STATE OF UTAH

NONPOINT SOURCE MANAGEMENT PLAN FOR HYDROLOGIC MODIFICATIONS

An addendum to the:

UTAH NONPOINT SOURCE MANAGEMENT PLAN

March 2013

Prepared for:
UTAH WATER QUALITY TASK FORCE

In Cooperation with:
The Utah Department of Environmental Quality

Utah Department of Environmental Quality

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The people of Utah rely heavily on its water resources. With the development and use of these resources, significant changes to the hydrologic regime and pollutant loading of rivers, streams, lakes, impoundments, and ground water systems can occur. These changes are called hydrologic modifications. This plan is an addendum to the Utah Nonpoint Source (NPS) Pollution Management Plan and identifies Utah's approach to minimizing negative impacts to water quality and other water resource benefits, such as aquatic wildlife habitat, as a result of hydrologic modifications. These same management measures can also be used to reverse water quality degradation occurring from hydrologic modifications of the past.

Plan Intent:

The intent of this plan is to document how to improve water quality during hydrologic modifications and address impairments resulting from previous modifications by identifying the best management practices and measures to reduce NPS pollutant loadings. Because the treatment of NPS pollution is as much an art as a science, judgments must be made in selecting the "best" management practices for specific cases. Stakeholders should work together in understanding the problem and agree upon the objectives and which course of action will best achieve those objectives for the particular site. This includes considering the needs of property owners as well as water quality and related aquatic wildlife habitat.

Opportunities for protecting and improving water quality and related aquatic wildlife habitat should be fully explored throughout the planning process. This plan considers regulatory requirements as the minimum standard and does not stand in lieu of the requirements of other governmental agencies. An objective of this plan is to meet and surpass regulatory requirements and empower stakeholders to consider the cost effectiveness and efficiency of alternative strategies in achieving water quality and other resource management objectives.

The plan describes the various types of hydrologic modification which can generate NPS water pollution and their impacts on aquatic wildlife habitat. This plan also identifies where these impacts are found within Utah's priority watersheds as defined by the Utah Water Quality Task Force. The Task Force also assists with identifying appropriate BMPs related to hydrologic modifications. The Task Force is made up of multiple state, federal and local agencies and organizations responsible for protecting and improving water quality. The member agencies' roles and responsibilities are provided in the plan along with milestones for updating and implementing the plan.

With the approval of this Hydromodification Plan by the Environmental Protection Agency (EPA), Best Management Practices (BMPs) can be funded with federal 319 cost share grants.

TYPES OF HYDROLOGIC MODIFICATION

Hydrologic modifications include physical alterations to a stream or river channel and its associated corridor, as well as lakes, reservoirs and ground water aquifers. Impervious surfaces such as pavement and rooftops can also contribute to hydrologic modification. These modifications disrupt the natural flow of water and can cause increased erosion, sediment, and other pollutant loadings. Examples include the widening, deepening and channelization of streams, hardening of streambanks, dam and reservoir operations, poorly designed stream barriers (e.g., bridges, dams, culverts) and construction in and along stream riparian buffers and wetlands.

Hydrologic modification includes a variety of activities defined in Section 304(f)(2) of the Federal Clean Water Act (CWA) such as salt water intrusion resulting from reductions of fresh water flow from any cause, including extraction of ground water, irrigation, obstruction, and diversion; and changes in the movement, flow, or circulation of any navigable waters or ground waters, including changes caused by the construction of dams, levees, channel, causeways, or flow diversion facilities.

Hydrologic modification activities can generally be classified into two types, those that alter the flow regime of a waterbody and those that alter the stability of a stream channel or floodplain. When hydrologic modifications generate water pollution not regulated as a point source, it is considered nonpoint source pollution. An outline of hydrologic modification activities is provided below:

Stream Flow:

Alterations to the flow regime of a stream include trans-basin diversions, reservoir releases, and diversions as well as timber harvesting, wildfire, brush removal, land disturbance, urbanization, and mining. These land uses can alter a stream's hydrologic regime with higher runoff peaks and shorter duration flows.

Lake and Reservoir Circulation:

Activities that alter the flow regime of lakes and reservoirs include dredging and sluicing to increase storage capacity and the construction of dikes and levees which can affect circulation patterns in the reservoir. These activities can cause sediment and nutrient loads to be re-suspended in high concentrations and transported back to the river.

Ground Water Flow:

Aquifer pumping and recharge modifies the hydrologic function and dynamics of ground water systems. All the activities that modify stream flow and stability can similarly affect ground water flow. Additional activities include drainage activities, wetland reclamation, and deep injection.

Stream Channel and Floodplain Function and Stability:

Diversions, bridge abutments, dams, channel straightening, utility crossings, stream stabilization, dredging, fill disposal, and significant disturbances to stream-side vegetation can alter the

function or stability of a stream. In Utah, most of these activities are regulated by the Utah Division of Water Rights pursuant to Utah Code Ann., 73-3-29 and the U.S. Army Corps of Engineers per CWA 404 requirements Sec. 10.

Wetland restoration or construction in streamside areas, floodplain modification activities, and riparian vegetation manipulation such as grazing or noxious weed control in riparian areas may also alter the function or stability of a stream. These hydrologic modifications alter stream function by changing the infiltration and flood dynamics of riparian and floodplain areas.

PRIORITIZATION AND IMPLEMENTATION

Utah's Priority Water Bodies:

Hydrologic modification accounts for impairment to 842 miles of Utah's streams per Utah's 2008 305(b) report to Congress. However this is most likely an underestimate as many water quality impairments related to total dissolved solids, temperature, and dissolved oxygen can be at least partially attributable to extensive hydrologic modifications that have occurred statewide.

Priority watersheds are defined as those implementing an approved Total Maximum Daily Load (TMDL) study. Eighty TMDLs have been completed to date with their implementation status depending on many factors including local stakeholder involvement and availability of financial and technical resources. Utah is currently developing a Recovery Potential Screening model to identify where to invest limited resources to optimize environmental benefits. The state has also identified a list of 127 priority lakes and reservoirs that are publicly owned and accessible with a surface area equal to or greater than 50 acres and provides important recreational benefit to the public.

Implementation Schedule:

Watersheds with hydrologic modification impacts are identified in the biennial §305(b) assessments. Implementation of Utah's Hydromod BMPs will occur in conjunction with ongoing NPS control projects in priority watersheds.

UTAH'S PLANNING STRATEGY

The State of Utah employs a watershed based approach to address water quality impairments as outlined in the Utah Nonpoint Source Management Plan. For more details on the watershed approach please see the Utah Statewide NPS Management Plan.

The Hydromod subcommittee of the Water Quality Task Force will be headed by the Division of Water Quality and will actively work on relevant issues identified by the Water Quality Task Force. The responsibilities of this sub-committee can include, but are not limited to:

1. Oversee development and updates of the Hydromod Plan;
2. Ensure the reassessment of Utah's Hydromod BMPs as they develop or improve on a four year cycle;

3. Implement Utah's Hydromod BMP implementation program reviews as determined necessary including the participation of appropriate parties;
4. Coordinate with participating agencies and organizations;

A schedule of activities of the subcommittee is included in Appendix A. Outputs include:

1. Hydromod Subcommittee activities
2. Hydromod Plan review and update
3. Reviews of and revisions to Utah's Hydromod BMPs
4. Implementation of Utah's Hydromod BMPs
5. Reporting

Hydrologic Modification NPS ControlPprograms:

Examples of hydrologic modification NPS control programs include:

1. Information and education efforts provide information about BMPs. Target audiences include landowners, water rights owners, and the general public.
2. Regulatory programs, such as the Utah Stream Alteration Permitting Program administered by the Utah Division of Water Rights.
3. Zoning regulations which dictate BMPs appropriate for a given location.
4. Planning programs determine which measures are appropriate while considering the objectives of all participants and interests.
5. Incentive programs provide financial assistance for the implementation of BMPs that benefit the public.
6. Research programs establish and verify standards and specifications which ensure that BMPs provide the intended benefits.
7. Agency coordination programs address competing public objectives, consolidate product or service delivery, and reduce governmental duplication.
8. Site planning programs identify the optimum locations of activities.

REGULATORY PROGRAMS

Federal Regulation:
The Department of the Army's Regulatory Program is one of the oldest in the federal government. Initially, it served a simple purpose: to protect and maintain the navigable capacity of the nation's waters. Changing public needs, evolving policy, court decisions and new statutory mandates have changed several aspects of the program including its breadth, complexity and authority. The U. S. Army Corps of Engineers (Corps), through its Regulatory Program, administers and enforces Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Section 404 of the Clean Water Act. The Rivers and Harbors Act prohibits the obstruction or alteration of navigable waters of the United States without a permit from the Corps. This

includes any work in or over these waters, or which affects the course, location, condition, or capacity of such waters. Five waterways in Utah are deemed Section 10 navigable waters:

1. Bear Lake;
2. Flaming Gorge Reservoir;
3. Green River, mouth to 20 miles above Green River Station;
4. Colorado River , mouth of Castle Creek to Cataract Canyon (4.5 miles below mouth of Green River and,
5. Lake Powell.

6. The Corps administers and enforces other navigable-in-fact waters, such as the Great Salt Lake, Bear River, Jordan River, Utah Lake, Pineview Reservoir, under Section 404 of the Clean Water Act. Many other rivers, reservoirs, streams, creeks, wetlands, playas and mudflats are also Section 404 waters of the United States.
7. Bear River
8. Jordan River

Section 404 of the Clean Water Act prohibits discharge of dredged or fill material, or excavation in waters of the United States without a permit from the Corps. Typical activities requiring these permits include:

1. depositing fill or dredging material in waters of the U. S. or adjacent wetlands;
2. site development fills for residential, commercial, or recreational developments;
3. linear projects for construction of roads and utility line;,
4. construction of revetments, levees, dams, dikes, and weirs;
5. placement of riprap and road fill; and
6. excavation, including land clearing, ditching, and channelization that destroys or degrades waters of the United States, including wetlands; and;
7. runoff or overflow from a land or water disposal area.

Other laws that may affect the processing of permit applications by the Corps of Engineers include:

1. Utah Stream Alteration Code
2. National Environmental Policy Act
3. Fish and Wildlife Coordination Act
4. Endangered Species Act
5. National Historic Preservation Act
6. Federal Power Act
7. Wild and Scenic Rivers Act
8. National Fishing Enhancement Act

Types of Permits:

Standard Individual Permits are required for projects on waters of the United States which will have significant impacts. Various types of permits exist for various scenarios depending on the

size, objective, and impacts of the project. Permits are issued following a full public notice and review period of an individual application. After evaluating all comments and information received a final decision on the application is made. Any individual that plans on undertaking project that may impact the waters of the United States should be in contact with the Army Corp of Engineers long before the project is scheduled to be implemented.

The following criteria are considered by the Corps in the evaluation of applications:

1. the relative extent of the public and private need for the proposed activity;
2. the practicability of using reasonable alternative locations and methods to accomplish the objective of the proposed activity; and
3. the extent and permanence of the beneficial and/ or detrimental effects which the proposed activity is likely to have on the public and private uses to which the area is suited.

The Corps also evaluates applications for compliance with the Section 404(b)(1) Guidelines. The Corps can only permit the least damaging practical alternative under these guidelines. The applicant must address whether the aquatic site can be avoided, and if not, why. If aquatic sites cannot be avoided, the applicant addresses how the impacts will be minimized and how unavoidable impacts can be compensated through creation or restoration of aquatic resources.

State Regulations:

The Division of Water Rights has regulatory authority over most hydrologic modifications. Principle regulatory responsibilities are defined in Utah Code Ann., Sections 73-2-1(3)(a) and 73-3-29 and include both surface and ground waters.

The Division of Water Rights is responsible for the distribution of surface and ground waters on 35 river systems in the state. River commissioners in each river system area are responsible for ensuring that waters are diverted in correct amounts and at the appropriate times. Commissioners also have responsibilities in ground water basins to ensure that yearly diversion amounts are not exceeded.

The dam safety section has the responsibility of overseeing dam construction and repair (U.A.C. R655-10). They review plans and specifications and perform periodic inspections on structures throughout the state to assure that structures are properly maintained. The Division also has the responsibility for licensing and supervising water well drillers (U.A.C. R655-10). Division notification is required for all water wells drilled in the State and logs of each well must be submitted upon well completion.

The Army Corps has issued Regional Programmatic General Permit 40 (RPGP40) to the State Engineer at the Division of Water Rights, giving 404/Sec 10 authorization for most approved State stream alteration activities. Some exceptions can include projects that involve adverse impacts to wetlands, threatened and endangered species, cultural resources, etc. The Stream Alteration Code requires a written authorization permit from the Division of Water Rights to alter or change the beds and banks of any natural stream (U.A.C. R655-13). Typical projects requiring Utah State Stream Alteration Permits include:

1. Dredging or excavation in or adjacent to any natural stream channel.
2. Erosion protection including jetties, gabions, riprap, concrete walls, barbs, bioengineering, flood control, etc.
3. Justifiable channel adjustment or realignment.
4. Installation or maintenance of irrigation works, sediment basins, or water control structures.
5. Utility line crossings and bridges, and
6. Construction of any facility adjacent to and impacting the channel or its natural environment.

The Division of Water Rights bases project approval on the impacts to the following:

1. Natural Stream Environment
2. Aquatic wildlife
3. Flood capacity
4. Existing water rights
5. Recreational Use

State Permits qualifying under PGP40 are in compliance with section 404 guidelines and does not need an additional permit from the Corps.

The Utah Department of Environmental Quality has regulatory jurisdiction over projects that may affect water resources under section 401 of the Clean Water Act. The Clean Water Act provides that all applicants for a federal license or permit for activities that may impact water quality must apply for and obtain state water quality certification, commonly known as 401 Water Quality Certification. Certification must be obtained prior to any permit or license application submitted to the affected federal agency. These include a Section 404, dredge and fill permit from the Corps of Engineers and a Federal Energy Regulatory Commission Permit or license to construct and operate a hydroelectric generating facility.

County Regulation:
The Utah State Code ann., Sections 17-8-5, and 17-8-5.5, delegate the authority and responsibility for flood control activities within both unincorporated county and incorporated municipal boundaries. This authorizes counties to regulate development within stream or river flood channel/meander boundaries, as defined historically, by more recent hydrologic measurements, or through the use of flood discharge projection models.

Municipal Regulation:

The Utah State Code ann., Title 10 Chapter 9a, authorizes counties and cities to control land use within their respective boundaries. Such controls include the "police powers" to zone property for appropriate uses to protect public health, safety, and welfare. Within zoning ordinances, conditional permits can be granted in sensitive areas which may require set-backs, buffer zones, or dedications of property for the public good.

BEST MANAGEMENT PRACTICES

Utah's Hydromod Best Management Practices are provided to guide NPS control efforts from hydrologic modifications and minimize impacts to aquatic wildlife habitat. Hydromod BMPs are included in Appendix B and organized according to the types of activities they address. For a practice or activity to be considered a BMP for NPS control it must satisfy the application standards identified in this plan.

It is important to include a variety of natural resource expertise and involve all affected parties including land and water rights owners in planning and implementing these practices as each will require location specific design, installation, and maintenance. The primary criterion to determine which BMP is the best suited to address a problem is that it must be effective at protecting water quality and include provisions for operation and maintenance that continue to protect water quality. For more on the application of BMP's please refer to Appendix B of the Utah Statewide NPS Management Plan.

While these BMPs have proven effective in reducing NPS pollution and impacts to aquatic wildlife it must be stressed that every effort should be made to avoid hydrologic modification impacts. It is always more effective, in both a financial and environmental sense, to prevent a water quality problem than try and correct one.

Another area that must be addressed before a BMP is implemented is what effect certain BMPs may have on other resource concerns during or after implementation. In some instances BMPs such as irrigation conversion or retention basins, to name a few, may alter the flow regimes within the watershed. In some instances this could be an increase in available flow in the river, but in other instances it could result in further degradation of the waterbody. The benefits of each BMP must be weighed against the possible impacts that could result from each BMP within the watershed.

Project implementation may also result in short term impacts within the watershed. One example would be implementation activities that may cause disturbances in the water column during project implementation. These disturbances can impact water quality, wildlife, and wildlife habitat. While the long-term effect of the project may be positive, and cooperator implementing a BMP within the stream corridor must be aware of any potential impact the implementation activity will have on the functionality of that waterbody. By applying for, and obtaining the proper permits, many of these issues can be avoided, and impacts can be minimized.

Adoption Process for Utah's Hydrologic Modification BMPs:

In Utah, BMPs for hydrologic modification were developed by the Hydrologic Modification Subcommittee and vetted through a scoping process which included public notice, a 30-day comment period, and public meetings as requested. Finally, the BMPs and associated comments were considered by the Utah Water Quality Task Force and were adopted in conjunction with this Hydromod Plan. In this manner, Utah's Hydromod BMPs and the Hydromod Plan became a

portion of Utah's NPS Management Plan.

The adopted Utah Hydromod BMPs and Hydromod Plan (addendum to the NPS Management Plan) were forwarded to the EPA for their approval. Section 319 (b) of the Clean Water Act requires that State Management Plans to address nonpoint sources of water pollution be submitted by the Governor of each State.

The Hydromod Subcommittee will review, at least once every four years, the list of Utah's Hydromod BMPs to update existing BMPs and to consider additional hydrologic modification activities that may need additional or refined BMPs. If it is shown to be effective, then the BMP will be added to the list of BMP standards and specifications.

Appendix A: Milestones Schedule

Outputs	Milestones
Addendum Schedule	
30-day Public Comment Period	April 1, 2013-May 1, 2013
Adoption by the NPS Task Force	March 2013
Addendum Updates	Review every 5 Yrs. Update as needed
Hydromod Subcommittee	
Coordination with BMP implementation agencies	Ongoing
Recommendations to NPS Task Force	Every Two Years
Ensure consistency	Ongoing
Hydromod BMPs	
Review of 25% to update and refine	Annual or as needed
Public Scoping	Every 5 Years
DWQ	
Reporting	Annually
Implementation of BMPs	(a) In conjunction with ongoing NPS control projects (see table below) (b) As priority watersheds are identified by DWQ to have specific hydromod impacts and are designated by the NPS Task Force as having high priority.
Project Tours	Annually conduct tours which highlight Hydromodification projects that have been implemented around the state. This may be held in conjunction with the Annual Consistency Review.

Appendix B: Best Management Practices

CONSTRUCTION ACTIVITIES

Definition: Standards for construction activities conducted in or adjacent to water bodies.

Objective: To protect water quality and related aquatic wildlife habitat during and after the construction of hydrologic modifications.

Conditions Where Practice Applies: Practices apply to all construction activities related to structure placement, channel modification or streambank stabilization, channel crossings, riparian modification, road construction, and site development that are conducted in stream channels, riparian areas, and floodplains.

BMP Application Standards: It is necessary to protect water quality and beneficial uses during the construction of hydrologic modifications. Four concepts are important with these construction activities: 1. Minimize the area and time of land/channel disturbance; 2. Manage and control runoff between the disturbed area and the stream or lake; 3. Time the activity to minimize exposure of disturbance to high streamflow or lake levels; and 4. Stabilize disturbed soils to prevent erosion.

1. Time construction activity to occur during periods of low flows and to avoid periods when aquatic life are most vulnerable (e.g. spawning). Consult the Utah Division of Wildlife Resources to determine appropriate times for construction.

2. Minimize disturbance in the channel by conducting only essential work in stream area. Conduct staging activities, material/equipment storage, equipment servicing, and excavated material placement well away from the stream. Use physical markers (flagging, stakes) to delineate area to be disturbed.

3. Minimize the length of time that construction occurs. Consolidate channel work and complete the installation without interruption. Avoid conducting concurrent site activities that may delay channel work and increase time of disturbance.

4. Conduct the construction activity in phases. Avoid area-wide clearance of the construction site. Disturb areas in small parcels and stabilize them before proceeding with the next phase.

5. Ensure that all needed materials, manpower, and equipment are available on-site prior to initiating any disturbance in the stream channel/floodplain and tributaries.

6. Protect existing vegetation except where removal is essential for work completion.

7. Dispose of excess material (excavated, debris, vegetation) out of the stream channel/floodplain.

8. Prevent wet cement from entering the water. Cement is highly toxic to aquatic organisms. Ensure that all concrete used during construction is set before allowing contact with streamflow. Wash equipment used during concrete work well away from the stream channel/floodplain and tributaries.

9. Minimize stream fords for equipment. Avoid any alteration to the elevation of the stream bed. Limit crossing frequency to absolutely essential trips (refer to Stream Crossings BMP).

10. Do not conduct work below the existing water level, except for essential preparation for footings or culvert beds. If project involves excessive disturbance below the water level, use coffer dams and divert flows as possible.

11. Control runoff from disturbed areas using temporary ditches, berms, catch basins, and pitting.

12. Install temporary sediment control measures (e.g., silt fencing, straw bales, ditches) prior to initiating construction in the stream channel/floodplain.

13. Completely remove all structures/temporary controls from the site at the end of the construction activity. Remove and dispose sediment accumulated in temporary sediment controls away from the stream environment or redistribute and stabilize as topsoil.

14. Immediately install permanent stabilization controls for disturbed areas (revegetation, revetments, riprap, biotechnical controls) following construction. Some delays may be acceptable for seasonal timing of revegetation (seeding). Maintain temporary controls until the disturbed area is adequately stabilized.

Concerns: Construction activities within the stream channel have significant potential to degrade water quality and exceed State Water Quality Standards (Utah Administrative Code, R-317-2, et. seq.). However, consistent application of construction BMPs will significantly reduce impacts. Construction within the stream channel is classified as a stream alteration and is regulated in the state by the Utah Division of Water Rights and requires acquisition of a permit. Significant activity may also be regulated by the Army Corp of Engineers under the 404 permit program. Each of these agencies must be consulted and the appropriate permits obtained prior to initiation of construction. Project success can be greatly enhanced with planning and personal commitment to reduction of sediment introduced into the stream environment.

BMP References:

Water and Sediment Control Basin
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #638

Fords
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Culverts
Utah's Forest Water Quality Guidelines, a Practical User's Guide for landowners, loggers & Resource Managers, Utah Department of Natural Resources, Division of Forestry Fire and State Lands, 2001, http://www.ffsl.utah.gov/forestryassist/fwqg/UFWQGBook.pdf

Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Sediment Traps
Utah Department of Transportation Erosion and Sediment Control Field Guide, UDOT Environmental Services, 2010,
http://www.udot.utah.gov/main/uconowner.gf?n=15220806279436191

Crossing Placement
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Seeding and Mulch / Mats
Utah Department of Transportation Erosion and Sediment Control Field Guide, UDOT Environmental Services, 2010,
http://www.udot.utah.gov/main/uconowner.gf?n=15220806279436191

Straw bales and Check dams
Utah Department of Transportation Erosion and Sediment Control Field Guide, UDOT Environmental Services, 2010,
http://www.udot.utah.gov/main/uconowner.gf?n=15220806279436191

Diversion of Flows around Construction Sites
USDA Forest Service, Region 4, 1988. Soil and Water Conservation Practices Handbook. Ogden, Utah. Forest Service Handbook 2509.22

Perimeter Controls (flagging, fencing, staking)
United States Environmental Protection Agency. 1993. Guidance Specifying Management Measures For Sources Of Nonpoint Pollution In Coastal Waters. Washington D.C. EPA 840-B-92-002.

Silt Fences and Filter Fabric
Utah Department of Transportation Erosion and Sediment Control Field Guide, UDOT Environmental Services, 2010,
http://www.udot.utah.gov/main/uconowner.gf?n=15220806279436191

EMERGENCY MEASURES

Definition: Standards for placing hydrologic modifications in emergency situations involving immediate, potential or actual injury or damage to person or property.

Objective: To protect water quality and related aquatic wildlife habitat to the extent possible, and to ensure appropriate reclamation of these resources after the event.

Conditions Where Practice Applies: This BMP applies whenever a hydrologic modification activity occurs in order to prevent injury or damage to persons or property. These conditions are characterized for stream alterations in Utah Code Ann., section 73-3-29 (2)(b). In addition to the Division of Water Rights being contacted as per code, the Corps may need to be contacted prior to commencement of activity.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses while placing hydrologic modifications during emergency situations. To the extent possible, apply the Construction Activities BMP. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Keep the amount of disturbance as low as possible.

3. To the extent possible, work with natural processes such as stream dynamics. Provisions should be made to accommodate natural events such as floods.

4. Identify and make appropriate repairs when the emergency is over.

5. Develop contingency plans prior to emergency situations. It is better to be prepared beforehand. See Flood Control Practices BMP.

Concerns: It is very important for land and water rights owners and managers to understand their legal responsibilities in implementing emergency hydrologic modifications.

BMP References:

See Flood Control Practices

TRANS-BASIN DIVERSIONS

Definition: Standards for diverting stream-flows from one drainage basin to another.

Objective: To protect water quality and related aquatic wildlife habitat as changes to historical stream-flows in the affected basins are made (from decreased stream-flows in the contributing drainage basin and from increased stream-flows in the receiving drainage basin).

Conditions Where Practice Applies: On diversions of water from one drainage basin to another.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses while diverting water from one drainage basin to another. Apply the Construction Activities BMP in implementing and constructing trans-basin diversions. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Minimize sediment loads to streams while operating trans-basin diversions.

3. Work to maintain instream flow regimes, of an adequate volume and duration in downstream environments of the contributing drainage basin. This is intended to protect stream channel function and habitat for the aquatic resources, including water quality parameters such as temperature. This objective does not supercede regulatory requirements or diversions for legitimate water rights.

4. Reduce adverse impacts of extreme high flow regimes such as downcutting and bank erosion in the receiving drainage basin by using conveyance systems other than existing stream channels such as pipelines.

5. For any impoundments associated with trans-basin diversions, see the Impoundments BMP.

6. Develop long term operation and maintenance procedures in order to meet the specified objectives.

Concerns: There must be an existing valid water right to pursue a trans-basin diversion (Utah Code Annotated, Sections 73-3-3 and 73-3-8). Trans-basin diversions have the potential to dewater stream reaches of the donating drainage basin, destroying the associated aquatic and riparian resources, and increasing flows over the historical levels in the receiving basin. Monitor instream flow regimes in order to protect them from further flow depletion.

BMP References:

Flow Release Timing Management
Bovee, K.D. and R. Milhous. 1978. Hydraulic simulation in instream flow studies: theory and techniques. In-stream Flow Information Paper 5. FWS/OBS-78/33 130 p.

Channel Maintenance Flows
Whiting P.J., Department of Geological Sciences, Case Western Reserve University, Cleveland, Streamflow Necessary for Environmental Maintenance, Earth Planet Sci. 2002 30:181-206

Fishery and/or Riparian Vegetation Maintenance Flows
Bovee, K.D. and R. Milhous. 1978. Hydraulic simulation in instream flow studies: theory and techniques. In-stream Flow Information Paper 5. FWS/OBS-78/33 130 p.

DIVERSIONS

Definition: Standards for placing and operating structures or devices within or on the banks of a stream channel for the purpose of diverting and distributing water which has been appropriated by a water rights claim.

Objective: To ensure adequate river function and to protect water quality and related aquatic wildlife habitat during the placement and operation of these structures or devices.

Conditions Where Practice Applies: Any stream channel where an active water right and point of diversion have been established.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses during the placement, operation, and maintenance of diversions. Apply the Construction Activities BMP in constructing diversions. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Design diversions that can pass the sediment load. Typically these are smaller in size.

3. Develop maintenance procedures for larger structures which trap sediment in order to minimize their impact to the surrounding aquatic and terrestrial environment. Remove dredged material and dispose of it away from the stream or redistribute it as topsoil and revegetate.

4. Sluicing should be avoided, but if required, conducted as part of a coordinated sediment management plan with input and review by the Utah Department of Natural Resources and Department of Environmental Quality, Division of Water Quality. General guidelines to follow if sluicing is required include conducting the activity only during high flow events such as spring runoff to distribute accumulated sediments and restore the sediment balance of downstream reaches.

5. Design diversions so that pushing or dredging streambed material to divert flow is not necessary or with large diversions, kept to a minimum.

6. Use materials in constructing diversions that are suitable for use in a natural stream channel. Demolition debris, asphalt, garbage, loose plastic, car bodies, etc. are not suitable material.

7. Locate diversions in sites that avoid changes in streambed elevation. An increase in bed elevation of the channel will result in an increase of channel meander, width, deposition, and streambank instability.

8. Larger diversions may require bank stabilization upstream and downstream of the structure.

9. Maintenance of structures can be reduced and efficiency improved if channel geometry and morphology are considered when the structures are sited.

10. Develop long term operation and maintenance procedures to minimize impact to the aquatic environment and riparian zone.

Concerns: There must be an existing, valid water right to place a diversion (Utah Code Annotated, Sections 73-3-3 and 73-3-8) along with a stream alteration permit. Placing a diversion structure can have a significant impact to a natural stream channel including the fixing of the channel location and inhibiting natural stream migration. Sediment is trapped behind the structures, creating a maintenance problem and continual impact to the system. Sediment balance downstream of the structure in the same manner is disrupted and channel degradation can occur. Large structures which take a substantial amount of flow, but bypass sediment, become unable to transport sediment downstream of the structure. Deposition of bedload immediately below the structure forms mid-channel and side- channel sediment bars. Sluicing of organic rich sediment from behind structures endangers aquatic wildlife.

BMP References:

Diversion Structures
State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

Diversion Dam
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #348

Sluicing
McKee, M. and L. Oman. 2009. Managing The Impacts Of Small Reservoir Flushing. Utah Water Research Laboratory, Utah State University. Appendix C in *Managing Sediment in Utah's Reservoirs, Utah Division of Water Resources, March 2010.*

U. S. Army Corps of Engineers. 2005. Guidance on the Discharge of Sediments From or Through a Dam. Appendix D in *Managing Sediment in Utah's Reservoirs, Utah Division of Water Resources, March 2010.*

Fish Screens and Barriers
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Submerged Weirs
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

IMPOUNDMENTS

Definition: Standards for placing and operating structures that impound water, such as dams for irrigation, stock-watering, water supply, recreation, wastewater treatment and flood control. These impoundments impact the downstream environment via changes in streamflow regime, and impact the upstream environment via changes in channel grade.

Loss of storage in impoundments due to sedimentation can also be another problem that can occur in impoundments. Various BMPs are available to remove and dispose of this sediment. BMPs may also be installed upstream or in neighboring uplands to reduce the amount of sediment entering into the impoundments.

Objective: To protect water quality and related aquatic wildlife habitat during the construction, operation and maintenance of these impoundments.

Conditions Where Practice Applies: On all impoundments of water, such as dams, reservoirs, ponds, stock ponds, retention basins, and off stream and on stream impoundments. Additional BMPs may also be installed above the structures to reduce the amount of sediment reaching the impoundment.

BMP Application Standards: Construction, operation and maintenance practices of impoundments and tributaries should be evaluated on a site specific basis. General standards include:

1. It is necessary to protect water quality and beneficial uses during the placement, operation, and maintenance of impoundments. The Construction Activities BMP should be applied in implementing and constructing impoundments. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Minimize sediment levels to streams during construction, maintenance, and sediment removal activities.

3. Maintain flow regimes of an adequate volume and duration in downstream environments to protect habitat for the aquatic resources, including riparian vegetation and stream channel.

4. Maintain adequate water quality in the downstream environments to protect designated beneficial uses.

5. Line wastewater impoundments to prevent movement of pollutants to groundwater or surface waters.

6. Develop long term operation and maintenance procedures in order to meet the specified objectives.

7. Conduct soil testing on all sediment removed from impoundments to determine if the soil contains high levels of potentially harmful contaminant to determine how to properly dispose of the dredge material.

8. Determine best method to remove, and dispose of sediment removed from these impoundments during dredging activities.

9. Maintain impoundment storage capacity by installing BMPs focused on Sediment retention and reduction higher in the watershed.

Concerns: There must be an existing valid water right when placing and operating an impoundment (Utah Code Annotated, Sections 73-3-3 and 73-3-8). Also, a Stream Channel Alteration Permit and a Dam Safety Review may be required.

Large on-stream impoundments have the potential to impact downstream reaches of the stream, from both water quantity and water quality aspects. The NEPA review process is required on federal projects.

All impounding structures are subject to the Dam Safety Act of 1990, administered by the Utah Division of Water Rights. Their program regulates safety related to the integrity of the impounding structure, and proximity to human populations. For many structures and dams, the law requires dam owners to formalize their Standard Operating Plans (SOP). These SOPs should include operation standards to minimize downstream impacts to the aquatic resources.

BMP References:

Regulating Reservoirs

USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #552-B

Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Whiting P.J., Department of Geological Sciences, Case Western Reserve University, Cleveland, Streamflow Necessary for Environmental Maintenance, Earth Planet Sci. 2002 30:181-206

Irrigation Storage Reservoirs

USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #436

Bovee, K.D. and R. Milhous. 1978. Hydraulic simulation in in-stream flow studies: theory and techniques. In-stream Flow Information Paper 5. FWS/OBS-78/33 130 p.

Armour, Carl L. 1991. Guidance for Evaluating and Recommending Temperature Regimes to Protect Fish. U.S. Fish Wildl. Serv., Biol. Rep. 90(22). 13 pp.

Dam, Multipurpose
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #402

Bovee, K.D. and R. Milhous. 1978. Hydraulic simulation in in-stream flow studies: theory and techniques. In-stream Flow Information Paper 5. FWS/OBS-78/33 130 p.

Armour, Carl L. 1991. Guidance for Evaluating and Recommending Temperature Regimes to Protect Fish. U.S. Fish Wildl. Serv., Biol. Rep. 90(22). 13 pp.

Sluicing
McKee, M. and L. Oman. 2009. Managing The Impacts Of Small Reservoir Flushing. Utah Water Research Laboratory, Utah State University. Appendix C in Managing Sediment in Utah's Reservoirs, Utah Division of Water Resources, March 2010.

U. S. Army Corps of Engineers. 2005. Guidance on the Discharge of Sediments From or Through a Dam. Appendix D in Managing Sediment in Utah's Reservoirs, Utah Division of Water Resources, March 2010.

Lakes and Ponds
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Multilevel Penstocks
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Armour, Carl L. 1991. Guidance for Evaluating and Recommending Temperature Regimes to Protect Fish. U.S. Fish Wildl. Serv., Biol. Rep. 90(22). 13 pp.

Wastewater Disposal Ponds
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Sediment Control Basins
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #350

Flood Retarding Dam
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #402

Sediment Removal
Palmermo, M.R., Shroeder P.R., Estes T.J, Francingues N.R., Army Corps of Engineers, 2008 Techincal Guidelines for Environmental Dredging of Contaminated Sediments. ERDC/EL TR-08-29.

Buffers
Johnson, C.W., and Buffer, J 2008, Riparian Buffer Design Guidelines For Water Quality and Wildlife Habitat Functions on Agricultural Landscapes in the Intermountain West. United States Department of Agriculture, U.S. Forest Service, Report RMRS-GTR-203

Mankin K.R., et.al, 2007, Grass-Shrub Riparian Buffer Removal of Sediment, Phosphorus, and Nitrogen from Simulated Runoff, Journal of the American Water Resourced Association, Volume 43, No. 5.

Grassed Waterways
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #412

Sediment Control Basin
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #350

GROUNDWATER WITHDRAWAL/RECHARGE

Definition: Standards for activities that alter the exchange of water in groundwater systems that change the rate and direction of ground water movement (and attendent pollutants) between surface waters and associated aquifers.

Objective: To minimize and prevent, to the extent possible, adverse impacts to surface water/ground water quality and quantity from changes in the direction and quantity of groundwater supply.

Conditions Where Practice Applies: In all aquifer and water table systems that influence the hydrology of a surface water body and where saline groundwater/fresh groundwater aquifer boundary conditions occur.

BMP Application Standards: Recognition that the groundwater/surface water system is a highly interrelated system and that withdrawal (pumping) and recharge (infiltration) practices can effect the flow (and associated pollutant) direction in the surface water/ground water regime is the basis for decisions regarding groundwater use and the selection of Best Management Practices. Pumping groundwater for use can lower existing water table elevations resulting in decreased supply rates to the stream and in extreme cases, drawdown can be sufficient to reverse the groundwater flow direction. Flow reversal can result in loss of flow from the stream to the groundwater or it can direct the flow from a polluted or saline aquifer to an uncontaminated system. Recharge activities (ponds, infiltration basins & trenches, injection wells) can similarly alter the groundwater flow rate and direction relative to the stream baseflow.

Due to the diverse nature of projects that can have an effect on the groundwater/stream hydrology and the interrelated factors effecting flow rates and pollutant loads/rates, the activities and selection of appropriate BMPs should be carefully analyzed on a project specific basis. The selection and implementation of BMPs will be influenced by how closely the groundwater system is hydrologically connected to surface waters, the quality of the waters, the presence of saline/fresh groundwater boundaries, the ownership of water rights, and the significance of the volume of withdrawal or recharge.

1. It is necessary to protect water quality and beneficial uses when changing the rate and direction of ground water movement and attendent pollutants between surface waters and associated aquifers. Plan and coordinate withdrawal/recharge activities as feasible to maintain in-stream flow regimes and water quality in downstream environments. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Conduct withdrawal/recharge activities in a manner that minimizes adverse impacts to baseflow reduction (dilution potential) and maintains adequate water quality to protect beneficial uses to the extent possible.

3. Conduct withdrawal activities in a manner that maintains adequate water supply (water table) to sustain riparian/wetland vegetation to the extent possible.

4. Address the effect of extensive recharge activities on the baseflow of the stream and the channel capacity for potential increased flows.

Concerns: There must be an existing, valid water right when changing direction or quantity of a ground water supply (Utah Code Annotated, Sections 73-3-3 and 73-3-8). Changes in groundwater level and flow direction as the result of withdrawal/recharge activities can result in pollution problems to the stream/ground water regime by changing the pollutant gradient. Most recharge activities are classified as point sources. These activities are regulated by the Groundwater Discharge Permit Program and Underground Injection Control programs of the State Department of Environmental Quality, Groundwater Protection Section (Utah Administrative Code, R317-6, et. seq.). When the withdrawal/recharge activity is significant enough to alter the flow regime of the stream or allow intrusion of pollutants into an aquifer, the activity will also be classified as a nonpoint source hydrologic modification. Prior to implementation of withdrawal/recharge activities, extensive groundwater investigations may be necessary to assure that there will be no undesirable short-term or long-range effects resulting from the expected maximum zone of influence.

BMP References:

Fishery and/or Riparian Vegetation Maintenance Flows
Tennant, D.L. 1976. In-stream Flow Regimes for Fish, Wildlife, Recreation and Related Environmental Resources. in: Osborn, J.F. and C.H. Allman (editors). Proceedings of the Symposium on In-stream Flow Needs. Western Division of American Fisheries Society. Volume II. 657 pp.

Channel Maintenance Flows
Whiting P.J., Department of Geological Sciences, Case Western Reserve University, Cleveland, Streamflow Necessary for Environmental Maintenance, Earth Planet Sci. 2002 30:181-206

Pumping Plant for Water Control
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #533

Infiltration Gallery, Trenches, Basins
Scholze R. J., Mcneilly M.P., 1993, Army Corps of Engineers, A Summary of Best Management Practices for Nonpoint Source Pollution, USACERL Technical Report EP-93/06

Waterspreading
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #640

Wells
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #642

U.S. Department of the Interior, United States Geological Survey, 2000, Water in Storage and Approaches to Ground-Water Management, High Plains Aquifer, 2000, I 19.4/2:1243.

CHANNEL REALIGNMENT

Definition: Standards for straightening, restoring, or relocating a stream channel.

Objective: To ensure appropriate river function, flood capacity, sediment transmission, and biological integrity, and to minimize detrimental effects from channel realignments. To protect water quality and related aquatic wildlife habitat during and after the realignment has been implemented.

Condition Where Practice Applies: Where appropriate planning processes have determined that channel realignment is necessary to accommodate development, reclaim riverine areas, or to remove the stream from problematic locations.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses when straightening, restoring, or relocating a stream channel and when maintaining the associated structures. The Construction Activities BMP should be applied in implementing and constructing channel realignments. Refer to other BMPs that may apply including, Grade Control, In-Stream Structures, Stream Crossings, and Bank Stabilization. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Sufficient hydrologic investigation should be done to determine the appropriateness of the new channel configuration. Data on channel width, depth, slope, sinuosity, bed materials, flow regime and velocity, floodplain width, soils and geology, and sediment yield and transport should be obtained and utilized.

3. Every effort should be made to retain as many natural functions of the river as possible in its new configuration including those provided by stream-side vegetation.

4. Re-alignments should not interfere with fish migration.

Concerns:

Channel straightening is not recommended due to long term negative effects on aquatic habitat, water quality and other hydrologic functions of streams such as increased peak flows, channel erosion, and sediment transport. An understanding of sediment transport, channel hydraulics, and stream dynamics is necessary for successful channel realignment. Consultation with qualified professionals such as a geomorphologist, engineer, and hydrologist is highly recommended.

Channel realignments which approximate natural river conditions and functions as closely as possible are most likely to succeed. Channel realignments constitute stream alterations. Stream alteration activities require a stream alteration permit obtained from the Utah Division of Water Rights. Other permits may be necessary and must be obtained before proceeding.

BMP References:

Channel Relocation

State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

Sear, D.A., 1994, River Restoration and Geomorphology, Aquatic Conservation: Marine and Freshwater Ecosystems, Vol. 4, 169-177

Stream Renovation

Sear, D.A., 1994, River Restoration and Geomorphology, Aquatic Conservation: Marine and Freshwater Ecosystems, Vol. 4, 169-177

Channel Straightening

CH2M-Hill. 1992. Jordan River Stability Study. Prepared for Salt Lake County.

Sear, D.A., 1994, River Restoration and Geomorphology, Aquatic Conservation: Marine and Freshwater Ecosystems, Vol. 4, 169-177

Channel Realignment

Sear, D.A., 1994, River Restoration and Geomorphology, Aquatic Conservation: Marine and Freshwater Ecosystems, Vol. 4, 169-177

GRADE CONTROL

Definition: Standards for the design and placement of structures to reduce excess stream power.

Objective: To stabilize a degrading stream channel without adversely affecting stream function and stability outside the treatment reach. To protect water quality and related aquatic wildlife habitat during and after the grade controls have been placed.

Conditions Where Practices Applies: In degrading channels that are undergoing headcutting or problems from local scour, and where grade and stream velocity must be managed to stabilize stream channels.

BMP Application Standards: Channel downcutting can be the result of high runoff events, loss of streamside vegetation, advancing valley scarps (Harvey, et. al., 1985), and loss of meanders with the subsequent steepening of channel grade (Berger, 1991). Grade control structures that are placed to treat a degrading stream reach can become the source of channel adjustments both upstream and downstream. These adjustments often include accelerated stream aggradation, lateral migration, bank erosion, sedimentation, and loss of stream habitat (Rosgen and Fittante, 1986). Grade controls often reduce local upstream slope. The width/depth ratio increases, and the stream responds with lateral adjustment (Rosgen, 1993). Design of grade control must accommodate these geomorphic processes.

Grade control structures should be installed in combination with other practices to best protect the stream and its associated resources. This combination of BMPs as a resource management system should stabilize the channel and direct the stream flow (USEPA, 1993), as well as include an appropriate mix of streambank protection (Bank Stabilization BMP), levee protection if necessary (Flood Control BMP), vegetative cover and management (Riparian Modification BMP), and terrace and meander reconstruction (Riparian Modification BMP). The planning process should also investigate watershed activities that may be contributing to the problem.

1. It is necessary to protect water quality and beneficial uses when placing and maintaining grade control structures to reduce excess stream power. The Construction Activities BMP should be applied in constructing grade control structures. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. It is important to rectify any and all factors contributing to the degradation of the channel bed in order to maximize grade control benefits. Structural alternatives can often be minimized or even eliminated if a healthy watershed condition can be maintained (Rosgen, 1993).

3. Grade control practices must be appropriate for the stream type. Conduct a baseline hydrologic investigation to determine the appropriateness of design and location of any structures. Consultation with a geomorphologist, professional engineer, or hydrologist familiar with stream dynamics and geomorphology is recommended.

4. Structures must be substantially keyed into the streambanks and installed to a depth below maximum expected bed scour to prevent loss of structure to erosional undercutting. Scour below the structure should be anticipated and managed with appropriate armoring or other stabilizing treatment.

5. Grade control structures are primarily successful in first and second order streams (especially ephemeral streams). Structure height should be less than 1/5 to 1/2 the bankfull depth to allow the stream to utilize the floodplain effectively and minimize backwater effects and aggradation upstream.

6. Multiple check dams may be required for adequate control. General guidance suggests installation at each 2-3 channel widths. Controls should be located in riffles or in runs or upstream and downstream locations of channel bends (i.e., @ head and tail of pool).

7. Grade control structures must be designed to provide fish passage in streams with a fishery.

8. Riparian vegetation should generally be planted and managed in association with any grade control project. Consider transplanting rooted native material or willow poles where available.

Concerns: A thorough understanding of the causes of channel degradation, stream dynamics and stream type is necessary in planning and implementing grade control projects. Check dams and drop structures must be appropriate for the stream type and incorporated with revegetation efforts. Grade control structures often result in adverse channel adjustments beyond the project area. These adjustments may require frequent and expensive maintenance and can result in impaired water quality and habitat values. A Stream Alteration Permit, issued by the Utah Division of Water Rights, is required for projects within the stream channel. Grade control projects must comply with all federal, state, and local regulations.

BMP References:

Drop Structures
State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

Grade Stabilization Structures
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #410

Control of In-channel Excavation
USDA Forest Service, Region 4, 1988. Soil and Water Conservation Practices Handbook. Ogden, Utah. Forest Service Handbook 2509.22

Stream Channel Stabilization
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #584

Structure for Water Control
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #587-1

Vortex Weir
Ruttenberg D., 2007. An Evaluation of Fish Passage at Rock Vortex Wiers, http://www.stream.fs.fed.us/fishxing/fplibrary/Ruttenburg_2007_EVALUATION_OF_FISH_PASSAGE_AT_ROCK_VORTEX.pdf

IN-STREAM STRUCTURES

Definition: Standards for the placement of material within an active channel as part or all of a diversion, checkdam, deflector, bridge abutment, bridge, or other piling, or other structure that reduces channel capacity, causes upstream back-watering or eddying, affects the downstream flow configuration, or causes the river to adjust its bankfull channel.

Objective: To protect water quality and related aquatic wildlife habitat during and after the in-stream structure is placed. To ensure that in-stream structures do not adversely affect the configuration and function of the bankfull channel in providing flow and sediment transport, especially during bankfull flow, or to ensure that such adverse effects are identified and appropriately mitigated.

Conditions Where Practice Applies: The practice applies whenever the placement of materials causes the stream to adjust its bankfull channel. In situations where the bankfull channel is not known, the apparent active channel (below the point on the streambanks where flow extends into an obvious floodplain that is utilized less often than once in three years on the average) will be considered bankfull.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses during the placement, operation, and maintenance of in-stream structures. Apply the Construction Activities BMP in implementing and constructing in-stream structures. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Sufficient hydrologic investigation should be done to determine the appropriateness of design and placement of any structures. Data on channel width, depth, slope, sinuosity, bed materials, flow regime and velocity, floodplain width, soils and geology, and sediment yield and transport should be obtained.

3. All structures should be keyed sufficiently into the streambanks and into the channel bed to reduce the possibility of erosion under, around, or through the structure. Special attention should be paid to the structures integrity during the 25-yr flood event or for a higher return interval flood as specified by the land owner, manager or by the design agency. The design event should be determined by structure use, public safety considerations, and acceptable risk of failure.

4. Apply the Bank Stabilization BMP upstream and downstream of the structure when back-watering, eddying, or flow redirection causes erosion or sediment deposition with attendant lateral stream migration and erosion.

5. Apply the Grade Control BMP when the structure causes downcutting in the channel bottom.

6. Make provisions that accommodate or mitigate natural meander migration by the river system.

7. In streams supporting a fishery, design and place all structures so as to not interfere with fish migration.

Concerns: An understanding of open channel hydraulics and stream dynamics is necessary for the successful building or upgrading of in-stream structures. Consultation with a professional engineer or hydrologist who understands stream geomorphology is highly recommended. A State stream alteration permit may also be required.

BMP References:

Diversion and Water Control Structures
State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

USDA Natural Resources Conservation Service. Field Office Technical Guide. Practices #362 & #587

Sediment Control Basins
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #350

Flood Retarding Dam
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #402

Grade and Channel Stabilization Structures
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practices #410 & #584

State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

Miscellaneous In-stream Structures
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Braid Block
U.S. Forest Service. 1992. Stream Habitat Improvement Handbook. Technical Publication R8-TP 16.

Bridges and Culverts
USDA Forest Service, Region 4, 1988. Soil and Water Conservation Practices Handbook. Ogden, Utah. Forest Service Handbook 2509.22

Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Meehan, W.R. 1991 Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society, Special Publication 19. Bethesda, Maryland.

Open Channels

USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #582

Sear, D.A., 1994, River Restoration and Geomorphology, Aquatic Conservation: Marine and Freshwater Ecosystems, Vol. 4, 169-177

Infiltration Gallery Stream Channel Protection

USDA Forest Service, Region 4, 1988. Soil and Water Conservation Practices Handbook. Ogden, Utah. Forest Service Handbook 2509.22

STREAM CROSSINGS

Definition: Standards for placing stream crossing structures and facilities in order to protect the stream and its beneficial uses from nonpoint sources of pollution or other adverse effects.

Objective: To enable installation and maintenance of stream crossing structures that do not significantly cause erosive velocities, unnecessary sedimentation or turbidity, or flooding; alter flow patterns; damage streams or channels; or obstruct fish passage. To protect water quality and related aquatic wildlife habitat during and after the stream crossing has been developed and during its use.

Conditions Where Practice Applies: Practices apply to all permanent or temporary road crossings, bridges, culverts, low-water crossings and fords, and utility crossings through any stream channel.

BMP Application Standards: It is necessary to protect water quality and beneficial uses during the placement, use, and maintenance of stream crossings. The number of crossings shall be kept to the minimum needed for access or efficient routing. Location, design criteria, and protective measures should be developed by an inter-disciplinary team considering stream type and geomorphological character, riparian and vegetative characteristics, stream flow regimen, and hydraulics, and local and downstream beneficial uses of the water.

Construction Activities BMPs shall be applied in the design and development of all crossing structures involving stream courses. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

Concerns: The development of a stream crossing constitutes a stream alteration. Stream alteration activities require a stream alteration permit obtained from the Utah Division of Water Rights. Other permits may be necessary and must be obtained before proceeding.

Structures shall be designed to avoid obstruction of the stream course, including the flood plain. Fill will be stabilized and kept to a minimum. Preventative measures include:

1. Divert stream flow around project sites during construction in order to minimize erosion and downstream sedimentation.

2. Deposit erodible materials well away from the stream channel.

3. Remove any material stockpiled on floodplains in order that rising waters will not reach them.

4. During excavation in or near the stream course, it may be necessary to use suitable coffer dams, caissons, cribs, or sheet piling. This will usually be the case where groundwater is

contributing a significant amount of water to the immediate excavation area. If pumping is used to remove water, discharge to the stream must be clear water by using settling ponds.

5. Construction activities in or adjacent to streams will be limited to specific times to protect beneficial water uses. Construction periods shall be as short as practicable.

6. Install culverts or pipe arches across small streams to conform to the natural stream bed and slope on streams that support fish or seasonal fish passage.

7. Place culverts slightly below normal stream grade to avoid culvert outfall barriers. Do not alter stream channels upstream from culverts, unless necessary to protect fill or to prevent culvert blockage.

8. Install culverts to prevent erosion of fill. Compact the fill material to prevent seepage or failure. Armor the inlet and/or outlet with rock or other suitable material where needed.

9. Align structures perpendicular to stream flow.

BMP References:

Crossing Placement

Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Bridge and Culvert Installation

Utah's Forest Water Quality Guidelines, a Practical User's Guide for landowners, loggers & Resource Managers, Utah Department of Natural Resources, Division of Forestry Fire and State Lands, 2001, http://www.ffsl.utah.gov/forestryassist/fwqg/UFWQGBook.pdf

State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

Culverts

State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Utah's Forest Water Quality Guidelines, a Practical User's Guide for landowners, loggers & Resource Managers, Utah Department of Natural Resources, Division of Forestry Fire and State Lands, 2001, http://www.ffsl.utah.gov/forestryassist/fwqg/UFWQGBook.pdf

Bridges
State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Piers
State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

Channel Pipelines and Utility Crossings
State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

Stream Crossings on Temporary Roads
Utah's Forest Water Quality Guidelines, a Practical User's Guide for landowners, loggers & Resource Managers, Utah Department of Natural Resources, Division of Forestry Fire and State Lands, 2001, http://www.ffsl.utah.gov/forestryassist/fwqg/UFWQGBook.pdf

Fords
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Bridge Monitoring and Inspection
CH2M-Hill. 1992. Jordan River Stability Study. Prepared for Salt Lake County.

BANK STABILIZATION

Definition: Standards for using vegetation or structures to stabilize and protect channel banks against scour and erosion. Practices in this category are designed to prevent or control lateral adjustment or migration of stream channels.

Objective: To stabilize or protect streambanks for one or more of the following purposes, in a manner that will minimize adverse impacts:

1. Reduce sediment loads causing downstream damage and pollution;
2. Prevent loss of land or damage to utilities, roads, buildings, or other facilities adjacent to stream banks;
3. Improve the stream for fish habitat or recreation;
4. Maintain channel capacity; and
5. Protect water quality and related aquatic wildlife habitat during and after the bank has been stabilized.

Conditions Where Practice Applies: Practices in this category apply to stream channels with eroding streambanks.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses during the placement and maintenance of bank stabilization. Apply the Construction Activities BMP in implementing and constructing bank stabilization. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Ensure that measures or practices selected to stabilize banks are suitable for the stream type.

3. Consider structural measures only after an evaluation by an interdisciplinary team of the amount of stabilization that can feasibly be achieved by vegetative protection and measures to manage land uses.

4. Avoid changes in channel alignment except where such changes will result in a more stable channel condition. Make channel alignment changes only after an interdisciplinary evaluation of effects on channel stability, streamflow characteristics, and fluvial processes (see the Channel Realignment BMP).

5. Structural protection should be constructed to a depth well below the anticipated lowest depth of bottom scour.

6. Vegetative protection should be used on upper parts of the bank above normal bankfull height.

7. Streambank protection shall be start and end at a stable or controlled points on the channel bank.

8. Measures and practices should be selected to achieve bank stabilization that:
    a. Are visually pleasing;
    b. Provide fish and wildlife habitat; and
    c. Provide adequate bank roughness to create flow velocities less than would occur under natural bank conditions.

9. All materials, placement and construction will be done according to acceptable standards and specifications for the measure or practice selected.

Concerns: Bank stabilization activities for the most part constitute stream alterations. Stream alteration activities require a stream alteration permit obtained from the Utah Division of Water Rights. Other permits may be necessary and must be obtained before proceeding.

Poorly designed and implemented bank stabilization measures have the potential to cause increased bank and channel erosion by changing flow velocities, obstructing channel capacity, and restricting the stream's access to its floodplain. Improperly planned, designed or placed structural measures can also be visually unpleasing and cause loss of fish habitat.

BMP References:

Riprap Slope Toe Only
Jensen, S.F. 1988. Jordan River Nonpoint Source Management Plan. Salt Lake City-County Health Department.

Riprap with Topsoil and Vegetation
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons.

Gabions
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

CH2M-Hill. 1992. Jordan River Stability Study. Prepared for Salt Lake County.

Soil Cement
CH2M-Hill. 1992. Jordan River Stability Study. Prepared for Salt Lake County.

Conifer Revetment
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Vegetation Enhancement
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons.

Channel Vegetation
USDA Natural Resource Conservation Service. Field Office Technical Guide. Practice #322

Streambank Protection
USDA Forest Service, Region 4, 1988. Soil and Water Conservation Practices Handbook. Ogden, Utah. Forest Service Handbook 2509.22

USDA Natural Resource Conservation Service. Field Office Technical Guide. Practice #580

Jetties
State of Utah, Administrative rules for Stream Channel Alterations, Division of Water Rights, Robert Morgan, P.E. State Engineer. Reprinted 1991. State Archives No. 8858.

Deflectors
Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

CHANNEL/FLOODPLAIN EXTRACTION OR REWORKING

Definition: Standards for the extraction or reworking of materials in stream channels or floodplains. Extraction involves mining of streambed or bank materials to extract gravel, cobbles, or other materials. Reworking materials involves excavation or dredging streambed and/or bank material to extract minerals or a fraction of the soil material.

Objective: To ensure continued appropriate function, flood capacity, sediment transmission, and biological integrity of the stream channel or floodplain. To protect water quality and related aquatic wildlife habitat during and after the extraction or reworking takes place.

Conditions Where Practice Applies: Any channel where the bed and/or bank material is suitable for construction, or where bed and bank materials contain precious minerals.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses during the placement, operation, and maintenance of equipment, materials and structures associated with these activities. Apply the Construction Activities BMP while performing these activities. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Large mining operations significantly impact the natural stream environment, water quality, bank and channel stability, and aquatic wildlife. Careful evaluation of the drainage is required to determine the existing values of the riverine system and the impact the project will impose on the system. The values and/or impact may be significant enough to deny the project.

3. The stream type and erosion deposition balance must be considered. Mining activity is less impacting to aggrading and/or braided systems then to stable or degrading systems.

4. Excavation below the streambed elevation should be avoided. Deep excavation can cause headcut migration and channel degradation.

5. Disturbance to riparian vegetation must be minimized or preferably avoided. Riparian vegetation greatly reduces streambank erosion.

6. Areas disturbed by mining, particularly the bed and banks, may be more susceptible to erosion which may result in an increase in both bedload and suspended material. Measures should be taken to minimize erodibility. Procedures could include (but are not limited to):

    a. Grade control;
    b. Geomorphic reconstruction;
    c. Bank stabilization;
    d. Collecting gravel in an off-channel site;

e. Removal of spoil piles from channel area;
f. replacing armoring; and/or
g. Vegetative reclamation.

7. Extraction of material shall be conducted in such a manner that the return water from the dredge does not significantly increase the turbidity of the stream below the operation.

8. Disturbance of graveled spawning areas at the tail of pools shall be avoided. This includes the discharge of fine material which deposits on the gravel beds.

9. No petroleum products, refuse, or other deleterious material shall be allowed to fall, be washed into, or deposited in or near surface water.

10. Significant changes to channel geometry, channel type and/or condition will require reclamation of the channel and riparian zone.

11. Work shall be timed to avoid spawning periods in streams where fisheries exist.

Concerns: Extracting material from a channel may have serious results including changes in:

1. Geomorphic channel type
2. Sediment transport capabilities
3. Sediment load
4. Streambed elevation
5. Erodibility
6. Stability
7. Riparian vegetation and
8. Water Quality

A Stream Alteration Permit and/or Recreational Gold Dredging permit maybe required for these activities.

BMP References:

Gravel Bar Removal
State of Utah, Administrative Rules for Stream Channel Alterations, Division of Water Rights, 2013, http://www.rules.utah.gov/publicat/code/r655/r655-013.htm

Clearing and Snagging
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #326

FISH HABITAT ENHANCEMENT

Definition: Standards for placing structures or practices to enhance fish habitat.

Objective: To ensure habitat improvements are successful and that they do not degrade water quality or channel conditions during and after the enhancements have been installed.

Condition Where Practice Applies: Surface waters where lack of habitat is limiting fish production; enhancements are often used as mitigation for projects that degrade natural habitat.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses during the placement, operation, and maintenance of equipment, materials and structures associated with these activities. Apply the Construction Activities BMP in implementing and constructing fish habitat enhancements. The Instream Structures BMP and other BMPs may also apply. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Factors causing degraded habitat conditions must be addressed before contemplating habitat improvements.

3. An evaluation of existing habitat conditions must be made prior to designing habitat enhancements. Factors limiting fish production must be identified. An accepted fish habitat evaluation procedure such as the Habitat Quality Index (Binns, 1982), Habitat Evaluation Procedure (U.S. Fish and Wildlife Service), or Instream Flow Incremental Methodology (U.S. Fish and Wildlife Service), should be used.

4. Appropriateness of the structure for the channel type, predicted changes in hydraulics, and predicted use by fish should be evaluated prior to construction. Whenever possible, a fisheries biologist, a hydrologist, and geomorphologist should all be consulted for approval of the project design.

Concerns: Projects will not be successful if the factors causing degradation are not addressed prior to implementing habitat improvements. Poorly designed or implemented fish habitat improvement projects have the potential to do more harm than good by de-stabilizing stream channels. Projects will not be successful if their effect on erosion and deposition are not considered. A stream alteration permit is required for most habitat enhancement projects. Other federal, state, or local laws may apply.

BMP References:

Fish Stream Improvement

USDA Natural Resource Conservation Service. Field Office Technical Guide. Practice #395

Rosgen, D. and B.L. Fittante. 1986. Fish Habitat Structures -- A Selection Guide Using Stream Classification. pp 163-179 in Miller, et al. 1986. Proceedings, 5th Trout Stream Habitat Improvement Workshop. Pennsylvania Fish Commission, Harrisburg. http://www.wildlandhydrology.com/assets/Fish_Habitat_Structures_A_Selection_Using_Stream_Classification.pdf

U.S. Forest Service. 1992. Stream Habitat Improvement Handbook. Technical Publication R8-TP 16.

Resting Area Development

Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3

Meehan, W.R. 1991 Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society, Special Publication 19. Bethesda, Maryland.

Rosgen, D. and B.L. Fittante. 1986. Fish Habitat Structures -- A Selection Guide Using Stream Classification. pp 163-179 in Miller, et al. 1986. Proceedings, 5th Trout Stream Habitat Improvement Workshop. Pennsylvania Fish Commission, Harrisburg. http://www.wildlandhydrology.com/assets/Fish_Habitat_Structures_A_Selection_Using_Stream_Classification.pdf

Spawning Habitat Improvement

Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3

Meehan, W.R. 1991 Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society, Special Publication 19. Bethesda, Maryland.

Rosgen, D. and B.L. Fittante. 1986. Fish Habitat Structures -- A Selection Guide Using Stream Classification. pp 163-179 in Miller, et al. 1986. Proceedings, 5th Trout Stream Habitat Improvement Workshop. Pennsylvania Fish Commission, Harrisburg. http://www.wildlandhydrology.com/assets/Fish_Habitat_Structures_A_Selection_Using_Stream_Classification.pdf

Migration Barriers

Rosgen, D. and B.L. Fittante. 1986. Fish Habitat Structures -- A Selection Guide Using Stream Classification. pp 163-179 in Miller, et al. 1986. Proceedings, 5th Trout Stream Habitat

Improvement Workshop. Pennsylvania Fish Commission, Harrisburg. http://www.wildlandhydrology.com/assets/Fish_Habitat_Structures_A_Selection_Using_Stream_Classification.pdf

U.S. Forest Service. 1992. Stream Habitat Improvement Handbook. Technical Publication R8-TP 16.

Habitat Improvement Dams

Rosgen, D. and B.L. Fittante. 1986. Fish Habitat Structures -- A Selection Guide Using Stream Classification. pp 163-179 in Miller, et al. 1986. Proceedings, 5th Trout Stream Habitat Improvement Workshop. Pennsylvania Fish Commission, Harrisburg. http://www.wildlandhydrology.com/assets/Fish_Habitat_Structures_A_Selection_Using_Stream_Classification.pdf

Deflectors, Barbs, Jetties

Rosgen, D. and B.L. Fittante. 1986. Fish Habitat Structures -- A Selection Guide Using Stream Classification. pp 163-179 in Miller, et al. 1986. Proceedings, 5th Trout Stream Habitat Improvement Workshop. Pennsylvania Fish Commission, Harrisburg. http://www.wildlandhydrology.com/assets/Fish_Habitat_Structures_A_Selection_Using_Stream_Classification.pdf

U.S. Forest Service. 1992. Stream Habitat Improvement Handbook. Technical Publication R8-TP 16.

Shelters, Log Cover

Rosgen, D. and B.L. Fittante. 1986. Fish Habitat Structures -- A Selection Guide Using Stream Classification. pp 163-179 in Miller, et al. 1986. Proceedings, 5th Trout Stream Habitat Improvement Workshop. Pennsylvania Fish Commission, Harrisburg. http://www.wildlandhydrology.com/assets/Fish_Habitat_Structures_A_Selection_Using_Stream_Classification.pdf

U.S. Forest Service. 1992. Stream Habitat Improvement Handbook. Technical Publication R8-TP 16.

References:

Beschta, R.L., J. Griffith, T.A. Wesche. 1993. Field Review of Fish Habitat Improvement Projects in Central Idaho. U.S. Department of Energy. Bonneville Power Administration. Project Number 84-24; 83-359.

Binns, Allen N. 1982. Habitat Quality Index Procedures Manual. Wyoming Game and Fish Department. Frissell, C.A., and R.K. Nawa. 1992. Incidence and Causes of Physical Failure of Artificial Habitat Structures in Streams of Western Oregon and Washington. North American Journal of Fisheries Management. 12:182-197.

FLOOD CONTROL PRACTICES

Definition: Standards for activities to reduce the loss of life or property due to flooding.

Objective: To minimize detrimental effects to natural channels and their long-term function from flood control activities. To protect water quality and related aquatic wildlife habitat during and after the practices have been placed.

Conditions Where Practice Applies: Areas containing valuable property which are prone to flooding.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses during these activities as well as during the placement, operation, and maintenance of structures associated with these activities. Apply the Construction Activities BMP in implementing and constructing flood control practices. The Impoundments, Channel Realignment, or Bank Stabilization BMPs may apply. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Non-structural methods of floodplain protection should be pursued first, then out-of-channel methods. In-channel alterations should be used only as a last alternative.

3. The cross-sectional area of the natural channel, the channel slope, and the mean water velocity, should not be significantly increased or decreased.

4. Preserve or replant stream-side vegetation; preserve pools, riffles, and channel substrate.

5. The flood hazard, including depth, velocity, duration, and frequency, the value of the property to be protected, long-term maintenance costs, and the natural values affected, must be considered prior to undertaking a flood control project.

6. Provisions should be made to retain a sufficiently wide floodplain. If enough width is not possible, then channel stability should be enhanced. As the floodplain is constricted, vegetation provided channel stability should be used if possible, then structural treatments if necessary.

Concerns: In-channel structural flood control measures frequently result in unintended channel adjustments that require additional maintenance, and most often result in severe degradation of water quality or aquatic and riparian habitat.

When using structural flood control practices, a stream alteration permit, 404 permit, and local flood control permit are likely required. Other federal, state, and local laws may also apply.

BMP References:

Non-structural

Land-use Planning

FEMA,1987 - Federal Emergency Management Agency. 1987. Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials. Federal Emergency Management Agency 116. Washington, D.C.

FEMA, 1989 - Federal Emergency Management Agency. 1989. Alluvial Fans: Hazards and Management. Federal Emergency Management Agency 165. Washington, D.C.

CH2M-Hill. 1992. Jordan River Stability Study. Prepared for Salt Lake County.

Urban Redevelopment and Preservation

Federal Emergency Management Agency. 1981. Design Guidelines for Flood Damage Reduction. Federal Emergency Management Agency 15. Washington, D.C.

Land Acquisition In Floodplain Areas

Federal Emergency Management Agency. 1981. Design Guidelines for Flood Damage Reduction. Federal Emergency Management Agency 15. Washington, D.C.

CH2M-Hill. 1992. Jordan River Stability Study. Prepared for Salt Lake County.

Flood-proofing

Federal Emergency Management Agency. 1981. Design Guidelines for Flood Damage Reduction. Federal Emergency Management Agency 15. Washington, D.C.

Forecasting, Warning & Emergency Preparedness

Federal Emergency Management Agency. 1981. Design Guidelines for Flood Damage Reduction. Federal Emergency Management Agency 15. Washington, D.C.

National Weather Service. 1981. Automated Local Evaluation in Real Time: A Cooperative Flood Warning System for Your Community. Salt Lake City, Utah.

Structural

Flood-proof or Retrofit Flood-prone Structures, including Elevation, Relocation, Levee or Flood-wall Construction, Closures, and Sealants

Federal Emergency Management Agency. 1989. Alluvial Fans: Hazards and Management. Federal Emergency Management Agency 165. Washington, D.C.

Federal Emergency Management Agency. 1986b. Retro-fitting Flood-prone Residential Structures. Federal Emergency Management Agency 114. Washington, D.C.

Selective Clearing and Snagging
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p201

American Fisheries Society. 1983. Stream Obstruction Removal Guidelines. Bethesda, MD.

Selective Weed Cutting
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p203

Dikes
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #356
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p200

Levees, Embankments
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p196

Flood Retarding Dam
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #402

Floodwater Diversion
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #400

Floodway
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #404
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p240)

Two-stage Channel
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p222

Channel Enlargement by Widening
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p195

Channel enlargement by Deepening
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p195

Dredging
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p203)

Channel Realignment
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p.193)

Channel Straightening
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p28 & 195

Lined Channels
Brookes, A. 1988. Channelized Rivers, Perspectives for Environmental Management. John Wiley and Sons. p197

RIPARIAN/FLOODPLAIN MODIFICATION

Definition: Standards for using vegetation, structures and/or management practices to restore and protect riparian areas and floodplains and to maintain their appropriate hydrologic functions.

Objective: To restore, protect, or maintain riparian areas and floodplains, and to minimize the adverse effect of actions that alter or modify riparian areas and floodplains. To protect water quality and related aquatic wildlife habitat during and after the modifications have been placed.

Conditions Where Practice Applies: Practices in this category apply to riparian areas and floodplains.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses during these activities as well as during the placement, operation, and maintenance of materials, equipment and structures associated with these activities. Apply the Construction Activities BMP with construction activities or modifications in riparian or floodplain areas. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Sufficient hydrologic investigation should be done to determine the appropriateness of design and placement of any structures in the floodplain.

3. Measures or practices selected to achieve riparian modification should be suitable for the riparian site and stream type, as determined by a qualified interdisciplinary team.

4. Access of a stream to it's floodplain should not be restricted unless it is determined that the loss of appropriate stream function and the associated values is warranted and unless substantial stabilization and other measures to mitigate losses to the system are implemented.

5. Structural measures, such as fences or barriers, may be used to facilitate proper protection and use of streamside areas. These must be maintained to function properly.

6. Measures and practices should be selected to achieve riparian modifications that:
    a. Are visually pleasing;
    b. Provide fish and wildlife habitat;
    c. Allow floodplains and riparian areas to function properly.

7. Uses of the area will be managed to protected riparian vegetation from damage and maintained consistent with the objective of this BMP.

8. All measures and practices used to achieve riparian modification will be implemented according to acceptable standards and specifications for the measure or practice selected.

Concerns: Structures and activities that limit a stream's access to its floodplain or decrease protective riparian vegetation can cause instability of stream banks, increased flooding, and degraded water quality.

If an activity will alter the bed or banks of a natural stream channel, a stream alteration permit from the Utah Division of Water Rights is required.

BMP References:

Riparian Area Designation
USDA Forest Service, Region 4, 1988. Soil and Water Conservation Practices Handbook. Ogden, Utah. Forest Service Handbook 2509.22

Control of Road Construction in Riparian Areas
USDA Forest Service, Region 4, 1988. Soil and Water Conservation Practices Handbook. Ogden, Utah. Forest Service Handbook 2509.22

Location and Design of Roads and Trails
USDA Forest Service, Region 4, 1988. Soil and Water Conservation Practices Handbook. Ogden, Utah. Forest Service Handbook 2509.22

Musclow, H.J., and L.B. Dalton. 1990. Wildlife Mitigation Technologies for Man-Made Impacts. Utah Department of Natural Resources, Division of Wildlife Resources. Publication Number 90-3.

Meehan, W.R. 1991 Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society, Special Publication 19. Bethesda, Maryland. p303

Meander Corridor Protection
CH2M-Hill. 1992. Jordan River Stability Study. Prepared for Salt Lake County.

Tree Planting
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #612

Critical Area Planting
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #342

Channel Vegetation
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #322

WETLAND ENHANCEMENT

Definition: Standards for placing structures and implementing practices that create, restore, or enhance wetlands.

Objective: To successfully create, restore, or enhance wetlands for groundwater recharge, base flow augmentation, recreation, education, flood reduction, research, aesthetics, water purification, wildlife habitat, and bank stabilization or protection. To protect water quality and related aquatic wildlife habitat during and after wetland enhancement.

Conditions Where Practice Applies: This practice applies to sites that were natural wetlands which were drained, and to sites that are capable of storing water for the development of a wetland; it includes structural and nonstructural facilities and practices.

BMP Application Standards:

1. It is necessary to protect water quality and beneficial uses during these activities as well as during the placement, operation, and maintenance of materials, equipment and structures associated with these activities. The Construction Activities BMP should be applied in implementing and constructing wetland enhancements. Persons implementing these activities remain responsible for adhering to applicable laws, rules and regulations.

2. Clearly define wetland objectives and which functional values are desired prior to proceeding with design and implementation.

3. Wetland site selection and evaluation must consider land ownership, use, and availability; water rights; topography; geology; hydrology; soil; climate and weather; biology; and regulations.

4. Provisions must be made to actively manage hydrology (at least until desired vegetation is established), and to perform routine monitoring and maintenance of structures and vegetation. Maintenance may include control of woody species or tunneling animals on dikes; controlled burning of vegetation to maintain a preferred successional stage; and weed control.

5. Select plant material from locally adapted sources when possible.

Concerns: Some wetland enhancement activities may require an existing, valid water right. Wetland creation failures are most often attributed to lack of adequate consideration of hydrology, and/or the lack of adequate care in the first few years of establishment. Possible negative impacts to downstream users from alterations in hydrology must be evaluated. Modification of an existing wetland requires a 404 permit. Other federal, state, or local laws may apply.

BMP References:

Wetland Development or Restoration
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #658

Wildlife Habitat Management
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #644

Wetland Reclamation via Destruction of Drainage Facilities
Hammer, D.A. 1992. Creating Freshwater Wetlands. Lewis Publishers. Chelsea, MI.

Sealing and Lining
Hammer, D.A. 1992. Creating Freshwater Wetlands. Lewis Publishers. Chelsea, MI. p165-166

Dikes, Dams, or Berms
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #356

Hammer, D.A. 1992. Creating Freshwater Wetlands. Lewis Publishers. Chelsea, MI. p167

Water Control Structures Such as Stoplogs, Flashboards, Culverts, Swivel pipes, or Valves
USDA Natural Resources Conservation Service. Field Office Technical Guide. Practice #587

Hammer, D.A. 1992. Creating Freshwater Wetlands. Lewis Publishers. Chelsea, MI. p167-178

Emergency Spillway
U.S. Soil Conservation Service Agricultural Handbook No. 590. Ponds -- Planning, Design, Construction.

Re-vegetate
Hammer, D.A. 1992. Creating Freshwater Wetlands. Lewis Publishers. Chelsea, MI. p195-226

Other References:
Kusler, J.A., and G. Brooks. 1987. Proceedings of the National Wetland Symposium: Wetland Hydrology. September 16-18, 1987. Chicago, Illinois. Association of State Wetland Managers, Box 2463, Berne, NY 12023.

Kusler, J.A. and M.E. Kentula. 1990. Wetland Creation and Restoration: The Status of the Science. Island Press, Washington, D.C.