

## APPENDIX G

### IMPOUNDMENT ALTERNATIVES

#### Alternative 1 - Wildlife and Livestock Watering Impoundments

Wildlife watering ponds are typically small reservoirs that are used to help supplement wildlife or livestock water demands in semi-arid to arid regions. There are many types of watering facility designs available. Choosing the correct one would depend on proper evaluation of the situation to ensure landowner needs are satisfied. Watering facilities can have simple designs, such as PVC pipe facilities capable of holding four gallons, or relatively complex designs like asphalt impregnated fabric catchment systems capable of supporting large herds or wildlife species. The Natural Resource Conservation Service (NRCS) provides nationwide standards and technical guidelines for wildlife watering facilities (Ponds – Planning, Design, Construction, Agriculture Handbook 590) to help facilitate the decision process and assure proper recommendations are presented to land owners. State NRCS offices in some cases have customized these standards to meet the demands or requirements for their particular region.

#### Alternative 2 - Fisheries

Constructed fisheries are water catchment systems designed to sustain healthy fish and other aquatic organism populations. Fishponds are typically small to medium sized privately owned reservoirs that are stocked by state agencies or individual landowners for recreational use. Designs for such ponds are simple and often depend on the water source and volume, topography (Missouri Department of Conservation, 1995), climate (temperature), and specific use. Commercial fisheries are, in general, large, complex aquaculture facilities designed to sustain large fish or other aquatic organism populations for resale and consumption. The operation of a commercial fishery requires significant investment capital, time, and management skills.

#### Alternative 3 - Recharge Ponds

Recharge ponds, also known as storm water ponds, retention ponds, or wet extended detention ponds, are constructed reservoirs typically containing a permanent pool of water, especially during regional wet seasons (Stormwatercenter.net, 2002). Recharge ponds are traditionally used to restore depleted groundwater sources by water infiltration into subsurface aquifers, whereas retention ponds are permanent pools constructed to improve water quality, attenuate peak flows, and minimize flooding (Kantrowitz and Woodham, 1995). Recharge ponds also have some treatment function to lower TDS by a settling removal mechanism (Stormwatercenter.net, 2002) or by water infiltration through a pre-fabricated pond liner. Nutrient uptake is also possible through various biological processes that could facilitate additional uses.

The infiltration of water in areas that had historically little infiltration of water will cause the soluble salts that have accumulated over time to be dissolved and moved down through the soil and bedrock. These may change the chemistry of the underlying groundwater, or, if intercepted by an impermeable layer, result in the formation of saline seeps.

#### Alternative 4 - Recreation

Traditionally, artificial lakes have been created to augment urban and industrial water supplies; uses for recreation have been considered a secondary benefit (Bennett, 1962). The conceptual use of artificial lakes has changed through the years, however, and is now commonly used in the Midwest for fishing, swimming, and boating. CBM produced water could be used to supply artificially constructed surface impoundments for recreational use. Depending on the quality of water, size of the production facility, and subsequent volume of pumped water, available lands could be converted into large artificial lakes and used for boating or canoeing. The lakes could also be stocked with native warm and possibly cold-water fish to increase local populations and/or used to accentuate camping grounds by providing swimming areas for local residents.

#### Alternative 5 - Evaporation Ponds

Evaporation ponds are usually off-channel; constructed impoundments designed to store water at the surface so that natural evaporative processes can move the water from the land surface into the atmosphere. They are either lined or placed on impermeable soils. These basins may include nebulizers or other technology to enhance the evaporation process. As evaporation occurs water is removed from the pond while the salts are left behind. This results in an increase in the TDS for the remaining water. Over time as more water is lost to the atmosphere, the water remaining in the pond can become a concentrated brine and eventual salt precipitation will occur. The disposal of this residual salt must be considered in advance if evaporation processes are to be used.

#### Alternative 6 - Constructed Wetlands

The U.S. Army Corps of Engineers (USACE) and the EPA define wetlands as areas that are inundated or saturated by surface or groundwater at a frequency and duration to support vegetation adapted for life in saturated soil conditions. According to USACE (1987), wetlands are characterized by three criteria: vegetation, soils, and hydrology.