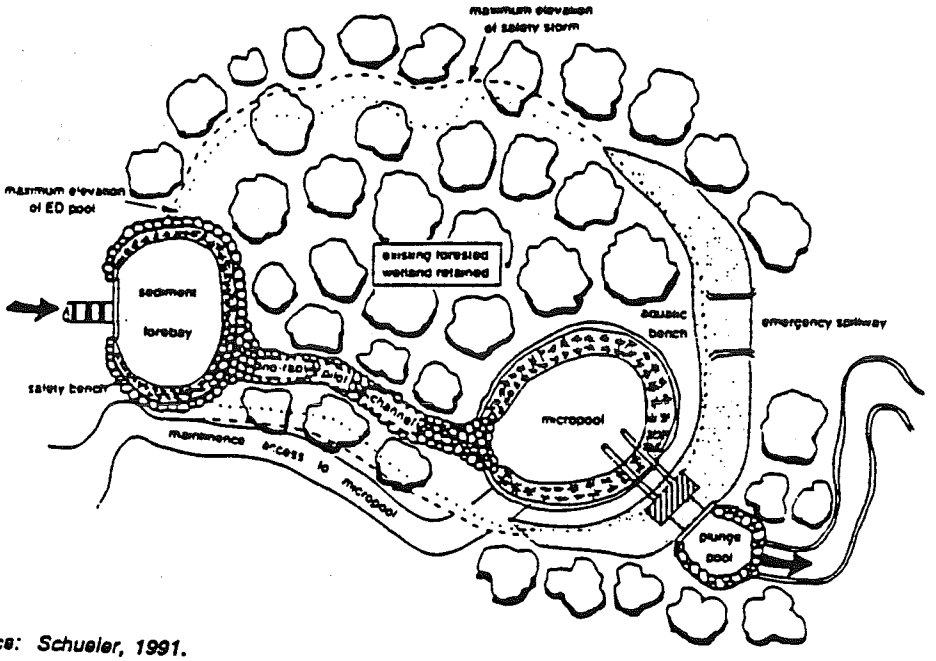
Key Design Factors:

- Avoid horizontal dewatering device and concrete pilot channel
- Two stage design
- Bottom stage is wetland, top stage is wet meadow

Notes:

- Provides excellent downstream channel protection
- Hard to achieve target ED times

Schematic Design of an Enhanced Dry ED Pond System



Source: Schueler, 1991.

Pond Systems:

No. 3 Micropool ED Pond

DA: 10 to 400 Acres

Pollutant Removal: TSS = 70% TP = 30% TN = 15%

Longevity: Excellent (20+Years), seldom clogs

Key Design Factors:

- Micropool and forebay prevent resuspension
- Wetland creation on fringe of pools
- Riprap pilot channel can cause stream warming

Notes:

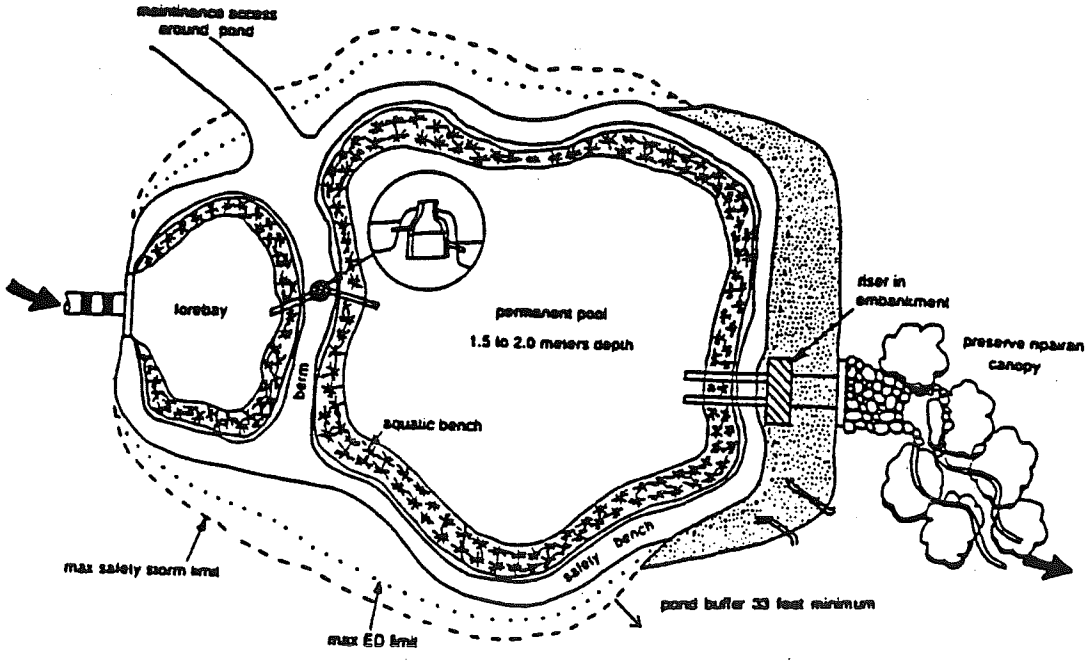
- Can be used to fingerprint a BMP around wetland/forest
- Poorly Maintained ED ponds create nuisance problems

Definition:

Conventional wet pounds have a permanent pool of water for treating incoming stormwater runoff.

In enhanced wet pond designs, a forebay is installed to trap incoming sediments where they can be easily removed; a fringe wetland is also established around the perimeter of the pond.

Schematic Design of an Enhanced Wet ED Pond



Source: Schueler, 1991.

No. 5 Wet Extended Detention Pond

DA: 25 + Acres or Reliable Baseflow

Pollutant Removal: TSS = 76 TP = 65 TN = 40

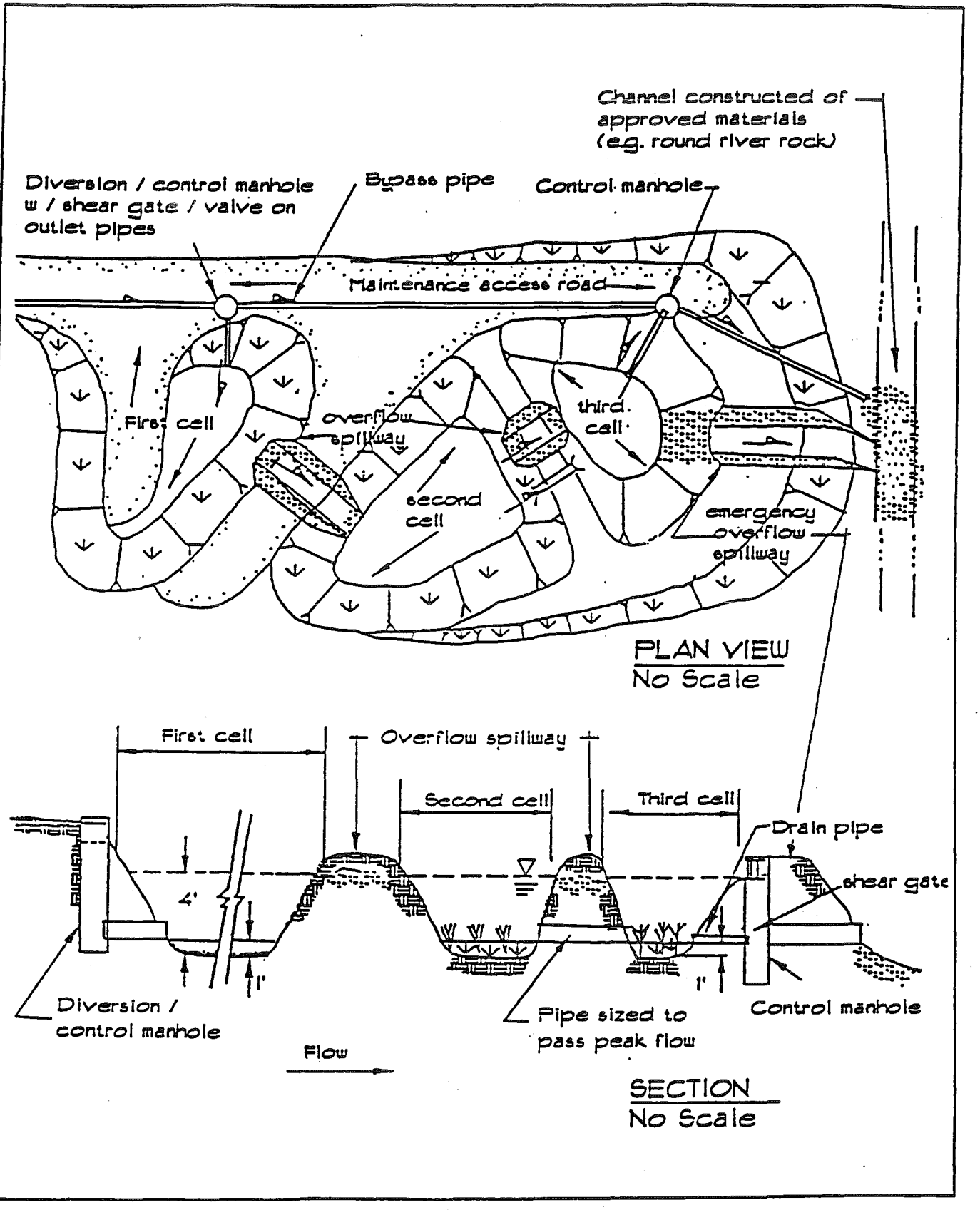
Longevity: Excellent (20 + Years)

Key Design Factors

- Forebay
- 12 to 24 hour volume ED
- Reverse-slope pipe with near surface withdrawal

Notes:

- Good downstream channel protection and pollutant removal
- Can save space, compared to wet pond


Channel constructed of approved materials (e.g. round river rock)
Diversion / control manhole w / shear gate / valve on outlet pipes
Bypass pipe
Control manhole
Maintenance access road
First cell
overflow spillway
second cell
third cell
emergency overflow spillway
PLAN VIEW
No Scale
First cell
Overflow spillway
Second cell
Third cell
Drain pipe
shear gate
4'
1'
1'
Diversion / control manhole
Pipe sized to pass peak flow
Control manhole
Flow
SECTION
No Scale

No. 6 Multiple Pond Systems

DA: 25 to 400 Acres

Pollutant Removal: TSS = 80 TP = 70 TN = 45

Longevity: Excellent (20 + Years)

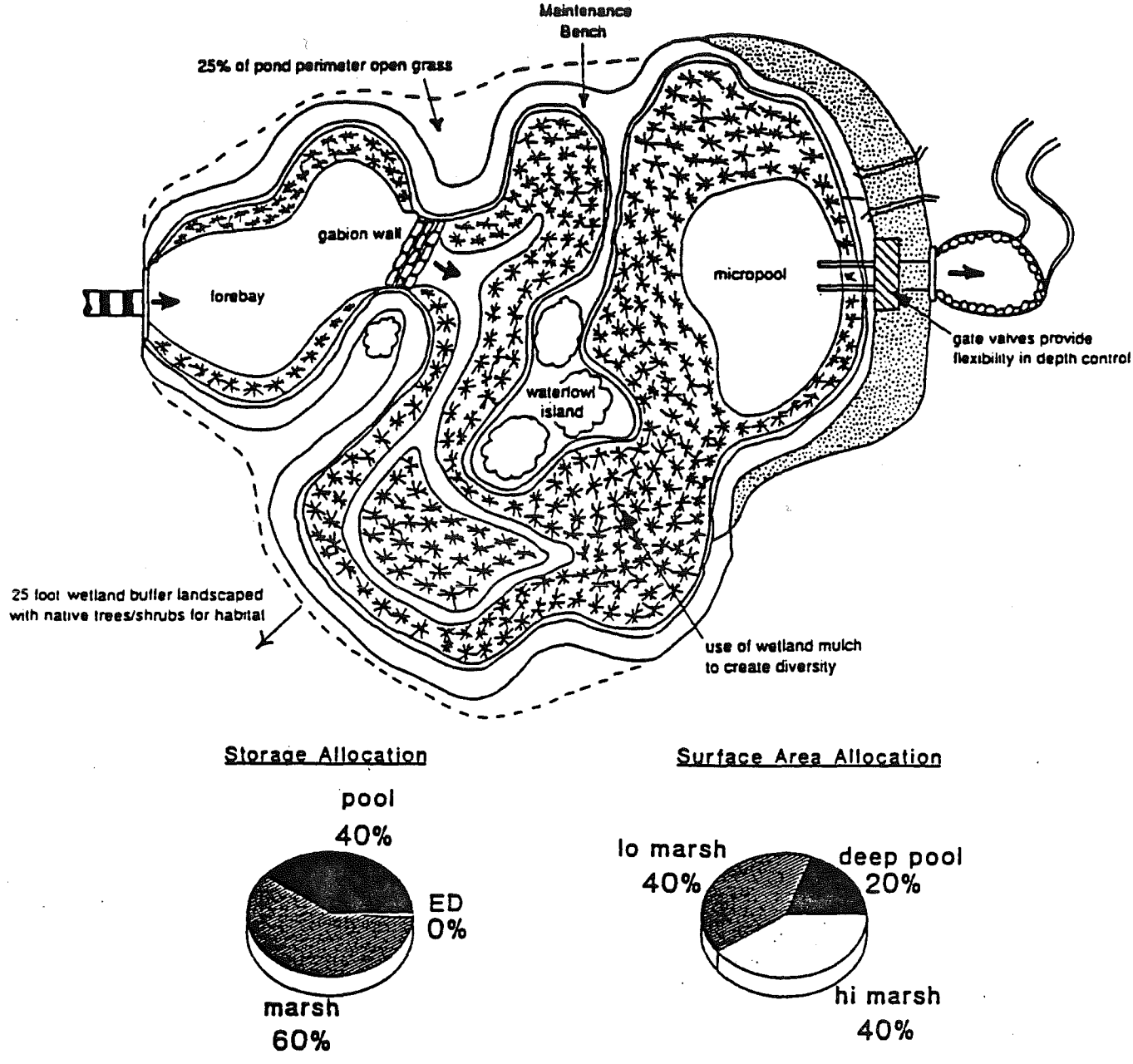
Key Design Factors:

- Multiple pond cells or treatment mechanisms
- Long flow path is key in removal

Notes:

- Subject to permitting constraints in wetlands, forests and trout streams

Figure 1. Design No.1 - The Shallow Marsh System



The majority of the shallow marsh system is zero to eighteen inches deep, which creates favorable conditions for the growth of emergent wetland plants. A deeper forebay is located at the major inlet, and a deep micropool is situated near the outlet.

No. 7 Shallow Marsh System

DA: 25 + Acres or Baseflow

Pollutant Removal: TSS = 75 TP = 45 TN = 25

Longevity: Excellent (20 + Years), with active management

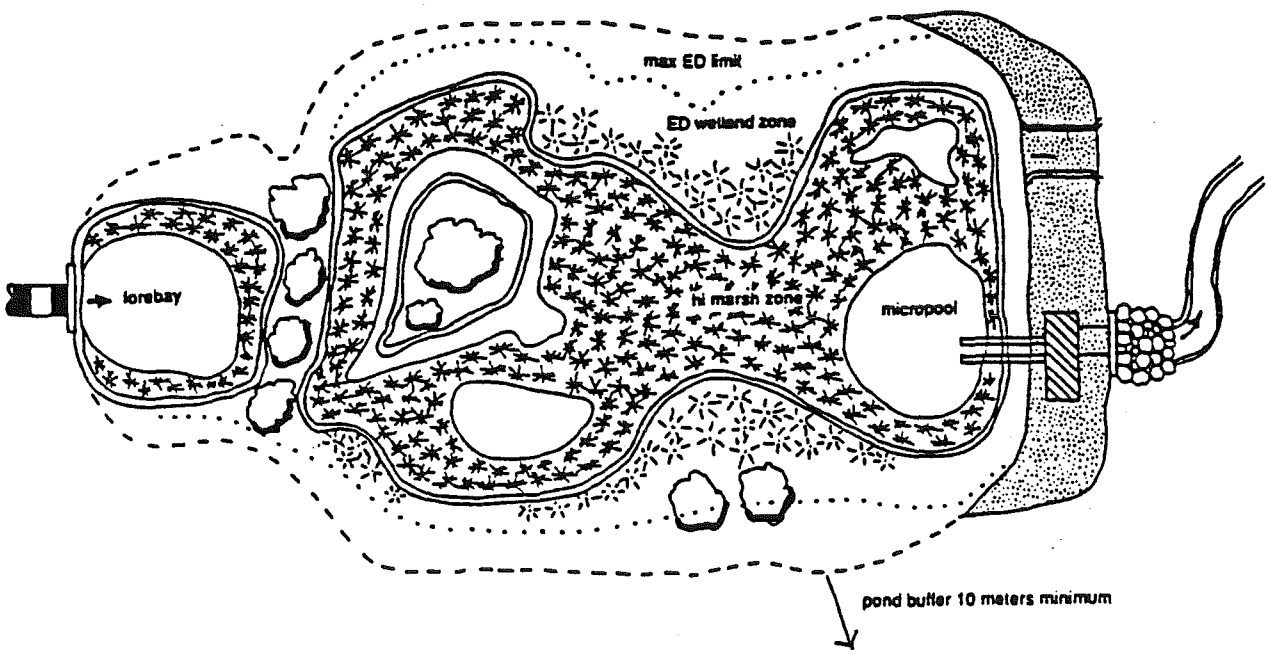
Key design factors:

- Forebay and micropool
- Shallow depths over most surface area (0 to 12 inches)
- Complex internal Microtopography

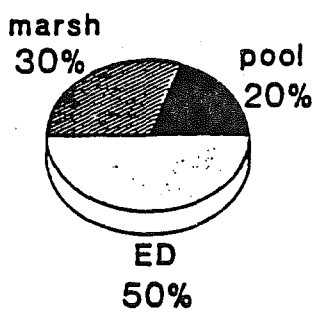
Notes:

- Potential wildlife habitat creation opportunities
- Most space intensive of all pond wetland options

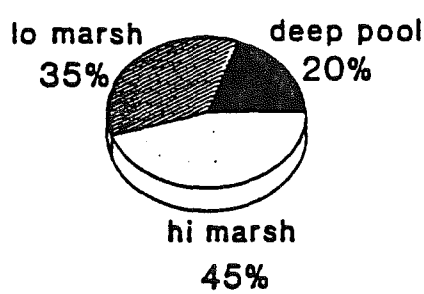
Figure 3. Design No. 3 - The Extended Detention (ED) Wetland



Storage Allocation



Surface Area Allocation



The water level within an ED wetland can increase by as much as three feet after a storm event, and then returns to normal levels within 24 hours. As much as 50% of the total treatment volume can be provided as ED storage, which helps to protect downstream channels from erosion, and reduce the wetland's space requirement.

No. 8: Extended Detention (ED) Wetland System

DA: 10 or more Acres

Pollutant Removal: TSS = 70 TP = 40 TN = 20

Longevity: Excellent (20 + Years), with active management

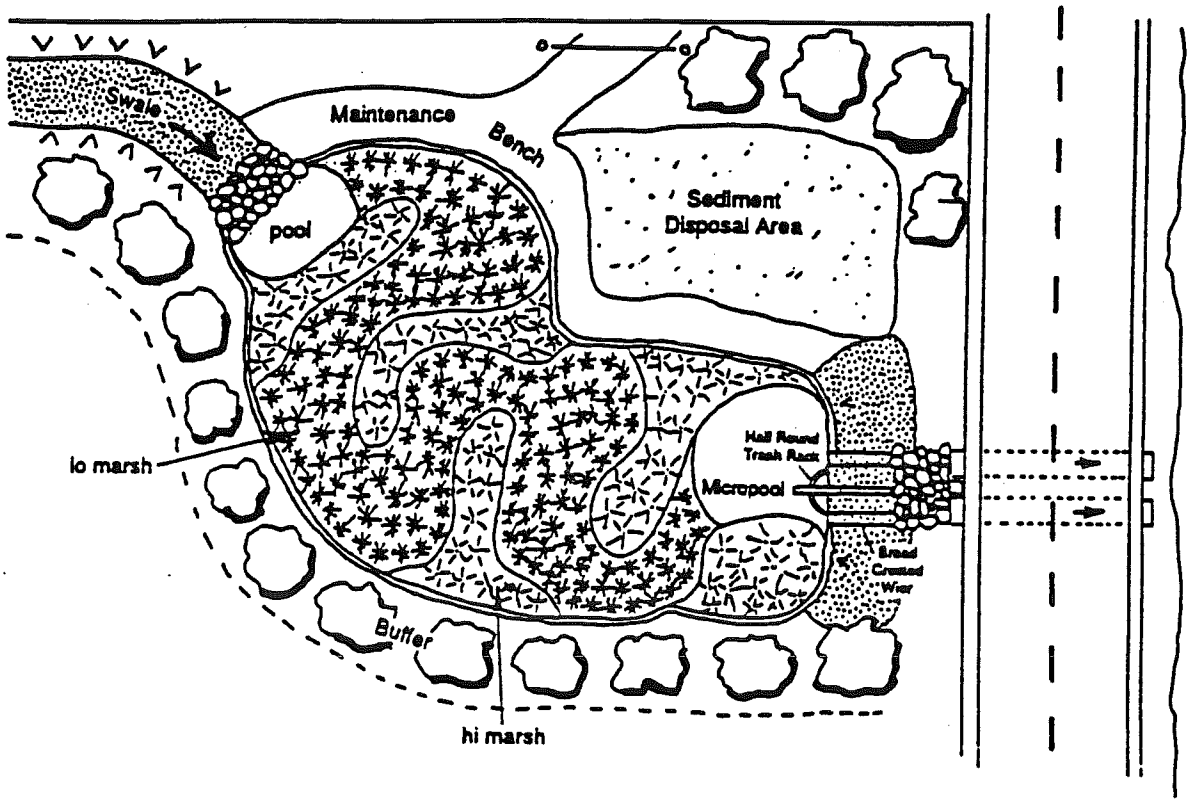
Key design factors:

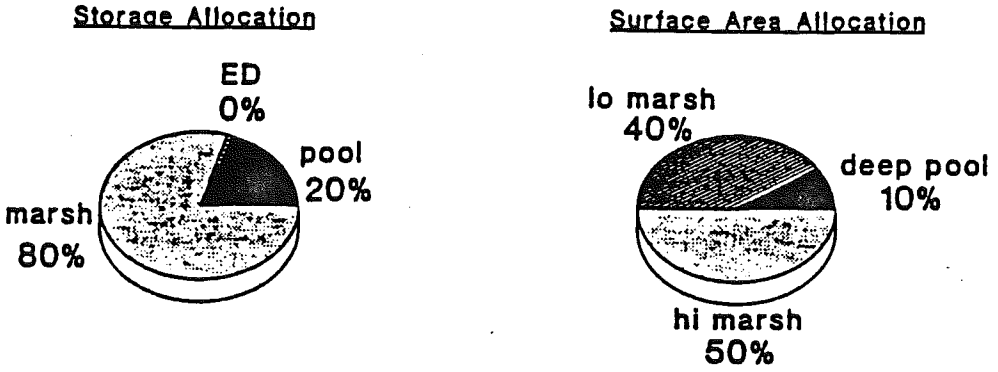
- Forebay/Micropool
- Up to 1/2 of VT for ED
- Range of depth zones
- 2-3 foot vertical ED limit

Notes

- Save space, protects downstream channels

Figure 4. Design No. 4 - The Pocket Stormwater Wetland





Pocket wetlands seldom are more than a tenth of acre in size, and serve development sites of ten acres or less. Due to their size and unreliable water supply, pocket wetlands do not possess all of the benefits of other wetland designs. Most pocket wetlands have no sediment forebay. Despite many drawbacks, pocket wetlands may be an attractive BMP alternative for smaller development situations.

No. 9: Picket Wetland

DA: 5 Acres or less

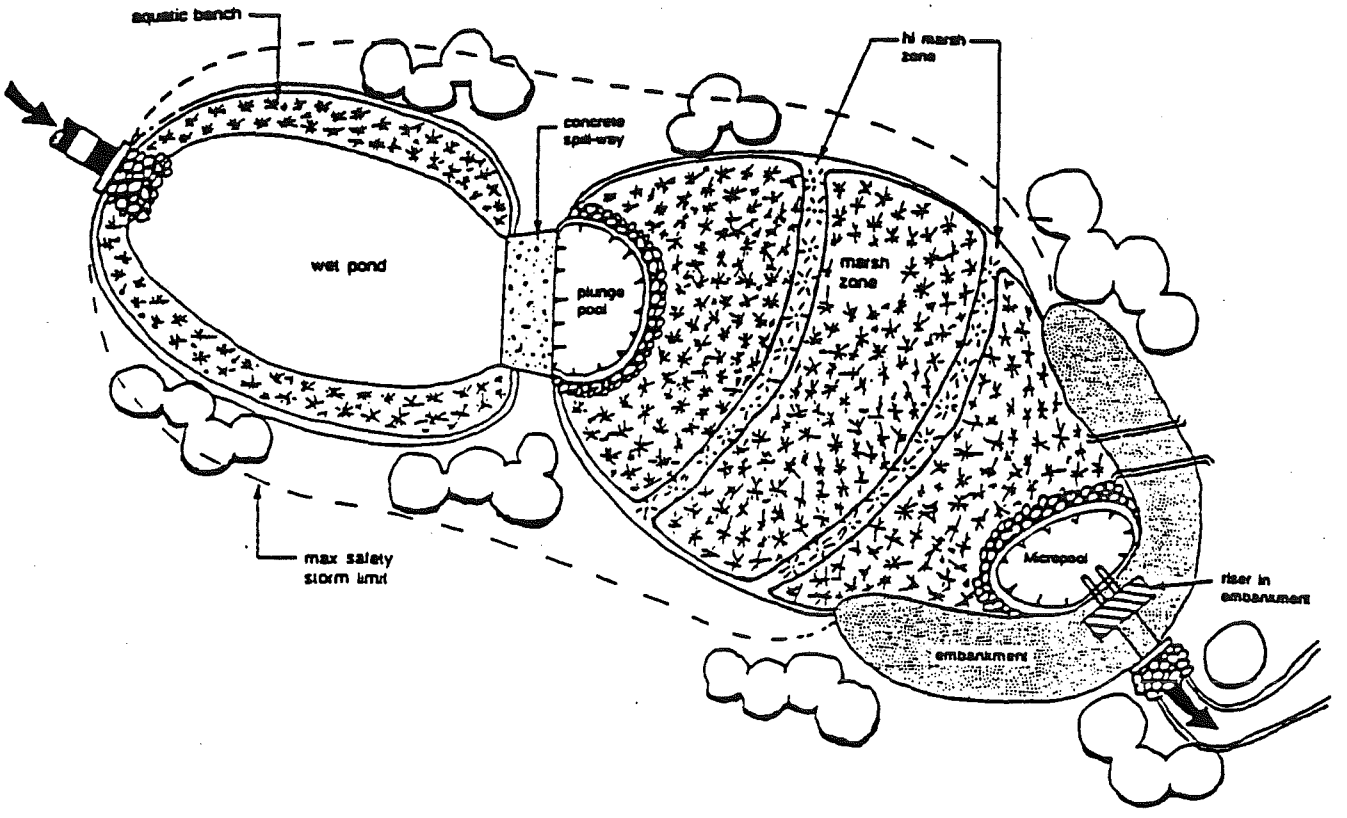
Pollutant Removal: TSS = 60 TP = 25 TN = 15

Longevity: 20 + years, with sediment clean out and on-site disposal

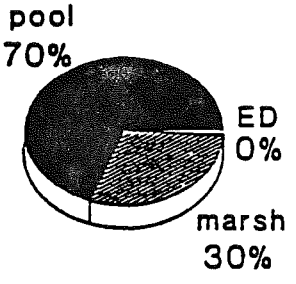
Key design factors:

- Excavate to groundwater
- High maintenance costs
- Stagnation/odor risks

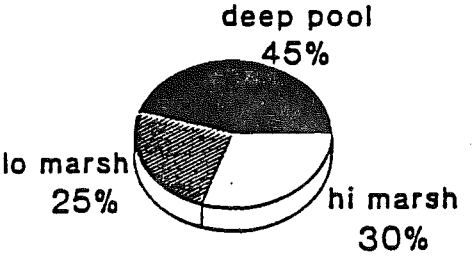
Figure 2. Design No. 2 - The Pond/Wetland System



Storage Allocation



Surface Area Allocation



The pond/wetland system consists of two separate cells - a deep pond leading to a shallow wetland. The pond removes pollutants, and reduces the space required for the system.

No. 10: Pond/Marsh System

DA: Best with 25 + Acres or Baseflow

Pollutant Removal: TSS = 85 TP = 60 TN + 45

Longevity: 20 + Years

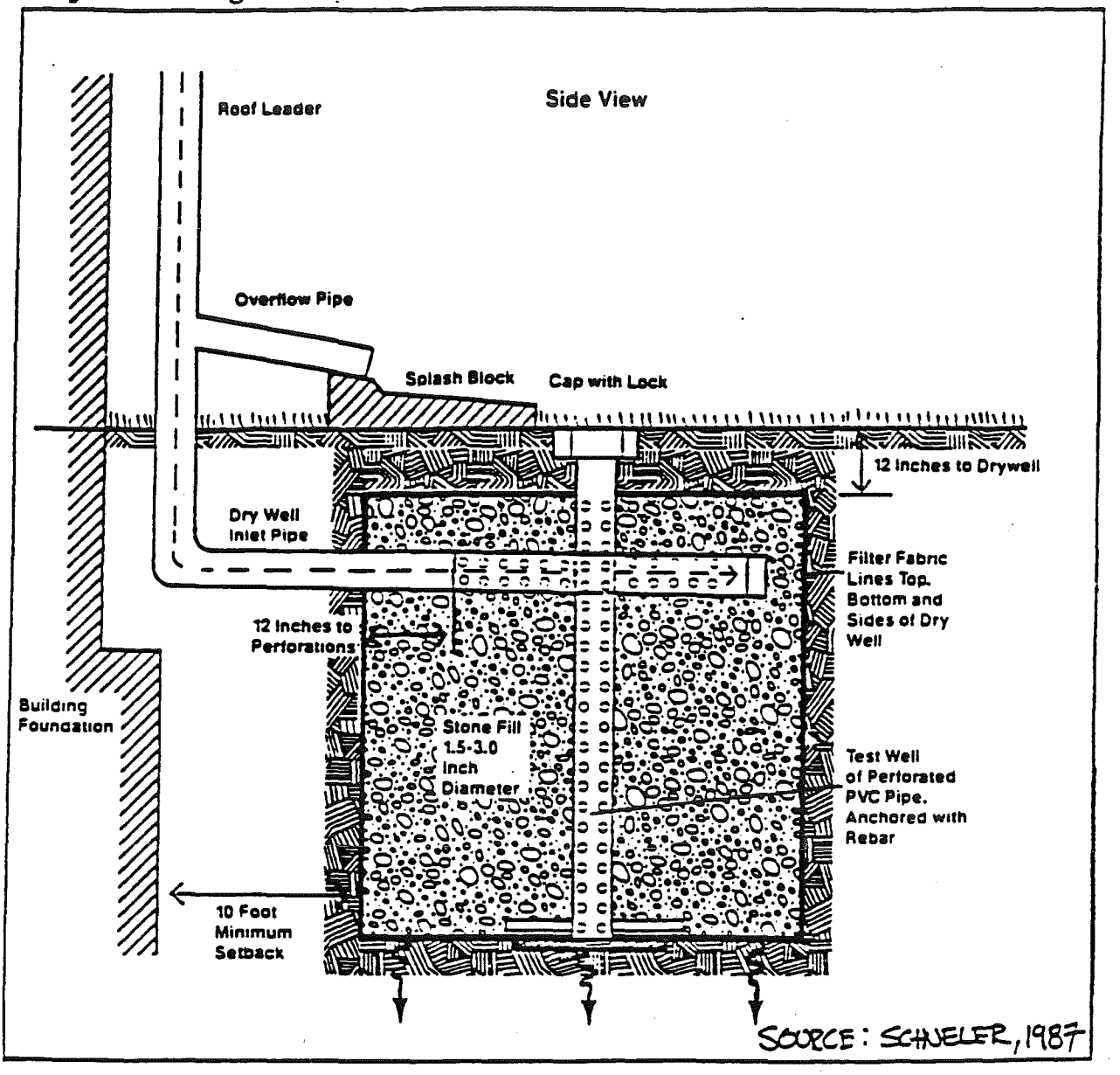
Key design factors:

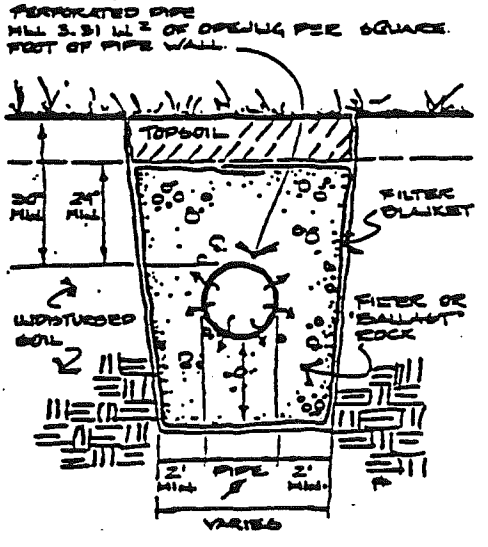
- Microtopography
- Long flow path
- High marsh Wedges
- First cell as pool (as much as 60-70% of VT)

Notes:

- Very reliable and effective urban BMP
- Pond helps toregulate sediment sediment supply to wetland
- Highest reported N/P/S/S removal of any pond/wetland option.

Dry Well Design





Infiltration Systems:

No. 11 Dry Well

DA: Up to one acre of rooftop

Pollutant Removal: TSS = 90 TP = 60 TN = 50 (Projected)

Longevity: Projected to be moderate, but limited data

Key design factors:

- Overflow chute
- Sand layer
- Leaf screen

Notes:

- Unreliability of homeowner maintenance
- Requires permeable soils (FC more that 0.5 in/hr)

Definition

A conventional infiltration trench is a shallow, excavated trench that has been backfilled with stone to create an underground reservoir. Stormwater runoff diverted into the trench gradually exfiltrates from the bottom of the trench into the subsoil and eventually into the water table.

Enhanced infiltration trenches have extensive pretreatment systems to remove sediment and oil. They require on-site geotechnical investigations to determine appropriate design and location.

No. 12 Conventional Infiltration Trench

DA: 1 to 5 Acres

Pollutant Removal: TSS =90 TP = 60 TN = 50 (Projected)

Longevity: Projected to be moderate (50% failure in first five years)

Key design factors:

- Field verification of soil permeability
- Helps to augment groundwater recharge
- Provides volume control

No. 13 Enhanced Infiltration Trench

DA: 1 to 5 Acres

Pollutant Removal: TSS = 90 TP = 60 TN = 50 (Projected)

Longevity: Projected to be moderate

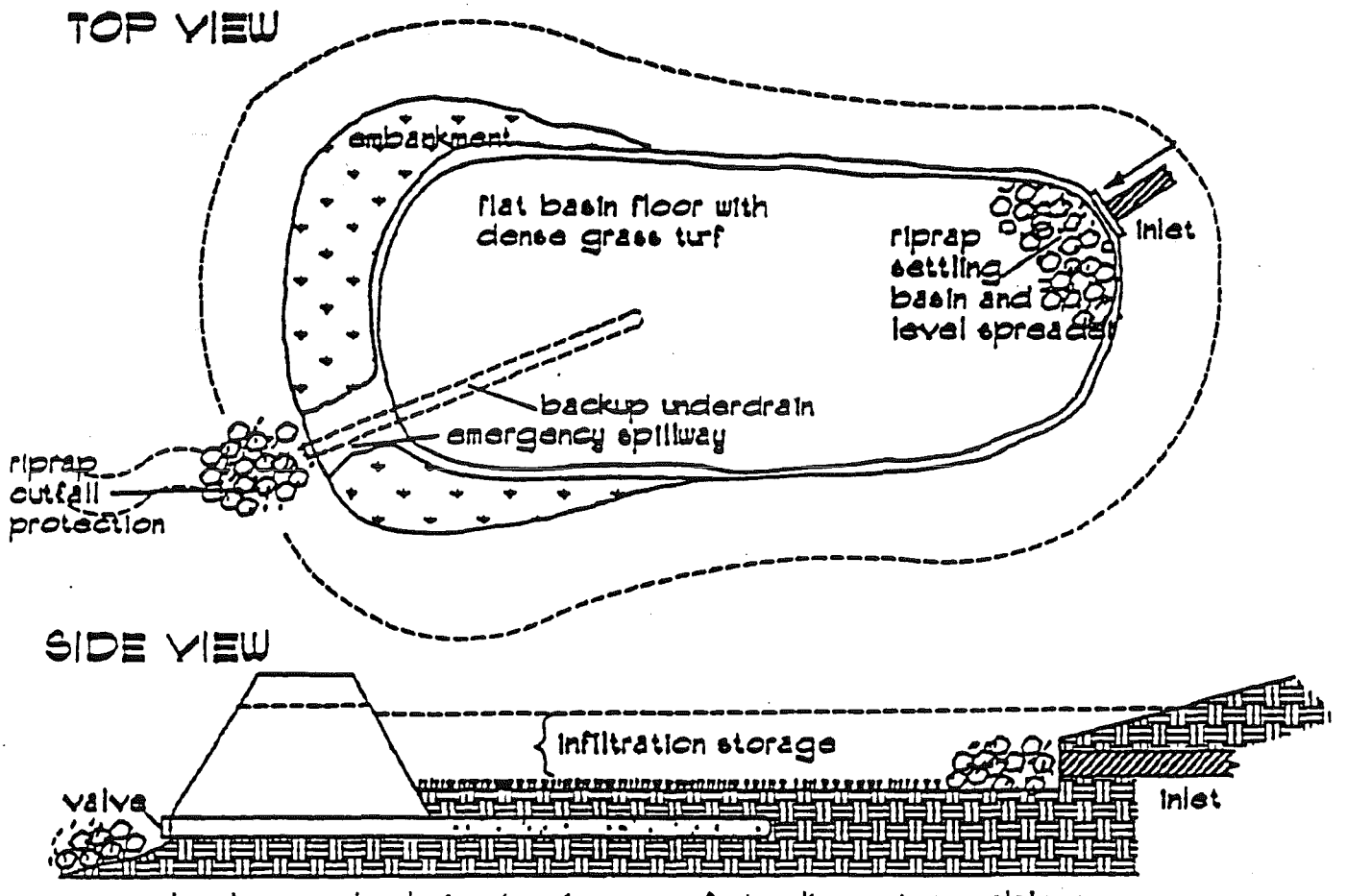
Key design factors:

- Redundant pretreatment using setting basin, sump pit, sand-layer, filter fabric barrier, grassed swale, clean bank run gravel, and test wells

Notes:

- Requires field confirmation of acceptable soil permeability rates

SCHEMATIC OF AN INFILTRATION BASIN



back-up underdrain pipe in case of standing water problems

No. 14 Infiltration Basin

DA: 2 to 5 Acres (NO Baseflow)

Pollutant Removal: TSS = 90 TP = 60 TN = 50 (Projected)

Longevity: Poor-up to 100% failure in first five years (1)
25% to 50% failure in permeable soils (2)

Key Design Factors:

- Off-line design
- Backup underdrains
- Sand layer
- Forebay
- Flow spreaders
- Shallow basin depths

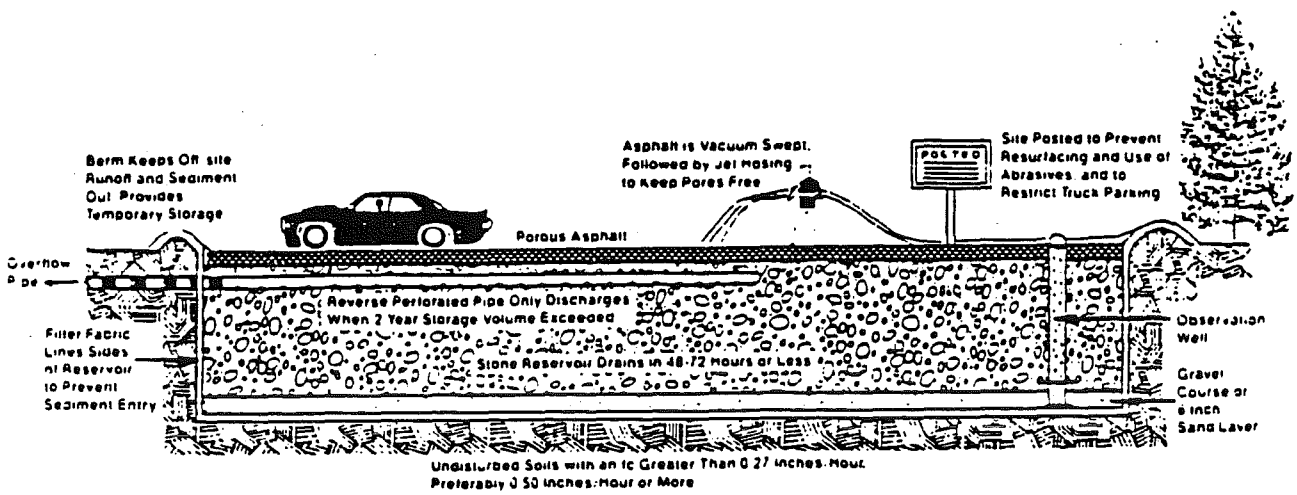
Notes:

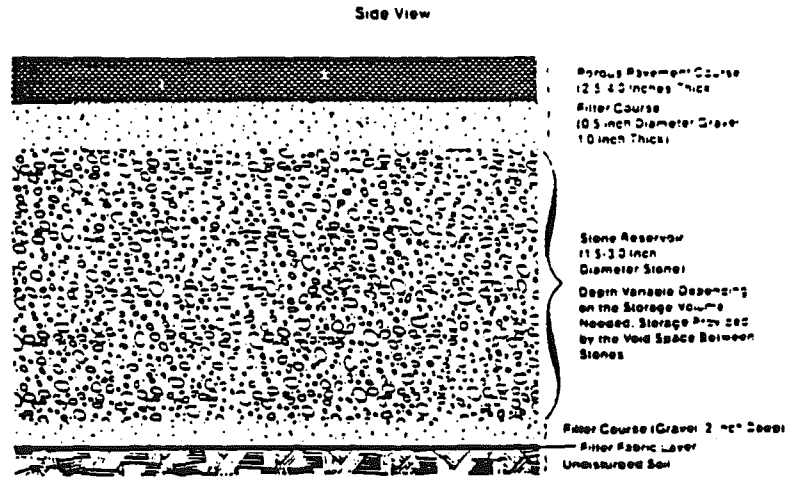
- Not a recommended BMP

Definition

Porous pavement is an alternative to conventional pavement whereby runoff is diverted through a porous asphalt layer and into an underground stone reservoir. The stored runoff then gradually infiltrates into the subsoil.

Schematic Design of a Porous Pavement System





Source: Schueler, 1987

No. 15 Porous Pavement

DA: 10 acres or less of low intensity

Pollutant Removal: TSS = 90 TP = 60 TN = 80

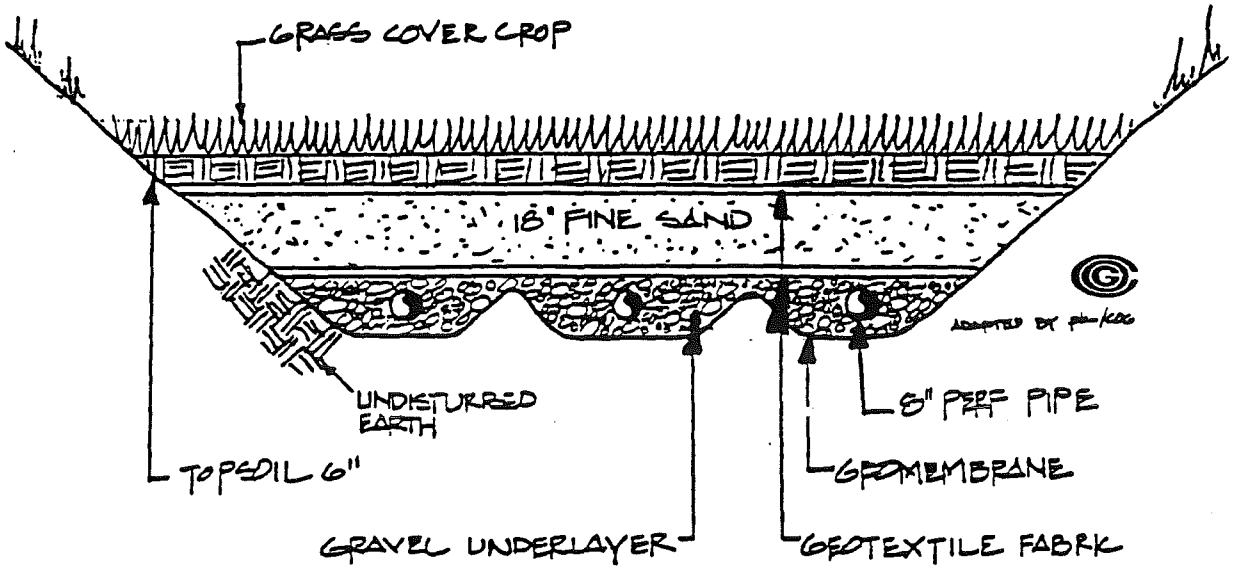
Longevity: Poor - up to 75% failure in five years some designers cite better results.

Key design factors:

- Vacuum sweeping
- Construction stage sediment control
- Overflow inlets
- Careful geotechnical analysis

Notes:

- Snow removal and resurfacing practices can compromise system


GRASS COVER CROP
18" FINE SAND
UNDISTURBED EARTH
TOPSOIL 6"
GRAVEL UNDERLAYER
6" PERF PIPE
GEOMEMBRANE
GEOTEXTILE FABRIC

No. 16 Sand Filters

DA: 1 to 50 acres, depending on design

Pollutant Removal: TSS = 85 TP = 50 TN = 35

Longevity: Excellent 20 + Years

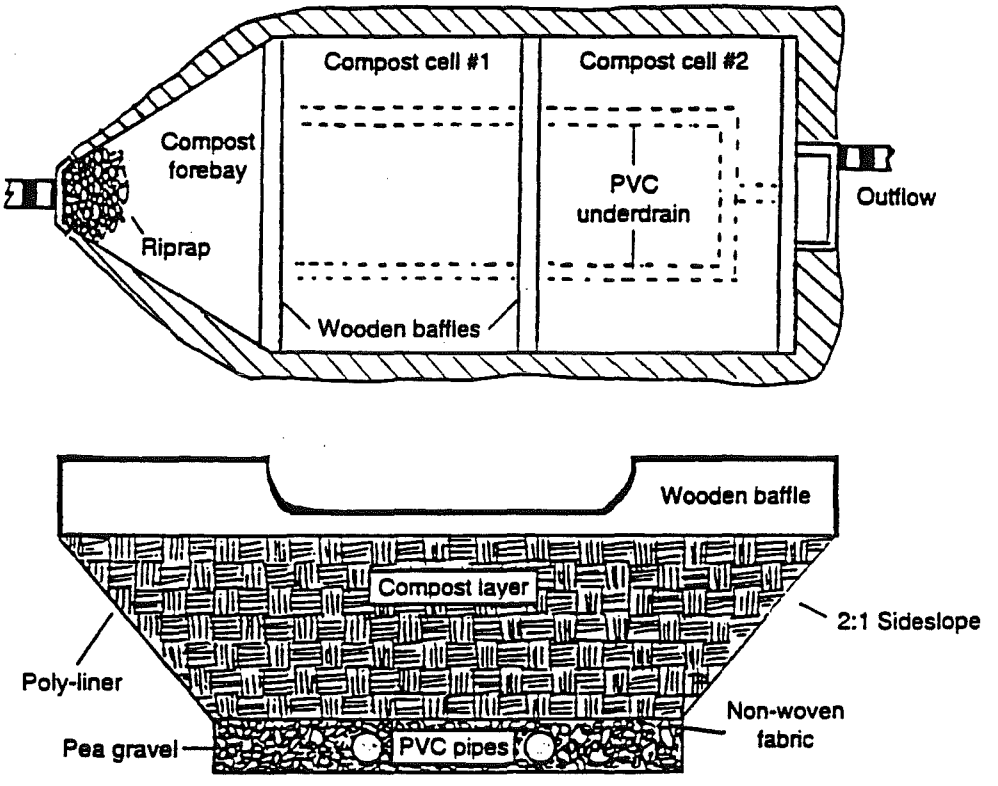
Key Design Factors:

- Off-line design
- Flow splitters
- Pretreatment (dry or wet sedimentation)
- Grass cover crop

Notes:

- Require frequent maintenance, and can be unsightly

Figure 3.1: Plan view and cross-section of the leaf compost treatment system ***(adapted from Stewart, 1992)***



No. 17 Peat sand and compost filters

DA: 5 to 50 Acres

Pollutant removal: TSS = 90 TP = 40-70 TN = 20-50 (limited monitoring)

Longevity: projected to be excellent

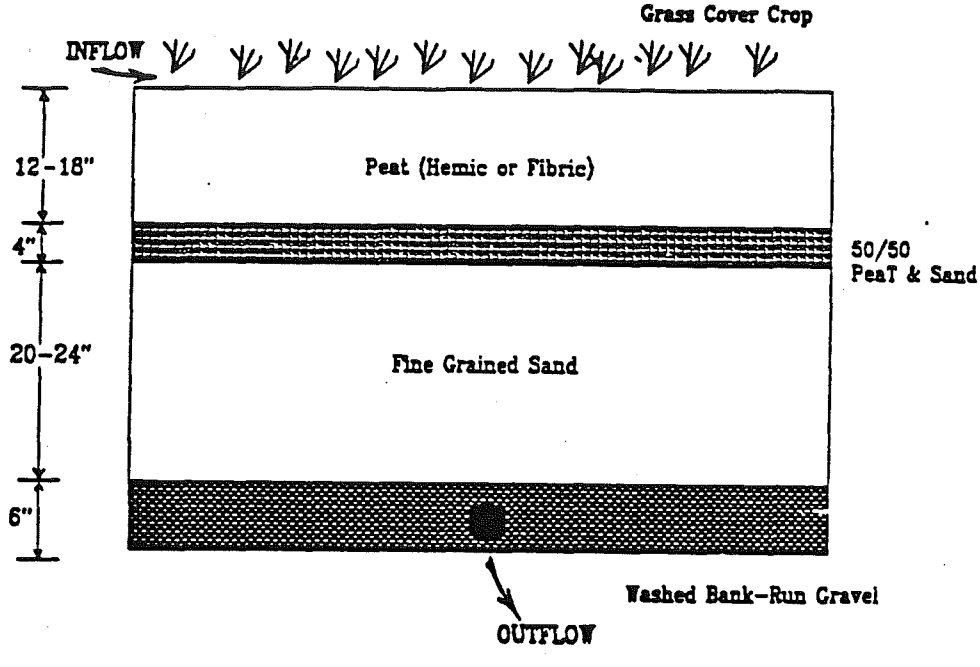
Key design factors:

- Selection of appropriate peat limestone layer or compost
- Winter cut-off
- Grass cover crop
- Peat and compost replacement cycle

Notes:

- Relatively untested practice in most areas of country, some leaching of soluble nutrients from organic media. The compost system is a proprietary technology.

Peat-Sand Filters: A promising new retrofit technique, whose primary application up to this point has been for tertiary wastewater treatment design. The general concept for this technique is to obtain higher percent removals of nutrients, especially phosphorus, through plant up-take and ion exchange with the organics present in peat.

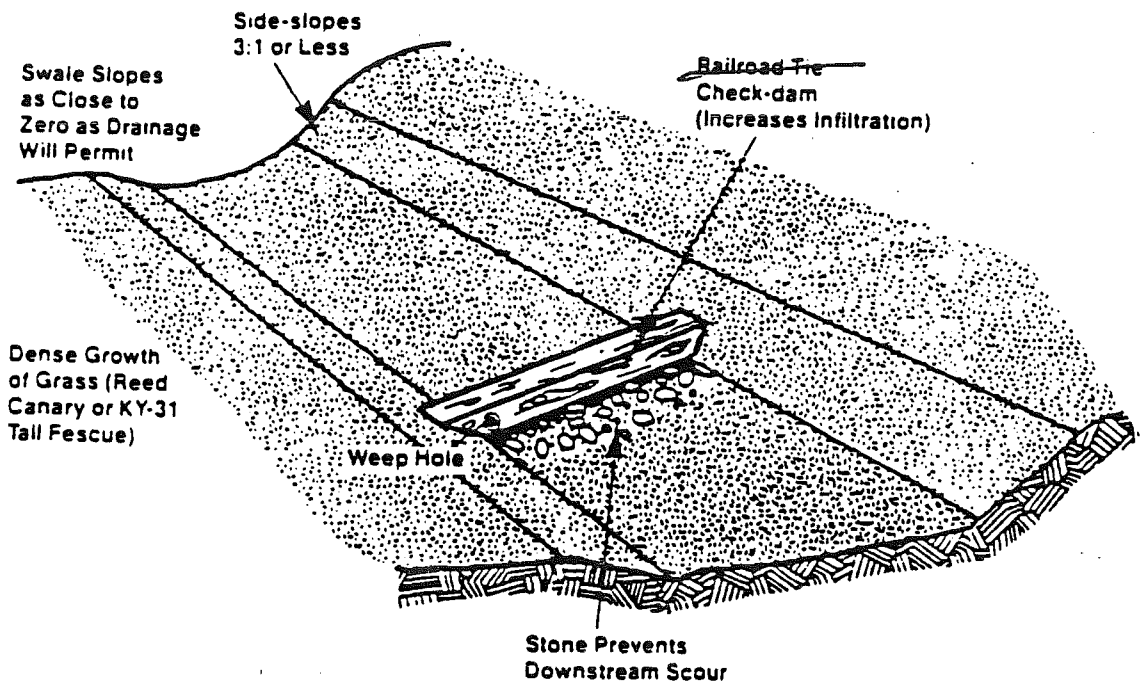


Definition

Conventional grassed swales are earthen conveyance systems in which pollutants are removed from urban stormwater by filtration through grass and infiltration through soil.

Enhanced grassed swales, or biofilters, utilize check dams and wide depression to increase runoff storage and promote greater settling of pollutants.

Schematic Design of an Enhanced Grassed Swale



Source: Schueler, 1987.

Filtering Systems:

No. 18 Grassed Swales

DA: 5 acres of less

Pollutant removal: TSS = 70 TP = 40 TN = 25
(variable depending on site conditions)

Longevity: Projected to be Moderate

Key Design Factors:

- Check dams
- Basic dimension to convey 10 year QP
- Dense grass cover
- Low slopes
- Permeable soils

Notes:

- Effective when coupled with pocket wetlands or other BMPs
- Some homeowner acceptance problems (standing water)

No. 19 Biofilters

DA: up to 10 acres, but usually less

Pollutant removal: TSS 80% TP 45% TN 25% (limited monitoring)

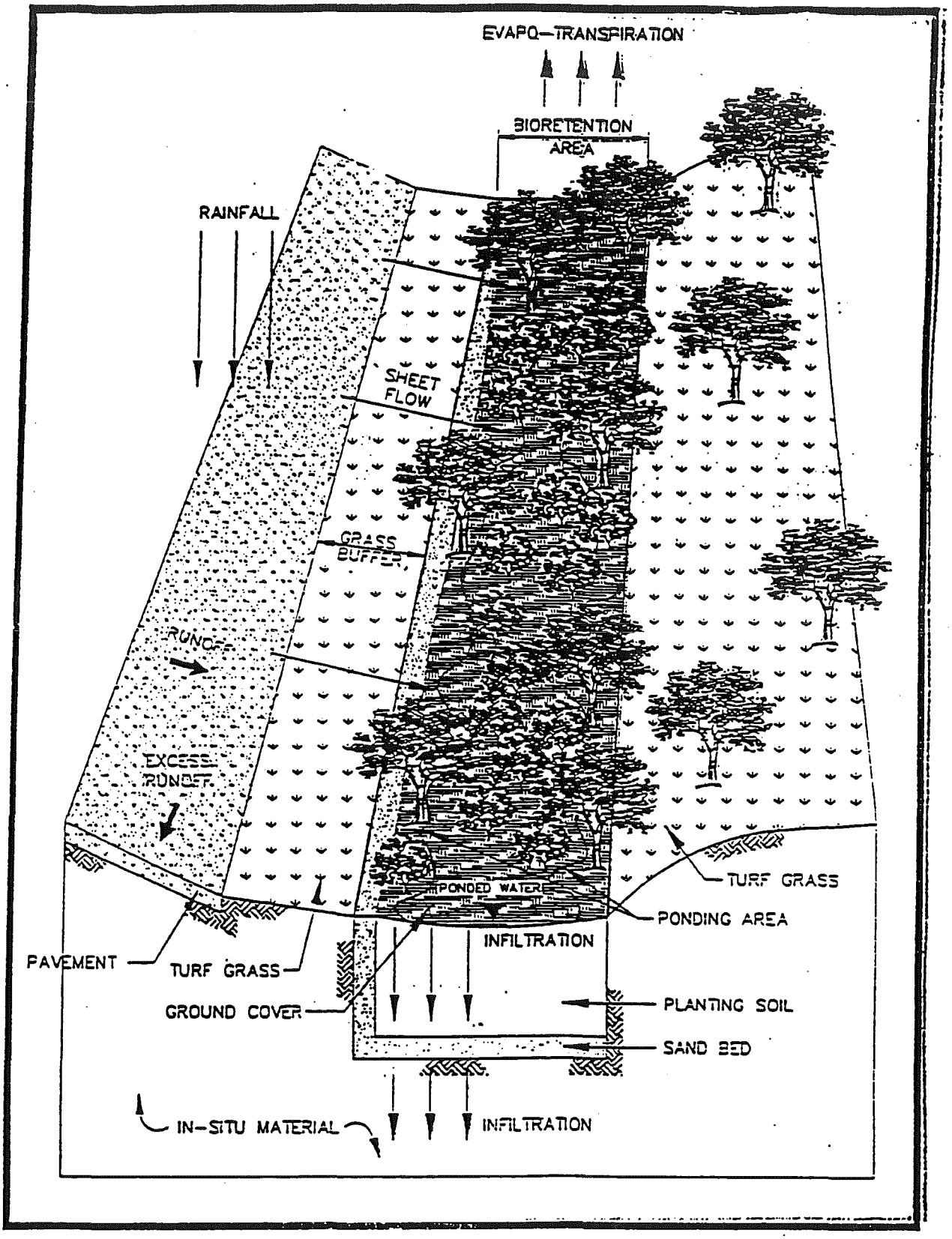
Longevity: generally good with routine maintenance

Key Design Factors:

- Essentially a swale designed explicitly for WQ
- Checkdams
- Underdrains
- Swale dimensions set by 6 month or 1 year storm
- Can be a made-soil system
- Grass height (mowing) very important
- Off-line design promising

Notes:

- Need to define water table
- Gentle side slopes
- Maintenance requirements not always recognized
- Effect of road salts/inundation on grasses


EVAPO—TRANSPIRATION
BIORETENTION AREA
RAINFALL
SHEET FLOW
GRASS BUFFER
RUNOFF
EXCESS RUNOFF
PONDED WATER
TURF GRASS
PONDING AREA
INFILTRATION
PAVEMENT
TURF GRASS
GROUND COVER
PLANTING SOIL
SAND BED
IN-SITU MATERIAL
INFILTRATION

Filtering Systems:

No. 20 Bioretention

DA: Up to one acre impervious area each

Pollutant Removal: TSS 90% TP 50% TN 25% (projected, but not yet monitored)

Longevity: Projected to be high

Key Design Factors:

- Incorporate into mandatory commercial open space
- Combines swale, and filter, infiltration, shallow ponding and vegetative pumping into one BMP
- Traffic island, parking lot perimeter or off-line swale
- Careful selection of trees, shrubs, grass, and mulch

Notes:

- Maintained by commercial landscapers
- Relatively cheap to construct
- Does not consume excess land

Definition

Filter strips are vegetated sections of land designed to accept runoff as overland sheet flow from upstream development. They may adopt any natural vegetated form, from grassy meadow to small forest. The dense vegetative cover facilities pollutant removal. Filter strips cannot treat high velocity flows; therefore, they have generally been recommended for use in agriculture and low density development.

Filter strips differ from natural buffers in that strips are not "natural"; rather, they are designed and constructed specifically for the purpose of pollutant removal. A filter strip can also be an enhanced natural buffer, however, whereby the removal capability of the natural buffer is improved through engineering and maintenance activities such as land grading or the installation of a level spreader.

Filter strips also differ from grassed swales in that swale are concave vegetated conveyance systems, whereas filter strips have fairly level surface.

No. 21 Vegetated Filter Strips

DA: 5 acres or less of primarily pervious area

Pollutant Removal: TSS = 65% TP = ? TN = ?

Longevity: Mixed, up to 50% failure in first five years without maintenance (for Ag strips)

Key Design Factors:

- Low slopes
- Grass strips leading to wider forested strips
- Unconcentrated flow (no more than 75 ft I, 150 ft P)
- Level spreaders

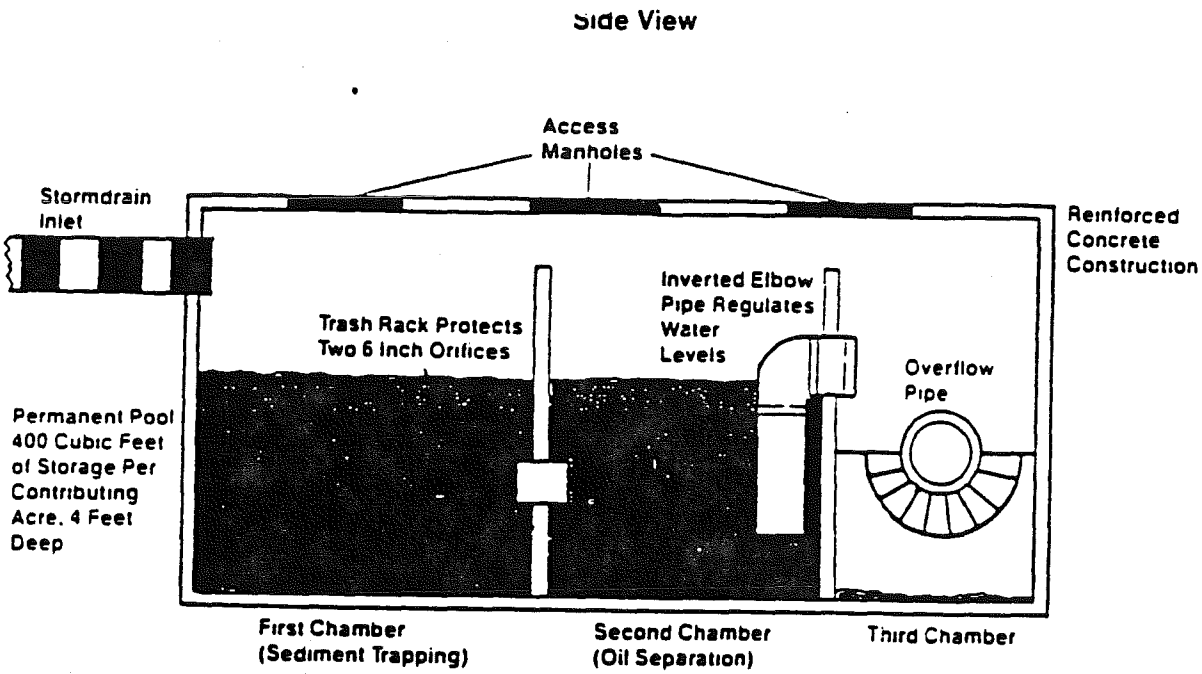
Notes:

- Best when linked to riparian buffer system

Definition

A water quality is a three-stage underground retention system designed to remove heavy particulates and absorb hydrocarbons from stormwater runoff. Also known as an oil/girt separator.

Schematic Design of a Water Quality Inlet/Oil Girt Separator



Source: Schueler, 1987.

No. 22 Oil / Girt Separators (Water Quality Inlet)

DA: 2 acres or less

Pollutant Removal: TSS = 10 TP = 0 TN = 0

Longevity: Excellent (2% failure in first five years)

Key Design Factors:

- Regular cleanout
- Off-line design
- Sand layers
- Adsorptive surfaces

Notes:

- Lack of acceptable methods for residual disposal. Trapped residuals enriched with hydrocarbons and toxics, high unit maintenance cost.

Recommended BMPs -- Long lived high performers

Wet pond

Wet ED pond

Multiple pond systems

Shallow marsh system

ED wetland system

Pond/marsh system

Dry well

Enhanced infiltration trench

Sand filter

Biofilter

BMPs Recommended with Caveats (*)

Micropool ED pond--(p)

Pocket wetland--(p)

Conventional infiltration trench (r) (m)

Porous pavement (c)

Peat sand filter (p)(m)

Grassed swales

Bioretention systems-(p)

Compost filter system (m) ©

(*) caveats:
(m) may require frequent maintenance,
(c) require sophisticated design contractors
(p) have little or no actual performance monitoring data, or
(r) significant site restrictions

Table 1

A comparative assessment of the effectiveness of current urban best management practices (MWCOG, 1992)

URBAN BMP OPTIONS*	RELIABILITY FOR POLLUTANT REMOVAL	LONGEVITY*	APPLICABLE TO MOST DEVELOPMENTS	WILDLIFE HABITAT POTENTIAL	ENVIRONMENTAL CONCERNS	COMPARATIVE COST	SPECIAL CONSIDERATIONS
STORMWATER WETLANDS	Moderate to high depending on design	20+ years expected	Applicable to most sites if land is available	High	Stream warming; natural wetland alternation	Marginally higher than wetland alteration	Recommended with design improvements and with the use of micropool and wetlands
EXTENDED DETENTION PONDS	Moderate, but not always reliable	20+ years, but frequent clogging and short detention common.	Widely applicable, but requires at least 10 acres of drainage area	Moderate	Possible stream warming and habitat destruction	Lowest cost alternative in size range	Recommended with design improvements and with the use of micropool and wetlands
WET PONDS	Moderate to high	20 + years	Widely applicable, but requires drainage area of greater than 2 acres	Moderate to high	Possible stream warming, trophic shifts, habitat	Moderate to high compared to conventional	Recommended with careful site evaluations
MULTIPLE POND SYSTEMS	Moderate to high; redundancy increases reliability	20+ years	Widely applicable	Moderate to high	Selection of appropriate pond option minimize overall environmental impact	Most expensive pond option	Recommended
INFILTRATION TRENCHES	Presumed moderate	50% failure rate within 5 years	Highly restricted (soils, ground water, slope, area, sediment input)	Low	Slight risk of ground water contamination	Cost-effected on smaller sites. Rehab costs can be considerable	Recommended with pretreatment and geotechnical evaluation
INFILTRATION BASINS	Presumed moderate, if working	60- 100% failure rate within five years	Highly restricted (see infiltration trench)	Low to moderate	Slight risk of ground water contamination	Construction cost moderate, but rehab cost high	Not widely recommended until longevity is improved
POROUS PAVEMENT	High, if working	75% within five years	Extremely restricted (traffic, soils, ground water, slope, area, sediment input)	Low	Possible ground water impacts; uncontrolled runoff	Cost-effective compared to conventional asphalt when working properly	Recommended in highly restricted applications with careful construction and effective maintenance.
SAND FILTERS	Moderate to high	20 + years	Applicable for smaller developments	Low	Minor	Comparatively high construction costs and frequent maintenance	Recommended, with local demonstration
GRASSED SWALES	Low to moderate, but unreliable	20 + Years	Low density development and roads	Low	Minor	Low compared to curb and gutter	Recommended, with checkdams, as one element of a BMP system
FILTER STRIPS	Unreliable in urban settings	Unknown, but may be limited	Restricted to low density areas	Moderate if forested	Minor	Low	Recommended as one element of a BMP system
WATER QUALITY INLETS	Presumed low	20 + years	Small, highly impervious catchments (2<acres)	Low	Resuspension of hydrocarbon loadings. Disposal of hydrocarbon and toxic residuals	High. Compared to trenches and sand filters	Not currently recommended as a primary BMP option

Key factors to Enhance BMP Performance

1. Redundant treatment mechanism
2. Runoff pretreatment
3. Off-line design
4. Long flow path through BMP (time or distance)
5. 90% of annual runoff volume capture
6. High surface area to volume ratio
7. Accurate geotechnical data
8. Rapid establishment of dense vegetative cover
9. Frequent cleanout
10. Appropriate contributing area
11. Protection of BMP during site construction

Preparing an effective BMP plan for the site

Six elements of BMP
Runoff frequency spectrum
Thirteen steps to select and design BMPs.

13 Steps for Designing a Site Stormwater Quality Management Plan

The following step-by-step process is recommended when designing a stormwater quality management plan for a site.

Step 1: Evaluate the Site

- Research soil conditions.
- Identify surface and groundwater features that affect or could be affected by the site
- Determine the capacity of the receiving system (natural or manmade) for the site.
- Consider existing site opportunities/constraints.
- Other factors to consider include climate and location of utilities.

Step 2: Check Current Requirements

- Local water quality design requirements.
- Regulations for stormwater quality control.
- Restrictions in environmental zones, greenway zones, and plan districts.
- State or federal regulations regarding proposed site development, such as dredge and fill permits, NPDES construction site permits, etc.
- Other known problems that could affect or be effected by the project.
- Reports, tests or calculations, such as infiltration tests, required for site development.

Step 3: Overall Site Design

- Involve all members of the design team to collaborate on identifying opportunities to reduce and improve the quality of site stormwater runoff.
- Design sites to preserve and minimize disturbance to existing soils, vegetation and water quality sensitive areas.

Consider:

- Innovative approaches to design of facilities and site to limit and/or cover impervious areas.
- Facilities or designs that promote water reuse on site.
- Reducing impervious areas through cluster development and roof top parking.
- Maximizing vegetation canopy over impervious area, especially using large trees.

- Preserving tree canopy overhang from outside the site boundaries.
- Providing effective wind and rain interceptive canopy with coniferous tree forms.
- Creating and maintaining vegetative areas of grasses, wildflowers, shrubs and other vegetation.

Step 4: Characterize the Runoff -- Flow Volumes and Peaks, Water Quality

Consider:

- Upstream activities currently impacting the site.
- Upstream activities likely to impact the site in the future, considering planned land use.
- Planned land use for the site itself.
- Temperature and seasonal fluctuations for the area since this will affect the temperature of runoff entering the facility and the density of vegetation required.

Step 5: Consider and Plan for Source Controls

- Keep pollutants out of stormwater runoff in the first place.
- Most cost-effective way of controlling stormwater pollution on site.
- Source controls include covers over outdoor storage and work areas or berms to contain or divert runoff from material storage areas.

Step 6: Evaluate Possible Facilities

- Consider pollutant removal effectiveness to make a preliminary determination of which facilities are most suited to your project conditions.
- Evaluate site factors such as steep slopes and high sediment loads that may severely limit your options in selecting a stormwater quality facility.
- Plan to implement erosion and sediment controls on the site to reduce the amount of sediments in the site runoff.
- Consider combining facilities to enhance pollutant removal.
- Consider an offline facility.
- Consider additional secondary benefits such as flood control, fish and wildlife habitat enhancement, recreational uses, and meeting landscaping requirements.
- Considering expected lifespan of facilities and maintenance requirements.

Step 7: Prepare Preliminary Facility Design

- Design to capture and treat 80 to 90 percent of the total long-term runoff volume from small, more frequent storms.
- Many options for providing stormwater facilities dispersed throughout a development, or a few regional facilities.
- Designs can be a mix of storage and flow-through capacity (or infiltration rate) to achieve the combination that works best for the site.
- Sites can be designed with natural areas and less impervious areas, reducing stormwater runoff volumes and flow rates.

Step 8: Prepare Preliminary Landscaping Plan

- Plant materials commonly used for stormwater quality facilities are generally grasses or plants associated with native wetlands.
- Proper plant section and site preparation are crucial to plant establishment.
- Vegetation should be planted during favorable planting and seeding seasons.
- Consider site preparation, irrigation, mulching, and weed and pest control during their period of establishment.

Step 9: Prepare and Submit the Conceptual Site Plan to Reviewing Agency

- Complete the conceptual site plan and needed site reports and submit them for approval.
- Include the preliminary design calculations to demonstrate that the facilities you have selected will meet the applicable water quality, standards and if appropriate quantity standards.

Step 10: Complete the Facility Design

- Complete the final plans and permit items.
- Make sure that all other design criteria for that facility are met, including inlet and outlet size, landscaping, construction techniques, and maintenance needs.
- Ensure that your design addresses maintenance access and safety issues.

Step 11: Prepare a Maintenance Plan and Obtain Permits

- Prepare a maintenance plan that out lines the scope of activities, schedule, and responsible parties for inspecting and maintaining the facility.

- Vegetation, sediment management, access, and safety are primary issues.
- Plantings many require a number of control practices during their period of establishments.
- Avoid using fertilizers, herbicides or pesticides for vegetation maintenance or insect control.
- Make provisions for testing of sediments removed during maintenance activities.

Step 12: Submit Final Plan and Maintenance Plan and Obtain Permits

- Submit the final documents to agencies for final approval and permitting.
- Include design calculations to clearly demonstrate that water quality and quantity requirements are satisfied.
- Calculations can include sizing and flow calculations, hydrology, soils, and soils, and slope impacts on design and in general how the design will meet the requirements specified for the site.
- Plans are a licensed professional should certify specifications.

Step 13: Obtain Permits and Notify Agencies/Residents

- Obtain permit for the project.
- Before beginning construction, notify all appropriate agencies and neighboring residents.

1. Runoff Attenuation
2. Runoff Conveyance
3. Runoff Pretreatment
4. Runoff Treatment
5. System Maintenance
6. Secondary Environmental Impacts

1. Runoff Attenuation

Objective: Reduced the generation of urban stormwater from the site.

Techniques:
Reduce site imperviousness
Disconnect imperviousness
Utilize cluster development
Reserve environmental areas

Examples:
Narrower residential roads widths
Shorter rod lengths/networks
Cul-de-sac donuts
Smaller, angled parking stalls
Stream buffer requirements
Shared driveways
Flexible lot sizes
Disconnecting roof leaders

Imperviousness costs money!

2. Runoff Conveyance

Objectives: Safely deliver stormwater to BMP, minimize disruption to natural channels, avoid storm drain enclosures, and promote filtering and infiltration.

Techniques:
- grassed swales rather than curb/gutter
- parallel pipe systems
- avoid hard channels
- off-line vs. on-line design

3. Runoff Pre-Treatment

Objectives: Trap or capture coarse sediments before they enter the treatments system.

Locate where sediments can be moved and disposed in a convenient manner.

Techniques:
- sediment forebay or micropool
- grass filter strips
- catch basin treatment
- sedimentation chamber

3. Runoff Treatment

Objective: Provide treatment at multiple points across the runoff frequency spectrum.

Techniques:
detention/retention (ponds)
shallow wetlands
infiltration
filtering

Control Points:
1) water quality volume
2) control of frequent floods
3) control of bankfull floods
4) control of overbank floods

5. System Maintenance

Objectives: Realistic plan to maintain the long-term performance of the entire BMP system.

Techniques:
sediment removal or containment
Sediment disposal technique or method
Easy access to BMP
Frequent inspection
Maintenance of vegetative systems

6. Avoid Secondary Environmental Impacts

Objectives: Adjust design to minimize any secondary stream impacts created by BMPs.

Reestablish natural stream conditions in the shortest possible distance from BMP outfall.

Comply with applicable state/federal permit requirements.

Examples: stream warming (ponds/wetlands)
groundwater contamination (infiltration)
forest/wetland alteration (all)
safety
nuisances

BMP Selection Factors

Seven groups of factors are important:

1.) Watershed management objective(s)
2.) Site conditions
3.) Regional variations
4.) Local/State approval process
5.) Client needs
6.) Contractor expertise
7.) Maintenance capability

The best BMP system effectively addresses each group of factors.

No simple cookbook exists to select most appropriate BMP system for a particular site.

Selection is both a process of elimination and a process of combination.

BMP Selection Factors

1. Watershed Management Objectives

   a. nutrient removal
   b. stream bank protection
   c. maintain stream biodiversity
   d. bacteria (shellfish protection)
   e. aquatic toxicity (trace metals/hydrocarbons)
   f. flood protection
   g. sedimentation
   h. protection of watershed ecological services
   i. groundwater recharge

2. Site Factors

   a. contributing drainage area
   b. land use
   c. soils
   d. slope, topography
   e. available space
   f. receiving water sensitivity
   g. environmental permit issues
   h. water balance
   i. type of development

3. BMP factors

   a. pollutant removal rate
   b. future maintenance burden
   c. possible environmental impacts
   d. ability to provide stormwater management

4. Local/State Design Practice

   a. maintenance tolerance
   b. water quality design storm
   c. stormwater management design storm(s)
   d. subdivision and conveyance codes
   e. prior experience with similar BMPs
   f. comfort with experimental BMPs

5. Regional Factors

   a. rainfall frequency, volume, seasonally
   b. snowfall and winter temperature
   c. evaporation rate
   d. vegetative cover
   e. land prices

6. Client factors

   a. construction cost
   b. developable land consumed
   c. construction cost
   d. will it get permit/approval faster?
   e. developable land consumed

7. Contractor expertise

8. Maintenance capability of owner

TABLE 1-1

Selected Requirements and Pollutant Removal Effectiveness for Stormwater Quality Facilities[1]

STORMWATER TYPES	AREA SERVED (acres) 0 5 10 15 20 25 30 35 40 45 50+	INSPECTION & MAINTENANCE: Short Term[2]	INSPECTION & MAINTENANCE: Long Term	POLLUTANT REMOVAL EFFECTIVENESS[3]: Sediments	Nutrients	Bacteria & Viruses	Heavy Metals	BOD	Oil & Grease	Floatables
FILTERS (chapt. 2)										
Vegetated Swale	0–15	●	◍	●	○	NA	◍	◍	●	◍
Vegetative Filter Strip	0–5	●	◍	●	○	NA	◍	◍	●	◍
Large Sand Filter (e g , Basin)	0–50+	◍	◍	●	◍	NA	◍	◍	●	●
Small Sand Filter (e g , Inlet)	0–5	◍	◍	●	◍	NA	◍	◍	●	●
PONDS (chapt. 3)										
Wet Pond	5–20	◍	◍	●	◍	◍	◍	◍	◍	●
Dry Extended Detention Pond	10–50+	◍	◍	●	○	NA	◍	◍	○	◍
Wet Extended Detention Pond	10–50+	○	○	●	◍	NA	◐	●	◍	●
MARSHES (chapt. 4)										
Shallow Marsh	25–50+	●	○	●	●	○	●	●	NA	◐
Pond/Marsh System	25–50+	●	◍	●	●	○	●	●	NA	◐
Ext. Detention Marsh	10–50+	◍	○	●	●	○	●	●	NA	◐

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TABLE 1-1
Continued

STORMWATER TYPES	AREA SERVED (acres) 0 5 10 15 20 25 30 35 40 45 50+	INSPECTION & MAINTENANCE: Short Term [2]	INSPECTION & MAINTENANCE: Long Term	POLLUTANT REMOVAL EFFECTIVENESS [3]: Sediments	Nutrients	Bacteria & Viruses	Heavy Metals	BOD	Oil & Grease	Floatables
INFILTRATION (chapt. 5)										
Infiltration Trench		◐	◐	●	◐ [4]	●	●	●	●	●
Infiltration Basin		◐	◐	●	◐ [4]	●	●	●	●	●
Concrete Grid Pavement		◐	◐	●	◐ [4]	●	●	●	●	●
STRUCTURAL STORM SEWER DEVICES (chapt. 6)										
Trapped Catch Basin	(1 acre)	○	●	◐	○	NA	○	NA	NA	●
Manholes Sediment Trap	(5 acres)	○	●	◐	○	NA	○	○	NA	●
Oil/Water Separator	(1 acre)	○	●	○	○	NA	○	◐	●	●
Underground Det. Vault/Tank	(5 acres)	○	●	◐	○	NA	○	NA	◐	●

1 This table presents a brief overview, refer to Chapters 2-6 for detailed information on each facility type

2 Maintenance requirements for 1-2 years following construction, generally necessary for establishment of vegetation

3 Projected effectiveness, assuming proper design, construction, and routine maintenance See Chapters 2 through 6 and Appendix C for estimated percentage removals and associated background information

4 In general, infiltration facilities have a high pollutant removal capability for particulate pollutants and moderate removal for soluble pollutants

○ low or none ◐ medium ● high
NA no published data currently available

			PARCEL	APPL#	CERT#	PRIORITY
673-000 00 00	40.00	AF	000150 WORLD PROP			4.5
674-000 00 00	441.00	AF	000150 WORLD PROP			4.5
675-000 00 00	14.00	AF	000158 DAVIS VERN			4.5
676-679 00 01	4.41	AF	000046 SOARES DIA	17-430-08		4.5
676-679 00 02	4.50	AF	000043 GREENHALGH	17-371-03		4.5
676-679 00 03	4.50	AF	000062 MOSS MICHA	17-380-10		4.5
676-679 00 04	13.50	AF	000044 GREENHALGH	17-430-09		4.5
676-679 00 05	99.81	AF	000060 HAWKINS JI	17-430-01		4.5
676-679 00 06	12.69	AF	000138 MITCHELL C	17-430-02		4.5
676-679 00 07	4.50	AF	000073 LEHMAN ROB	17-380-11		4.5
676-679 00 08	4.37	AF	000099 SCARBOROUG	17-371-04		4.5
676-679 00 09	0.31	AF	001000 SPARKS/SPP	AFFIDAVIT		4.5
676-679 00 10	4.50	AF	000145 RINI MICHA	17-380-09		4.5
676-679 00 11	4.46	AF	000111 STEIGER WO	17-380-05		4.5
676-679 00 12	2.00	AF	000101 HUGHES SAN	17-372-05		4.5
676-679 00 13	1.50	AF	000125 WASH/EFF			4.5
676-679 00 14	4.73	AF	000111 STEIGER WO	17-380-04		4.5
676-679 00 15	4.50	AF	000228 RENTSCH EL	17-380-08		4.5
676-679 00 16	4.50	AF	000229 MCINTYRE T	17-371-01		4.5
676-679 00 17	4.46	AF	000230 OBER CRAIG	17-371-02		4.5
676-679 00 18	1.23	AF	000110 ROSS JAMES	17-371-05		4.5
676-679 00 19	4.23	AF	000231 FERGUSON L	17-372-06		4.5
676-679 00 20	27.00	AF	000233 WOOLMAN MA	45-280-34*		4.5
676-679 00 21	4.45	AF	000016 SJORK LIND	17-380-06		4.5
676-679 00 22	4.46	AF	000237 JOHNSON CA	17-380-07		4.5

					PARCEL	APPL#	CERT#	PRIORITY
676-679 00 23	10.15	AF	000338	BOOHER MIC	17-372-05			4.5
676-679 00 24	10.15	AF	000125	WASH/EPF		52317		4.5
680-683 00 01	203.76	AF	000049	HANSON AND	17-330-54			4.5
680-683 00 02	96.75	AF	000049	HANSON AND	17-342-44			4.5
680-683 00 03	6.48	AF	000535	FERGUSON E	17-330-09			4.5
680-683 00 04	4.50	AF	000539	COMBS MICH	17-330-08			4.5
680-683 00 05	4.50	AF	000543	CAZDEN BAR	17-330-07			4.5
680-683 00 06	4.50	AF	000544	MENA CYNTH	17-330-06			4.5
680-683 00 07	4.50	AF	000554	JONES BARB	17-330-05			4.5
680-683 00 08	4.50	AF	000557	ROBINSON V	17-330-04			4.5
680-683 00 09	4.50	AF	000568	MUNNS WILL	17-330-03			4.5
680-683 00 10	6.62	AF	000569	STOLZ JOHN	17-330-22			4.5
680-683 00 11	4.92	AF	000049	HANSON AND	17-330-15			4.5
680-683 00 12	3.45	AF	000570	INGALLS DE	17-430-03			4.5
680-683 00 13	1.94	AF	000571	JAIME MART	17-430-04			4.5
680-683 00 14	0.36	AF	000138	MITCHELL C	17-430-05			4.5
680-683 00 15	2.66	AF	000225	WALTERS CA	17-430-06			4.5
680-683 00 16	0.63	AF	000223	WALTERS CA	17-430-07			4.5
680-683 00 17	4.41	AF	000335	WALTERS CA	17-342-41			4.5
680-683 00 18	14.84	AF	000202	NDOT	HWY 395			4.5
680-683 00 19	3.44	AF	000675	GILDESGARD	17-430-08			4.5
680-683 00 20	59.94	AF	000049	HANSON AND	17-330-54	52391P	13948	4.5
680-683 00 21	3.00	AF	001353	WARREN DAN	17-330-15			4.5
684-686 00 01	9.27	AF	000004	JURMAN END	17-310-14			4.5
684-686 00 02	18.09	AF	000004	PRIEBE CON	17-320-14			4.5

					PARCEL	APPL#	CERT#	PRIORITY
684-686 00 03	4.82	AF	000037	GARRETT C	17-310-04			4.5
684-686 00 04	4.82	AF	000140	SULUJIAN J	45-221-01			4.5
684-686 00 05	5.63	AF	000069	LACA LOIS	17-310-02			4.5
684-686 00 06	5.49	AF	000075	LUGASKI TH	17-310-12			4.5
684-686 00 07	4.91	AF	000086	REED JAMES	17-310-06			4.5
684-686 00 08	91.31	AF	000010	CANTLON A	17-320-04			4.5
684-686 00 09	9.27	AF	000130	MURPHY MAR	17-310-13			4.5
684-686 00 10	81.00	AF	000103	SHELHAMER	17-320-02			4.5
684-686 00 11	4.73	AF	000069	LACA LOIS	17-310-05			4.5
684-686 00 12	35.46	AF	000107	SIMONS WIL	17-310-18			4.5
684-686 00 13	35.46	AF	000106	SIMONS FER	17-310-17			4.5
684-686 00 14	7.92	AF	000136	BROWN CLYD	17-310-10			4.5
684-686 00 20	4.59	AF	000240	KEITH HUGH	D#1496186			4.5
684-686 00 21	0.59	AF	000241	MATASSA TH	45-222-08			4.5
684-686 00 22	4.59	AF	000238	KROFT LEW	45-222-09			4.5
684-686 00 23	4.41	AF	000242	C I C CONS	45-222-10			4.5
684-686 00 24	4.41	AF	000237	CULVERWELL	45-222-11			4.5
684-686 00 25	4.41	AF	000244	HILL WILDA	45-222-13			4.5
684-686 00 26	4.28	AF	000245	BOWDEN DON	45-222-15			4.5
684-686 00 27	12.78	AF	000097	ROSASCHI G	45-300-01			4.5
684-686 00 28	5.49	AF	000232	GERHARD FR	17-310-03			4.5
684-686 00 29	4.77	AF	000130	MURPHY MAR	17-310-07			4.5
684-686 00 30	5.58	AF	000137	KNIGHT NAN	17-310-08			4.5
684-686 00 31	5.81	AF	000137	KNIGHT NAN	17-310-09			4.5
684-686 00 32	6.75	AF	000112	LEGRAS JEA	17-310-11			4.5

					PARCEL	APPL#	CERT#	PRIORITY
684-686 00 34	42.35	AF	000151	TOGLIATTI	17-320-07			4.5
684-686 00 35	6.44	AF	000151	TOGLIATTI	17-320-17			4.5
684-686 00 36	12.67	AF	000151	TOGLIATTI	17-320-18			4.5
684-686 00 37	4.41	AF	000237	CULVERWELL	45-222-12			4.5
684-686 00 38	4.77	AF	001366	CRAIN JERR	45-222-14			4.5
684-686 00 39	44.00	AF	000323	BOOHER MIC	PURCHASES			4.5
684-686 00 40	11.88	AF	000208	MILES DAVI	17-320-16			4.5
684-686 00 41	18.00	AF	000455	HUANG HOW	17-320-15			4.5
684-686 00 42	30.84	AF	000202	NDOT	US 395			4.5
684-686 00 43	2.00	AF	000541	MANHA FRED	17-320-14			4.5
687-688 00 01	4.51	AF	000013	COLLINS CH	17-342-05			4.5
687-688 00 02	4.33	AF	000023	DELONG MEL	17-342-40			4.5
687-688 00 03	8.66	AF	000026	DEAL TIMOT	17-342-34			4.5
687-688 00 04	9.75	AF	000027	TATAR GEOR	17-342-29			4.5
687-688 00 05	4.51	AF	000031	FARNSWORTH	17-342-28			4.5
687-688 00 06	22.37	AF	000033	ANDERSON F	17-342-33			4.5
687-688 00 07	4.40	AF	000204	SMULLEN JO	17-342-06			4.5
687-688 00 08	6.18	AF	000675	SANFORD RI	17-342-53			4.5
687-688 00 09	4.24	AF	000048	HANSEN GEO	17-342-11			4.5
687-688 00 10	4.74	AF	000050	HARKEMA KE	17-342-14			4.5
687-688 00 11	4.65	AF	000058	KONRATH TE	17-342-36			4.5
687-688 00 12	0.62	AF	000053	NAST ANTHO	17-342-08			4.5
687-688 00 13	6.91	AF	000110	ROSS JAMES	17-342-01			4.5
687-688 00 14	6.01	AF	000064	JONES DAVI	17-342-17			4.5
687-688 00 15	4.65	AF	000069	CANON WARR	17-342-25			4.5

RIGHT NO.	ACRES	CLMT	ALPHA	PARCEL	APPL#	CERT#	PRIORITY
687-688 00 16	4.24 AF	000065	KELLEY JOH	17-342-10			4.5
687-688 00 17	4.15 AF	000074	TEAGUE HEN	17-342-38			4.5
687-688 00 18	0.19 AF	000205	SAMMIS CLI	17-342-20			4.5
687-688 00 19	5.19 AF	000084	NEILSON AL	17-342-30			4.5
687-688 00 20	4.74 AF	000095	SPRADLING	17-342-07			4.5
687-688 00 21	4.74 AF	000096	ROSA RICHA	17-342-15			4.5
687-688 00 22	9.02 AF	000095	SPRADLING	17-342-19			4.5
687-688 00 23	2.39 AF	000153	JULIAN KEN	17-342-37			4.5
687-688 00 24	4.42 AF	000141	STOLL ELBE	17-342-24			4.5
687-688 00 25	4.65 AF	000462	NAUERT LOU	17-342-26			4.5
687-688 00 26	4.56 AF	000121	VAILLANCOU	17-342-09			4.5
687-688 00 27	4.65 AF	000159	STEWART BA	17-342-13			4.5
687-688 00 28	1.31 AF	000085	NEILSON JE	17-342-48			4.5
687-688 00 29	3.39 AF	000207	ATKINSON D	17-342-18			4.5
687-688 00 30	4.39 AF	000208	MILES DAVI	17-342-22			4.5
687-688 00 31	4.40 AF	000208	MILES DAVI	17-342-23			4.5
687-688 00 32	4.31 AF	000159	STEWART BA	17-342-31			4.5
687-688 00 33	4.51 AF	000211	LUND ARTHU	17-342-32			4.5
687-688 00 34	5.84 AF	000212	MCGREER WM	17-342-52			4.5
687-688 00 35	11.51 AF	000044	GREENHALGH	17-430-10			4.5
687-688 00 36	4.51 AF	000169	CEBE DENNI	17-430-11			4.5
687-688 00 37	1.40 AF	000169	CEBE DENNI	17-430-14			4.5
687-688 00 38	3.11 AF	000328	BOOHER MIC	17-342-12			4.5
687-688 00 39	0.90 AF	000060	HAWKINS JI	17-430-01			4.5
687-688 00 40	87.21 AF	000185	WASH/EPF				4.5

RIGHT NO.	ACRES	CLMT	ALPHA	PARCEL	APPL#	CERT#	PRIORITY
687-688 00 41	7.62 AF	000144	CAMARA DAV	17-342-04			4.5
687-688 00 42	2.26 AF	000093	RENO/SPP	AFFIDAVIT			4.5
687-688 00 43	4.86 AF	000552	WEHRLI KAT	17-342-35			4.5
687-688 00 44	1.52 AF	001000	SPARKS/SPP	17-342-08			4.5
687-688 00 46	5.73 AF	000095	SPRADLING	17-342-02			4.5
687-688 00 47	5.01 AF	001370	HOLMES JOH	17-342-16			4.5
687-688 00 48	5.01 AF	000113	THEOBALD J	17-342-27			4.5
687-688 00 49	0.58 AF	000085	NEILSON JE	17-342-49			4.5
687-688 00 50	4.11 AF	000046	SOARES DIA	17-342-39			4.5
687-688 00 51	0.04 AF	000126	WASH/SPP	17-350-38			4.5
687-688 00 52	3.61 AF	000678	GILDESGARD	17-350-39			4.5
687-688 00 53	0.09 AF	000085	NEILSON JE	17-350-40			4.5
687-688 00 54	0.14 AF	000085	NEILSON JE	17-350-43			4.5
687-688 00 55	4.56 AF	000044	GREENHALGH	17-430-15			4.5
687-688 00 56	1.00 AF	000125	WASH/EPF	52316P			4.5
688-000 aA 01	0.22 AF	000206	SEXTON BIL	17-342-19			4.5
688-000 aA 02	3.06 AF	000205	SAMMIS CLI	17-342-20			4.5
688-000 aA 03	0.90 AF	000212	MCGREER WM	17-342-52			4.5
688-000 aA 04	0.32 AF	000675	SANFORD RI	17-342-53			4.5
688-000 aB 01	0.81 AF	000207	ATKINSON D	17-342-18			4.5
688-000 aB 02	2.25 AF	000206	SEXTON BIL	17-342-19			4.5
688-000 aB 03	0.45 AF	000208	MILES DAVI	17-342-22			4.5
688-000 aB 04	0.45 AF	000208	MILES DAVI	17-342-23			4.5
688-000 aB 05	0.32 AF	000141	STOLL ELBE	17-342-24			4.5
688-000 aB 06	0.22 AF	000675	SANFORD RI	17-342-53			4.5

RIGHT NO.	ACRES	CLMT	ALPHA	PARCEL	APPL#	CERT#	PRIORITY
688-000 aC 01	0.13 AF	000206	SEXTON BIL	17-242-19			4.5
688-000 aC 02	0.49 AF	000205	SAMMIS CLI	17-242-20			4.5
688-000 aC 03	1.75 AF	000125	WASH/EPF	ANDREW LN			4.5
688-000 aC 04	0.99 AF	000218	PEARSON LL	17-350-10			4.5
688-000 aC 05	2.03 AF	000171	WALLER BOB	17-350-11			4.5
688-000 aC 06	1.76 AF	000668	ARMER KENT	17-350-12			4.5
688-000 aC 07	4.59 AF	000171	WALLER BOB	17-350-13			4.5
688-000 aC 08	3.69 AF	000214	FITZGERALD	17-350-14			4.5
688-000 aC 09	0.36 AF	000214	FITZGERALD	17-350-15			4.5
688-000 aC 10	1.17 AF	000085	NEILSON JE	17-350-34			4.5
688-000 aC 11	0.76 AF	000215	KEEFE DAN	17-350-35			4.5
688-000 aC 12	2.84 AF	000139	TARANTINO	17-350-36			4.5
688-000 aC 13	1.94 AF	000126	WASH/SPP	17-350-35	AFFDVT		4.5
688-000 aD 01	2.25 AF	000206	SEXTON BIL	17-342-19			4.5
688-000 aD 02	0.99 AF	000139	TARANTINO	17-350-36			4.5
688-000 aD 03	0.22 AF	000328	BOOHER MIC	17-350-37			4.5
688-000 aD 04	1.04 AF	000125	WASH/EPF	ANDREW LN			4.5
689-691 A 01	107.09 AF	000010	CANTLON A	17-372-09			4.5
689-691 A 02	22.91 AF	000481	GRIFFIN JO	17-372-08			4.5
689-691 B 00	135.00 AF	000010	CANTLON A	17-380-02			4.5
692-694 A 00	137.25 AF	000010	CANTLON A	17-370-01			4.5
692-694 B 00	158.40 AF	000010	CANTLON A	17-380-01			4.5
692-694 C 00	3.28 AF	000010	CANTLON A	50-520-12			4.5
692-694 D 00	6.86 AF	000097	ROSASCHI G	45-300-01			4.5
692-694 E 00	21.73 AF	000010	CANTLON A	17-380-01			4.5

RIGHT NO.	ACRES	CLMT	ALPHA	PARCEL	APPL#	CERT#	PRIORITY
692-694 F 00	4.63 AF	000002	BOEGLE.C	17-390-06			4.5
692-694 G 01	45.00 AF	000010	CANTLON A	17-320-04			4.5
692-694 G 02	29.83 AF	000002	BOEGLE.C	17-320-05			4.5
695-000 00 00	5.00 AF	000010	CANTLON A	50-520-12			4.5
696-697 A 01	8.33 AF	000002	BOEGLE,C	17-390-10			4.5
696-697 A 02	6.30 AF	000335	ERICKSON M	17-390-08			4.5
696-697 A 03	3.82 AF	000083	MULL MAX R	17-390-09			4.5
696-697 A 04	1.80 AF	000391	BOEGLE DAL	17-390-11			4.5
696-697 A 05	2.25 AF	000390	BOEGLE ALL	17-390-07			4.5
696-697 B 01	9.00 AF	000402	SURRETT	17-400-21			4.5
696-697 B 02	3.71 AF	000424	SNIDER ART	17-400-08			4.5
696-697 B 03	4.50 AF	000465	HILLERBY M	17-400-26			4.5
696-697 B 04	3.71 AF	000465	HILLERBY M	17-400-10			4.5
696-697 B 05	1.58 AF	000471	W C TREASU	17-400-11			4.5
696-697 C 01	112.79 AF	000002	BOEGLE.C	17-390-10			4.5
696-697 C 02	1.98 AF	000391	BOEGLE DAL	17-390-11			4.5
696-697 C 03	1.30 AF	000390	BOEGLE ALL	17-390-07			4.5
696-697 D 01	6.73 AF	000640	RHODES BRY	17-310-19			4.5
696-697 D 02	8.54 AF	001066	SMITH EDWA	17-400-35			4.5
696-697 D 03	21.45 AF	003213	MILSTEIN S	17-400-19			4.5
696-697 D 04	3.33 AF	000370	PARTRIDGE	17-400-41			4.5
696-697 D 05	8.33 AF	000463	HILLERBY M	17-400-26			4.5
696-697 D 06	4.33 AF	000465	HILLERBY M	17-400-31			4.5
696-697 D 07	4.34 AF	000465	HILLERBY M	17-400-32			4.5
696-697 D 10	15.37 AF	000465	HILLERBY M	17-400-40			4.5

RIGHT NO.	ACRES	CLMT	ALPHA	PARCEL	APPL#	CERT#	PRIORITY
696-697 D 09	4.40 AF	000640	RHODES BRY	17-400-36			4.5
696-697 D 10	5.96 AF	000640	RHODES BRY	17-400-37			4.5
696-697 D 11	7.39 AF	000640	RHODES BRY	17-400-38			4.5
696-697 E 00	9.00 AF	000640	RHODES BRY	17-310-19			4.5
696-697 F 00	59.40 AF	000002	BOEGLE,C	17-390-10			4.5
696-697 G 01	31.50 AF	001320	BURLAND H	17-400-34			4.5
696-697 G 02	9.90 AF	000465	HILLERBY M	17-400-40			4.5
696-697 H 00	16.45 AF	000002	BOEGLE,C	17-320-05			4.5
696-697 I 01	38.30 AF	000155	TAYLOR LIN	17-310-21			4.5
696-697 I 02	23.45 AF	000640	RHODES BRY	17-310-19			4.5
696-698 a 01	10.62 AF	000021	MONROE LAR	17-301-18			4.5
698-698 a 03	174.48 AF	000115	TOWNE DORO	17-301-10	52396P		4.5
698-698 a 03	5.36 AF	000021	MONROE LAR	17-301-19			4.5
698-698 a 04	0.34 AF	000021	MONROE LAR	17-301-20			4.5
698-698 a 00	37.00 AF	000108	SINAI DAVI				4.5
700-701 A 01	92.30 AF	000020	CURTI GEOR				4.5
700-701 A 03	2.30 AF	000165	CURTI EUGE				4.5
700-701 A 03	4.55 AF	000166	CURTI GARY				4.5
700-701 A 04	26.05 AF	000209	BALDECCHI				4.5
700-701 B 00	23.25 AF	000209	BALDECCHI				4.5
700-701 C 00	9.05 AF	000020	CURTI GEOR				4.5
700-701 D 01	144.35 AF	000020	CURTI GEOR				4.5
700-701 D 02	27.05 AF	000001	CURTI & PI				4.5
700-701 E 01	183.30 AF	000020	CURTI GEOR				4.5
700-701 E 03	2.30 AF	000165	CURTI EUGE				4.5

				ALPHA	PARCEL	APPL#	CERT#	PRIORITY
700-701 F	00	180.00	AF	000020	CURTI GEOR			4.5
700-701 G	00	96.80	AF	000020	CURTI GEOR			4.5
702-706 A	01	103.95	AF	000001	CURTI & PI			4.5
702-706 A	02	31.50	AF	000168	CURTI HARO			4.5
702-706 A	03	18.00	AF	000168	CURTI HARO			4.5
702-706 B	00	18.20	AF	000001	CURTI & PI			4.5
702-706 C	01	136.35	AF	000020	CURTI GEOR			4.5
702-706 C	02	20.70	AF	000163	DAMONTE LO			4.5
702-706 C	03	23.95	AF	000164	BALLARDINI			4.5
702-706 D	01	5.40	AF	000163	DAMONTE LO			4.5
702-706 D	02	108.60	AF	000164	BALLARDINI			4.5
702-706 D	03	72.00	AF	000011	CARAMELLA			4.5
702-706 E	01	23.35	AF	000001	CURTI & PI			4.5
702-706 E	02	103.50	AF	000164	BALLARDINI			4.5
702-706 E	03	7.20	AF	000011	CARAMELLA			4.5
702-706 F	01	40.50	AF	000020	CURTI GEOR			4.5
702-706 F	02	139.50	AF	000001	CURTI & PI			4.5
702-706 G	00	8.30	AF	000011	CARAMELLA			4.5
702-706 H	00	133.10	AF	000011	CARAMELLA			4.5
702-706 I	00	4.95	AF	000011	CARAMELLA			4.5
702-706 J	00	179.90	AF	000163	DAMONTE LO			4.5
702-706 K	01	62.00	AF	000163	DAMONTE LO			4.5
702-706 L	02	116.00	AF	000011	CARAMELLA			4.5
702-706 L	00	147.50	AF	000001	CURTI & PI			4.5
702-706 M	00	87.30	AF	000163	DAMONTE LO			4.5

RIGHT NO.	ACREE	CLMT	ALPHA	PARCEL	APPL#	CERT#	PRIORITY
702-706 N 00	140.75 AF	000163	DAMONTE LO				4.5
702-706 O 00	33.40 AF	000163	DAMONTE LO				4.5
702-706 P 00	113.40 AF	000163	DAMONTE LO				4
702-706 Q 01	56.40 AF	000163	DAMONTE LO				4
702-706 Q 02	42.00 AF	000022	DAMONTE BE				4
702-706 R 00	160.00 AF	000022	DAMONTE BE				4
702-706 S 00	108.80 AF	000022	DAMONTE BE				4
702-706 T 00	98.00 AF	000163	DAMONTE LO				4
702-706 U 01	10.40 AF	000020	CURTI GEOR				4
702-706 U 02	108.80 AF	000163	DAMONTE LO				4
702-706 V 00	160.00 AF	000163	DAMONTE LO				4
702-706 W 01	108.20 AF	000163	DAMONTE LO				4
702-706 W 02	21.20 AF	000011	CARAMELLA				4
702-70[illegible] Y 00	102.00 AF	000163	DAMONTE LO				4
702-70[illegible] Y 00	160.00 AF	000163	DAMONTE LO				4
702-706 Z 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZA 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZB 00	81.60 AF	000163	DAMONTE LO				4
702-706 ZC 00	32.00 AF	000163	DAMONTE LO				4
702-706 ZD 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZE 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZF 01	130.40 AF	000163	DAMONTE LO				4
702-706 ZG 01	102.60 AF	000163	DAMONTE LO				4
702-706 ZH 00	108.00 AF	000160	DAMONTE LO				4
702-706 ZI 00	160.00 AF	000163	DAMONTE LO				4

RIGHT NO.	ACRES	CLMT	ALPHA	PARCEL	APPL#	CERT#	PRIORITY
702-706 ZJ 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZK 00	66.00 AF	000163	DAMONTE LO				4
702-706 ZL 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZM 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZN 00	29.60 AF	000163	DAMONTE LO				4
702-706 ZO 00	8.40 AF	000163	DAMONTE LO				4
702-706 ZP 00	79.60 AF	000163	DAMONTE LO				4
702-706 ZQ 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZR 00	151.20 AF	000163	DAMONTE LO				4
702-706 ZS 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZT 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZU 00	160.00 AF	000163	DAMONTE LO				4
702-706 ZV 00	21.60 AF	000163	DAMONTE LO				4
702-706 ZW 00	67.20 AF	000163	DAMONTE LO				4
707-702 00 01	87.60 AF	000025	DOUBLE DIA				4
707-708 00 02	1102.57 AF	000025	DOUBLE DIA		41666P		4
707-708 00 03	225.83 AF	001321	WASHOE COU		41666P		4
709-000 00 00	2374.00 AF	000005	BUTLER PAU				4
711-712 00 00	1294.00 AF	000005	BUTLER PAU				4
713-000 00 00	25.00 CF	000005	BUTLER PAU	ALEX LAKE			4
714-000 00 00	115.00 AF	000005	BUTLER PAU				4

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT *(33 CFR 325)*	OMB APPROVAL NO. 0710-003 Expires October 1996

Public reporting burden for this collection of information is estimated to average 5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Service Directorate of InformationOperations and Reports, 1215 Jefferson Davis Highway, Suite 204, Arlington, VA 22202-4302; and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003), Washington, DC .0503. Please DO NO RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authority: 33 USC 401, Section 10; 1413, Section 404. Principal Purpose: These laws require permits authorizing activities in, or affecting, navigable waters of the United States, the discharge of dredged or fill material into waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. Routine Uses: Information provided on this form will be used in evaluating the application for a permit. Disclosure: Disclosure of requested information is voluntary. If information is not provided, however, the permit application cannot be processed nor can a permit be issued.

One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETED

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE *(an agent is not required)*
6. APPLICANT'S ADDRESS	9. AGENT'S ADDRESS
7. APPLICANT'S PHONE NOS. W/AREA CODE	10. AGENT'S PHONE NOS. W/AREA CODE
a. Residence	a. Residence
b. Business	b. Business

11. STATEMENT OF AUTHORIZATION

I hereby authorize, _____ to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

APPLICANT'S SIGNATURE DATE

NAME, LOCATION AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE *(see instructions)*

13. NAME OF WATERBODY, IF KNOWN *(if applicable)*	14. PROJECT STREET ADDRESS *(if applicable)*
15. LOCATION OF PROJECT	
COUNTY _____ STATE _____	

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN, *(see instructions)*

17. DIRECTIONS TO THE SITE

19. Project Purpose *(Describe the reason or purpose of the project, see instructions)*

USE BLOCKS 20-22 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards

22. Surface Area in Acres of Wetlands or Other Waters Filled *(see instructions)*

23. Is Any Portion of the Work Already Complete? Yes ____ No ____ IF YES, DESCRIBE THE COMPLETED WORK

24. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (If more than can be entered here, please attach a supplemental list).

25. List of Other Certifications or Approvals/Denials Received from other Federal, State or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED

Would include but is not restricted to zoning, building and flood plain permits

26. Application is hereby made for a permit or permits to authorize the work described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT	DATE	SIGNATURE OF AGENT	DATE

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

*U.S.GPO:1994-520-478/82018

Instructions for Preparing a Department of the Army Permit Application

Blocks 1 through 4. To be completed by Corps of Engineers.

Block 5. Applicant's Name. Enter the name of the responsible party or parties. If the responsible party is an agency, company, corporation or other organization, indicate the responsible officer and title. If more than one party is associated with the application, please attach a sheet with the necessary information marked **Block 5.**

Block 6. Address of Applicant. Please provide the full address of the party or parties responsible for the application. If more space is needed, attach an extra sheet of paper marked **Block 6.**

Block 7. Applicant Telephone Number(s). Please provide the number where you can usually be reached during normal business hours.

Blocks 8 through 11. To be completed if you choose to have an agent.

Block 8. Authorized Agent's Name and Title. Indicate name of individual or agency, designated by you, to represent you in this process. An agent can be an attorney, builder, contractor, engineer or any other person or organization. *Note:* An agent is not required.

Block 9 and 10. Agent's Address and Telephone number. Please provide the complete mailing address of the agent, along with the telephone number where he/she can be reached during normal business hours.

Block 11. Statement of Authorization. To be completed by applicant if an agent is to be employed.

Block 12. Proposed Project Name or Title. Please provide name identifying the proposed project (i.e., Landmark Plaza, Burned Hills Subdivision or Edsall Commercial Center).

Block 13. Name of Waterbody. Please provide the name of any stream, lake, marsh or other waterway to be directly impacted by the activity. If it is a minor (no name) stream, identify the waterbody the minor stream enters.

Block 14. Proposed Project Street Address. If the proposed project is located at a site having a street address (not a box number), please enter here.

Block 15. Location of Proposed Project. Enter the county and state where the proposed project is located. If more space is required, please attach a sheet with the necessary information marked **Block 15.**

Block 16. Other Location Descriptions. If available, provide the Section, Township and Range of the site and/or the latitude and longitude. You may also provide description of the proposed project location, such as lot numbers, tract numbers or you may choose to locate the proposed project site from a known point (such as the right descending bank of Smith Creek, one mile down from the Highway 14 bridge). If a large river or stream, include the river mile of the proposed project site if known..

Block 17. Directions to the Site. Provide directions to the site from a known location or landmark. Include highway and street numbers as well as names. Also provide distances from known locations and any other information that would assist in locating the site.

Block 18. Nature of Activity. Describe the overall activity or project. Give appropriate dimensions of structures such as wingwalls, dikes (identify the materials to be used in construction, as well as the methods by which the work is to be done), or excavations (length, width, and height). Indicate whether discharge of dredged or fill material is involved. Also, identify any structure to be constructed on a fill, piles or float supported platforms.

The written descriptions and illustrations are an important part of the application. Please describe, in detail, what you wish to do. If more space is needed, attach an extra sheet of paper marked **Block 18.**

Block 19. Proposed project Purpose. Describe the purpose and need for the proposed project. What will it be used for and why? Also include a brief description of any related activities to be developed as the result of the proposed project. Give the approximate dates you plan to both begin and complete all work.

Block 20. Reason(s) for Discharge. If the activity involves the discharge of dredged and/or fill material into a wetland or other waterbody, including the temporary placement of material, explain the specific purpose of the placement of the material (such as erosion control).

Block 21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards. Describe the material to be discharged and amount of each material to be discharged within Corps jurisdiction. Please be sure this description will agree with your illustrations. Discharge material includes: rock, sand, clay, concrete, etc.

Block 22. Surface Areas of Wetlands or Other Waters Filled. Describe the area to be filled at each location. Specifically identify the surface areas, or part thereof, to be filled. Also include the means by which the discharge is to be done (backhoe, dragline, etc.). If dredged material is to be discharged on an upland site, identify the site and the steps to be taken (if necessary) to prevent runoff from the dredged material back into a waterbody. If more space is needed, attach an extra sheet of paper marked **Block 22.**

Block 23. Is Any Portion of the Work Already Complete? Provide any background on any part of the proposed project already completed. Describe the area already developed, structures completed, any dredged or fill material already discharged, the type of material, volume in cubic yards, acreas filled, if a wetland or other waterbody (in acres or square feet). If the work was done under an existing Corps permit, identify the authorization if possible.

Block 24. Names and Addresses of Adjoining Property Owners, Lessees, etc., Whose Property Adjoins the Project Site. List complete names and full mailing addresses of the adjacent property owners (public and private) lessees, etc., whose property adjoins the waterbody or aquatic site where the work is being proposed so that they may be notified of the proposed activity (usually by public notice). If more space is needed, attach an extra sheet of paper marked **Block 24.**

Information regarding adjacent landowners is usually available through the office of the tax assessor in the county of counties where the project is to be developed.

Block 25. Information about Approvals or Denials by Other Agencies. You may need the approval of other Federal, state or local agencies for your project. Identify any applications you have submitted and the status, if any (approved or denied) of each application. You need not have obtained all other permits before applying for a Corps permit.

Block 26. Signature of Applicant or Agent. The application must be signed by the owner or other authorized party (agent). This signature shall be an affirmation that the party applying for the permit possesses the requisite property rights to undertake the activity applied for (including compliance with special conditions, mitigation, etc.).

DRAWINGS AND ILLUSTRATIONS

General Information.

Three types of illustrations are needed to properly depict the work to be undertaken. These illustrations or drawings are identified as a **Vicinity Map**, a **Plan View** or a **Typical Cross-section Map**. Identify each illustration with a figure or attachment number.

Please submit one original, or good quality copy, of all drawings on 8 1/2x11 inch plain white paper (tracing paper or film may be substituted). Use the fewest number of sheets necessary for your drawings or illustrations.

Each illustration should identify the project, the applicant, and the type of illustration (vicinity map, plan view or cross-section). **While illustrations need not be professional (for many small, private project illustrations are prepared by hand), they should be clear, accurate and contain all necessary information.**

INFORMATION SHEET ON THE US ARMY CORPS OF ENGINEERS
PERMITTING PROGRAM UNDER SECTION 404 OF THE CLEAN WATER ACT

The intent of this document is not to provide you with all requirements under our permitting program, only the regulations can do that, but rather to provide people in the field with enough information so that they can make decisions about whether or not projects in their areas need to be brought to the attention of the Corps for possible 404 permitting actions.

The Corps of Engineers' jurisdiction in this area is under Section 404 of the Clean Water Act (CWA). Section 404 of the CWA requires that a Department of the Army permit be issued prior to discharging dredged or fill materials into "waters of the United States." 33 CFR Parts 320, 323, 325 through 328, and 330 describes the specific requirements and procedures of the program. In general, a discharge of dredged material includes but is not limited to any addition, including redeposit, of dredged material, including excavated material, into the "waters of the United States" which is incidental to any activity including mechanized landclearing, ditching, channelization, or other excavation.

The definition, in part, of "waters of the United States", as described in 33 CFR Part 328, is: All waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce... including tributaries of these waters. In other words the Corps' jurisdiction is very broad and frequently extends to dry ephemeral channels where water neither currently exists, nor has existed for many months. The only requirement is that a channel be shown to provide water, at some time in the past, to a location where it (the water) may be used for purposes of interstate commerce. Interstate commerce could be construed as anything from cattle, to migratory water fowl, to providing recreation for out of state tourists.

There are some activities which are exempt from permitting requirements, as described in 33 CFR Part 323.4, however most activities impacting waters of the United States do require a permit. There are three categories of permits: Regional General Permits, Nationwide Permits, and Individual Permits.

Regional General Permits, as described in 33 CFR Parts 323.2 (h) and 325.2 (e)(2), are issued by a Corps of Engineers District for categories of activities that are similar in nature and cause only minimal impact. An example of a Regional General Permit in Nevada is General Permit number 0006 (GP0006) which authorizes fills associated with the construction of bridges and culverts assuming certain conditions are met. It must be understood however that the Corps retains the authority in all cases to determine whether or not a particular project will be authorized

under a particular Regional General Permit. Therefore anyone conducting activities under which they believe a Regional General Permit has been issued, must still notify the Corps so that the authority can be verified. This discretionary authority allows the Corps to require that Individual Permit procedures be followed for a particular project even if that project meets all the conditions of a Regional General Permit. As you will see in the next paragraph this discretionary authority holds true for Nationwide Permits as well.

Nationwide Permits: Nationwide Permits, as described in 33 CFR Part 330, is a type of general permit issued by the Chief of Engineers in Washington DC, and are designed to regulate with little, if any, delay or paperwork certain activities having minimal impacts. There are currently 36 Nationwide Permits for various activities described in 33 CFR Part 330. The primary difference between this permit and a Regional General Permit is that Nationwides are issued for the entire nation while Regionals are specific to a particular geographical area of the country. As with Regional General Permits, the Corps retains the authority in all cases to determine whether or not a particular activity will be authorized under a Nationwide Permit. In other words, if someone decides to perform a particular activity which they believe can be conducted under the authority of a Nationwide Permit, they should first notify the Corps to verify that the work is authorized under that Nationwide Permit. If they do not they run the risk of mis-interpreting the regulation or the permit requirements and therefore violating section 404 of the CWA.

Individual Permits: Applying for, and the processing of, Individual Permits is described in 33 CFR Part 325. Individual Permits are normally issued for large projects or projects that will have other than minimal impact on waters of the United States. However, as discussed above, small projects or projects with seemingly minimal impact can also require an Individual Permit. This is particularly true in the case of projects that may have minimal impact but do not fall into any category covered under a Regional General Permit or a Nationwide Permit. Again, at the discretion of the Corps, projects which may be authorized under a Regional or Nationwide Permit may still be required to go through procedures for an Individual Permit. There may be many reasons for the Corps to make such a decision. One of the most common reasons is what is known as "cumulative" impact. Frequently, a single project by itself may have only minimal impacts but taken in conjunction with other "minimally impacting" projects, may have quite a large overall or "cumulative" impact. In cases like this the Corps may require Individual Permit procedures be followed to insure appropriate protection for the environment. Individual Permit actions involve many outside resource agencies, both State and Federal, and may take quite a long time to be completed. Frequently, Environmental Impact Statements (EIS) or Environmental Assessments (EA) have to be completed, and/or public meetings held, before a permit can be issued.

Individual Permits also cost the applicant money; $10.00 for a private (non-commercial) project, $100.00 for projects with a commercial or industrial nature.

The primary function of the entire 404 permitting process is to protect wetlands. To do this, the Corps looks at every project in view of the following three issues: 1) Avoidance - Has the applicant taken all reasonable steps to avoid wetlands in designing his/her project?; 2) Minimization - Has the applicant taken all reasonable steps to minimize impacts to wetlands that are being impacted by his/her project?; 3) Mitigation - For those wetlands which could not be avoided, has the applicant proposed an adequate plan to mitigate for the loss? If an applicant can prove that he/she has met, in sequence, each of these issues to the satisfaction of the Corps, he/she stands a much better chance of having his/her project permitted.

For every permitting action the Corps must conform to requirements of the National Environmental Policy Act (NEPA) The Corps decision on any permitting action is made after performing a public interest review of all the direct and indirect impacts of the project for which the permit has been requested. Because of this public interest review, many projects are permitted only after special conditions, specific to that particular project, are attached to the permit. These special conditions frequently come about due to our coordination with other government agencies. These special conditions must be adhered to by the applicant or the permit becomes void. One of the most frequent special conditions is the requirement for mitigation for the impacts. Mitigation can be a special condition to any of the three types of permits and may be quite substantial.

This is a brief summary of the Corps' 404 permitting jurisdiction, requirements, and procedures. This is not an all inclusive document. Only the regulations can provide the exact
and detailed requirements. The information contained in this document is general in nature and should only be used as guidance on whether or not more research needs to be done on a particular project to determine if a Corps permit may be necessary. Only Corps regulatory personnel may make a definitive decision on whether or not a particular project requires a permit, or what type of permit is required. The bottom line is: If in doubt get a decision from the corps regulatory office. The time and effort taken to contact the Corps for a decision on projects that may indeed result in a "No Permit Required" before doing any work, is much cheaper and less time consuming than finding out you are in violation and have to "Cease and Desist" all activities related to that project.

U.S. Army Corps of Engineers
Regulatory Jurisdiction

AUTHORITY - Section 404 of the Clean Water Act authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits, after notice and opportunity for public hearing, for the discharge of dredged or fill material into waters of the United States at specified disposal sites. (33 U.S.C. 1344)

PERMIT APPLICATION EVALUATION - Policies applicable to review of all applications for permits:

a) Public Interest Review
b) Effect on Wetlands
c) Fish and Wildlife
d) Water Quality
e) Historic, Cultural, Scenic and Recreational Values
f) Effects on the Limits of Territorial Seas
g) Consideration of Property Ownership
h) Activities Affecting Coastal Zones
I) Activities in Marine Sanctuaries
j) Other Federal, State or Local Requirements
k) Safety of Impoundment Structures
l) Flood Plain Management
m) Water Supply and Conservation
n) Energy Conservation and Development
o) Navigation
p) Environmental Benefits
q) Economics
r) Mitigation

DEFINITIONS -
Waters of the United States:

1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to ebb and flow of the tide;
2) All interstate waters including interstate wetlands;
3) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use degradation or destruction of which could effect interstate or foreign commerce...; of the United States under the definition;

4) All impoundments of waters otherwise defined as waters
5) Tributaries of waters identified in items 1-4;
6) The territorial seas:
7) Wetlands adjacent to waters identified in 1-6 .

Wetlands:

Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

Ordinary High Water Mark:

That line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestial vegetation, the presence of litter or debris, or other appropriate means that consider the characteristics of the surrounding area.

TYPES OF PERMITS -

Individual Permit - Requires Public Notice
Requires WQ Certification or Waiver

Nationwide General Permit - Requires WQ Certification or Waiver

Letter of Permission - Minor Work
Requires consultation with resource agencies(EPA, USFWS, NDEP, NDOW, NSL)

Emergency Work - Coordination with Division Engineer
Consultation with resource agencies

NATIONWIDE PERMIT #27

RIPARIAN RESTORATION AND CREATION ACTIVITIES
(Sections 10 and 404)

Effective Date: 11 February 1997 Expires 11 February 2002

Note: Additional information on this and other Nationwide permits can be obtained on the internet at http://wetland.usace.mil

The Corps of Engineers has issued a nationwide general permit (NWP) authorizing activities in waters of the United States associated with the restoration of former non-tidal wetlands and riparian areas, the enhancement of degraded wetlands and riparian areas, and creation of wetlands and riparian areas;

(i) on non-Federal public lands and private lands, in accordance with the terms and conditions of a binding wetland restoration or creation agreement between the landowner and the U.S. Fish and Wildlife Service or the Natural Resources Conservation Service (NRCS) or voluntary wetland restoration, enhancement, and creation actions documented by the NRCS pursuant to NRCS regulations; or

(ii) on any Federal land; or

(iii) on reclaimed surface coal mined lands, in accordance with a Surface Mining Control and Reclamation Act permit issued by the Office of Surface Mining or the applicable state agency. (The future reversion does not apply to wetlands created, restored or enhanced as mitigation for the mining impacts, nor naturally due to hydrologic or topographic features, nor for a mitigation bank.); or

(iv) on any public or private land, provided the permittee notifies the District Engineer in accordance with the "Notification" general condition.

Such activities include, but are not limited to: installation and maintenance of small water control structures, dikes, and berms; backfilling of existing drainage ditches; removal of existing drainage structures; construction of small nesting islands; plowing or discing for seed bed preparation; and other related activities. This NWP applies to restoration projects that serve the purpose of restoring "natural" wetland hydrology, vegetation, and function to altered and degraded non-tidal wetlands and "natural" functions of riparian areas. This NWP does not authorize the conversion of natural wetlands to another aquatic use, such as creation of waterfowl impoundments where a forested wetland previously existed.

Reversion. For restoration, enhancement and creation projects conducted under paragraghs (ii) and (iv), this NWP does not authorize any future discharge of dredged or fill material associated with the reversion of the area to its prior condition. In such cases a separate permit at that time would be required for any reversion. For restoration, enhancement and creation projects conducted under paragraghs (i) and (iii), this NWP also authorizes any future discharge of dredged or fill material associated with the reversion of the area to its documented prior condition and use (*i.e.*, prior to the restoration, enhancement, or creation

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activities) within five years after expiration of a limited term wetland restoration or creation agreement or permit, even if the discharge occurs after this NWP expires. The five year reversion limit does not apply to agreements without time limits reached under paragraph (i). The prior condition will be documented in the original agreement or permit, and the determination of return to prior conditions will be made by the Federal agency or appropriate state agency executing the agreement or permit. Prior to any reversion activity the permittee or the appropriate Federal or state agency must notify the District Engineer and include the documentation of the prior condition. Once an area has reverted back to its prior physical condition, it will be subject to whatever the Corps regulatory requirements will be at that future date.

NATIONWIDE PERMIT CONDITIONS

GENERAL CONDITIONS:

The following general conditions must be followed in order for any authorization by a NWP to be valid:

1. *Navigation*: No activity may cause more than a minimal adverse effect on navigation.

2. *Proper Maintenance*: Any structure or fill authorized shall be properly maintained, including maintenance to ensure public safety.

3. *Erosion and Siltation Controls*: Appropriate erosion and siltation controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date.

4. *Aquatic Life Movements*: No activity may substantially disrupt the movement of those species of aquatic life indigenous to the waterbody, including those species which normally migrate through the area, unless the activity's primary purpose is to impound water.

5. *Equipment*: Heavy equipment working in wetlands must be placed on mats, or other measures must be taken to minimize soil disturbance.

6. *Regional and Case-by-Case Conditions*: The activity must comply with any regional conditions which may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state or tribe in its Section 401 water quality certification.

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7. *Wild and Scenic Rivers*: No activity may occur in a component of the National Wild and Scenic River System; or in a river officially designated by Congress as a "study river" for possible inclusion in the system, while the river is in an official study status; unless the appropriate Federal agency, with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely effect the Wild and Scenic River designation, or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency in the area (*e.g.*, National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service.)

8. *Tribal Rights*: No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

9. *Water Quality Certification*: In certain states, an individual Section 401 water quality certification must be obtained or waived (see 33 CFR 330.4(c)).

a. The State of California has denied this NWP without prejudice as an interim action to allow adequate time for the State Water Resources Control Board (SWRCB) to develop conditions and prepare a negative declaration for this NWP. In the interim, water quality certification or waver will need to be obtained from the Regional Water Quality Control Board (RWQCB).

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b. The State of Nevada has certified all NWP's with the following exception:

"404 Certification is denied for all NWP's when a discharge permit is required by the Division of Environmental Protection for the proposed project. These discharge permits include, but are not limited to NPDS Permits, Storm water Permits, State Discharge Permits, Rolling Stock Permits, etc."

10. *Coastal Zone Management*: In certain states, an individual state coastal zone management consistency concurrence must be obtained or waived (see Section 330.4(d)).

11. *Endangered Species*:

(a) No activity is authorized under any NWP which is likely to jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which is likely to destroy or adversely modify the critical habitat of such species. Non-federal permittees shall notify the District Engineer if any listed species or critical habitat might be affected or is in the vicinity of the project, and shall not begin work on the activity until notified by the District Engineer that the requirements of the Endangered Species Act have been satisfied and that the activity is authorized.

(b) Authorization of an activity by a nationwide permit does not authorize the "take" of a threatened or endangered species as defined under the Federal Endangered Species Act. In the absence of separate authorization (*e.g.*, an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, *etc.*) from the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS), both lethal and non-lethal "takes" of protected species are in violation of the ESA. Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the USFWS and NMFS or their World Wide Web pages at
http://www.fws.gov/~r9endspp/endspp.html (USFWS) and
http://kingfish.spp.mnfs.gov/tmcintyr/prot_res.html#ES and Recovery (NMFS).

12. *Historic Properties*: No activity which may affect historic properties listed, or eligible for listing, in the National Register of Historic Places is authorized, until the District Engineer. has complied with the provisions of 33 CFR Part 325, Appendix C. The prospective permittee must notify the District Engineer if the authorized activity may affect any historic properties listed, determined to be eligible, or which the prospective permittee has reason to believe may be eligible for listing on the National Register of Historic Places, and shall not begin the activity until notified by the District Engineer that the requirements of the National Historic Preservation Act have been satisfied and that the activity is authorized. Information on the location and existence of historic resources can be obtained from the State Historic Preservation Office and the National Register of Historic Places (see 33 CFR 330.4(g)).

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13. *Notification:*

(a) *Timing*: Where required by the terms of the NWP, the prospective permittee must notify the District Engineer with a Pre-Construction Notification (PCN) as early as possible and shall not begin the activity:

(1) Until notified by the District Engineer that the activity may proceed under the NWP with any special conditions imposed by the District or Division Engineer; or

(2) If notified by the District or Division Engineer that an individual permit is required; or

(3) Unless 30 days have passed from the District Engineer's receipt of the notification and the prospective permittee has not received notice from the District or Division Engineer. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) *Contents of Notification*: The notification must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) Brief description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permit(s) or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity.

(c) *Form of Notification*: The standard individual permit application form (Form ENG 4345) may be used as the notification but must clearly indicate that it is a PCN and must include all of the information required in (b) (1)-(3) of General Condition 13. A letter may also be used.

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(d) *District Engineer's Decision*: In reviewing the pre-construction notification for the proposed activity, the District Engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. The prospective permittee may, optionally, submit a proposed mitigation plan with the pre-construction notification to expedite the process and the District Engineer will consider any optional mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects of the proposed work are minimal. If the District Engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects are minimal, the District Engineer will notify the permittee and include any conditions the District Engineer deems necessary.

Any mitigation proposal must be approved by the District Engineer prior to commencing work. If the prospective permittee elects to submit a mitigation plan, the District Engineer will expeditiously review the proposed mitigation plan, but will not commence a second 30-day notification procedure. If the net adverse effects of the project (with the mitigation proposal) are determined by the District Engineer to be minimal, the District Engineer will provide a timely written response to the applicant stating that the project can proceed under the terms and conditions of the nationwide permit.

If the District Engineer determines that the adverse effects of the proposed work are more than minimal, then he will notify the applicant either:

(1) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit;

(2) That the project is authorized under the NWP subject to the applicant's submitting a mitigation proposal that would reduce the adverse effects to the minimal level; or

(3) That the project is authorized under the NWP with specific modifications or conditions.

(e) *Agency Coordination*: The District Engineer will consider any comments from Federal and State agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

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Optional Agency Coordination. Where a Regional Administrator of EPA, a Regional Director of USFWS, or a Regional Director of NMFS has formally requested general notification from the District Engineer for the activities covered by any of these NWPs, the Corps will provide the requesting agency with notification on the particular NWPs. However, where the agencies have a record of not generally submitting substantive comments on activities covered by any of these NWPs, the Corps district may discontinue providing notification to those regional agency offices. The District Engineer will coordinate with the resources agencies to identify which activities involving a PCN that the agencies will provide substantive comments to the Corps. The District Engineer may also request comments from the agencies on a case by case basis when the District Engineer determines that such comments would assist the Corps in reaching a decision whether effects are more than minimal either individually or cumulatively.

(f) *Wetlands Delineations*: Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic site. There may be some delay if the Corps does the delineation. Furthermore, the 30-day period will not start until the wetland delineation has been completed and submitted to the Corps, where appropriate.

(g) *Mitigation*: Factors that the District Engineer will consider when determining the acceptability of appropriate and practicable mitigation include, but are not limited to:

(i) To be practicable, the mitigation must be available and capable of being done considering costs, existing technology, and logistics in light of the overall project purposes;

(ii) To the extent appropriate, permittees should consider mitigation banking and other forms of mitigation including contributions to wetland trust funds, "in lieu fees" to organizations such as The Nature Conservancy, state or county natural resource management agencies, where such fees contribute to the restoration, creation, replacement, enhancement, or preservation of wetlands. Furthermore, examples of mitigation that may be appropriate and practicable include but are not limited to: reducing the size of the project; establishing wetland or upland buffer zones to protect aquatic resource values; and replacing the loss of aquatic resource values by creating, restoring, and enhancing similar functions and values. In addition, mitigation must address wetland impacts, such as functions and values, and cannot be simply used to offset the acreage of wetland losses that would occur in order to meet the acreage limits of some of the NWPs (*e.g.*, for NWP 26, 5 acres of wetlands cannot be created to change a 6-acre loss of wetlands to a 1 acre loss; however, 2 created acres can be used to reduce the impacts of a 3-acre loss.).

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14. *Compliance Certification*: Every permittee who has received a Nationwide permit verification from the Corps will submit a signed certification regarding the completed work and any required mitigation. The certification will be forwarded to the Corps and will include:

a. A statement that the authorized work was done in accordance with the Corps authorization, including any general or specific conditions;

b. A statement that any required mitigation was completed in accordance with the permit conditions;

c. The signature of the permittee certifying the completion of the work and mitigation.

15. *Multiple Use of Nationwide Permits:* In any case where any NWP number 12 through 40 is combined with any other NWP number 12 through 40, as part of a single and complete project, the permittee must notify the District Engineer in accordance with paragraphs a, b, and c on the "Notification" General Condition number 13. Any NWP number 1 through 11 may be combined with any other NWP without notification to the Corps, unless notification is otherwise required by the terms of the NWPs. As provided at 33 CFR 330.6(c) two or more different NWPs can be combined to authorize a single and complete project. However, the same NWP cannot be used more than once for a single and complete project.

SECTION 404 ONLY CONDITIONS:

In addition to the General Conditions, the following conditions apply only to activities that involve the discharge of dredged or fill material into waters of the U.S., and must be followed in order for authorization by the NWPs to be valid:

1. *Water Supply Intakes*: No discharge of dredged or fill material may occur in the proximity of a public water supply intake except where the discharge is for repair of the public water supply intake structures or adjacent bank stabilization.

2. *Shellfish Production*: No discharge of dredged or fill material may occur in areas of concentrated shellfish production, unless the discharge is directly related to a shellfish harvesting activity authorized by NWP 4.

3. *Suitable Material*: No discharge of dredged or fill material may consist of unsuitable material (*e.g.*, trash, debris, car bodies, asphalt, *etc.*,) and material discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

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4. *Mitigation*: Discharges of dredged or fill material into waters of the United States must be minimized or avoided to the maximum extent practicable at the project site (*i.e.*, on-site), unless the District Engineer approves a compensation plan that the District Engineer determines is more beneficial to the environment than on-site minimization or avoidance measures.

5. *Spawning Areas*: Discharges in spawning areas during spawning seasons must be avoided to the maximum extent practicable.

6. *Obstruction of High Flows*: To the maximum extent practicable, discharges must not permanently restrict or impede the passage of normal or expected high flows or cause the relocation of the water (unless the primary purpose of the fill is to impound waters).

7. *Adverse Effects From Impoundments*: If the discharge creates an impoundment of water, adverse effects on the aquatic system caused by the accelerated passage of water and/or the restriction of its flow shall be minimized to the maximum extent practicable.

8. *Waterfowl Breeding Areas*: Discharges into breeding areas for migratory waterfowl must be avoided to the maximum extent practicable.

9. *Removal of Temporary Fills*: Any temporary fills must be removed in their entirety and the affected areas returned to their preexisting elevation.