7.10 BRA Sediment Reduction Program

7.10.1 Description of Option

The protection of already developed water supplies is a key element of water supply planning. Because Region G's inventory of suitable sites for new reservoirs is limited, extending the life of existing reservoirs in the region through sediment control strategies could be a cost effective way to maintain supplies. Over time sediment accumulation can significantly reduce storage capacity and reliability of water supplies. For BRA reservoirs in Region G, there is a projected reduction in reservoir capacity of almost 313,000 acre-feet, or 6,254 acre-feet per year over the 50-year planning period from 2020 to 2070 (Table 7.10-1). The lost storage causes a loss in firm yield of 700 acre-feet per year over the same period.

The BRA and the Little River-San Gabriel Soil and Water Conservation District developed a Watershed Protection Plan for Lake Granger and the San Gabriel River to identify and implement strategies that reduce sediment loading to the lake[1]. The results from a 1999 study of Lake Granger indicate that a combination of conversion of highly erodible cropland to grassland and employment of terracing, minimum tillage, and contour farming had the potential to reduce sediment loads by 20%, and that soil control dams would reduce loads by an additional 7%[2]. The Little River-San Gabriel Soil and Water Conservation District (SWCD) received funding to provide assistance to participants implementing these BMPs on agricultural lands. There are also watershed protection plans in place for Lakes Granbury[3], Belton[4], and Stillhouse Hollow[5].

7.10.2 Available Yield

Sediment production rates in Region G vary considerably due to land use, soil types and topography. Estimates of reservoir capacities for years 2020 and 2070, based on reservoir drainage area and sedimentation rate, are presented in Table 7.10-1. The sedimentation rates in column 2 Table 7.10-1 reported in the BRA Water Management Plan6, and were used to develop the projected capacities used in the water availability modeling (WAM) for regional water planning. The rates in column 3 are normalized by a

1 Lake Granger and San Gabriel River Watershed Protection Plan. Developed by Brazos River Authority. November 2011.

2 Assessment of Flow and Sediment Loadings and BMP Analyses for Lake Granger. USDA - Natural Resources Conservation Service. Prepared in Cooperation with the Brazos River Authority. May 1999.

3 Lake Granbury Watershed Protection Plan. Prepared by Brazos River Authority and Espey Consultants, Inc. for the U.S. Environmental Protection Agency and Texas Commission on Environmental Quality. July 2010.

4 Watershed Protection Plan for the Leon River below Proctor Lake and above Belton Lake. Prepared by Parsons Water and Infrastructure Inc. and the Brazos River Authority for the Stakeholders of the Leon River Watershed. December 2010.

5 Lampasas River Watershed Protection Plan. Prepared by L. Prcin, R. Srinivasan, and P. Casebolt for the Lampasas River Watershed Partnership. July 2010.

6 Brazos River Authority, Water Management Plan for Water Use Permit No. 5851, Appendix G-2. Updated May 2014.

time-weighted contributing drainage area. Because the water yield of a reservoir is affected by the reservoir storage volume, reservoirs experiencing higher sedimentation rates will experience more rapid reduction in firm yield over time than reservoirs with lower sedimentation rates. The projected reservoir yields over the planning period are also shown in Table 7.10-1. Reservoirs with higher sedimentation rates, and therefore greater yield reductions over time, include Lakes Limestone, Granbury, Granger, and Aquilla.

Lake Limestone was chosen for a more detailed evaluation in this plan because it has a relatively high loss in yield, the highest sedimentation rate per square mile, and a large ratio of yield lost to capacity lost (Table 7.10-1). Two sediment reduction best management practices (BMPs) are considered for the Lake Limestone watershed:

1. BMP 1 - conversion of cropland to grassland, and
2. BMP 2 - establishment of filter strips.

The USDA-NRCS Conservation Reserve Program facilitates the conversion of cropland to grassland by providing financial incentives for farmers to retire lands from growing annual crops and establish perennial pastures (grass or hay). It is assumed that the conversion extends throughout the 50-year project planning horizon. Filter strips are vegetated areas, typically 50 feet wide, on the edge of fields that trap sediment from the runoff water before it enters streams or lakes. BMP 2 develops one acre of filter strip for every 20 acres of cropland, for a total management unit of 21 acres. For the purposes of this plan, this BMP is assumed to require reinstallation every five years throughout the 50 year planning horizon, with one acre of filter strip per 21 acres of participating cropland7.

Table 7.10-1 Estimated Sedimentation Rates, Projected Capacities and Firm Yields

Reservoir	Sedimentation Rate	Sedimentation Rate	Capacities (acft)			Yields (acft/yr)		
	(acft/yr)	(acft/yr/sq mi)	2020	2070	% Lost	2020	2070	% Lost
Aquilla	116	0.46	43,174	37,374	13%	13,315	12,099	9%
Belton	393	0.16	430,976	411,325	5%	98,562	96,722	2%
Georgetown	7	0.03	36,799	36,449	1%	11,743	12,003	-2%
Granbury	724	0.50	116,703	80,503	31%	64,712	53,310	18%
Granger	234	0.48	47,971	36,271	24%	17,017	14,192	17%
Possum Kingdom	2588	0.22	501,520	372,120	26%	230,750	224,692	3%
Limestone	614	1.28	196,965	166,265	16%	65,364	55,677	15%
Proctor	101	0.10	53,639	48,589	9%	17,742	16,957	4%
Somerville	355	0.35	141,069	123,319	13%	41,308	38,910	6%
Stillhouse Hollow	212	0.16	224,645	214,045	5%	66,230	66,195	0%
Whitney	910	0.45	540,553	495,053	8%	18,336	18,366	0%

There are approximately 11,700 acres of cultivated crops in the Lake Limestone watershed. Assuming a 25% adoption rate for both BMPs, means there are 2,925 acres available for BMP implementation. The expected annual sediment reduction rate for BMP 1 is 21.1% [7,8], and it is 17.5% for BMP 2 [7,8]. Given these assumptions, an average of 32 acft/yr of sediment is trapped by BMP 1 plus 27 acft/yr from BMP 2 for a total of 59 acft/yr, assuming the BMPs are adopted by different eligible areas. This translates to a reduced sedimentation rate of 555 acft/yr instead of the current 614 acft/yr (Table 7.10-2), so the projected capacity in 2070 would be 169,215 acft instead of 166,265 acft. This extra capacity increases the 2070 firm yield of Lake Limestone to 56,565 acft/yr, an increase of 888 acft/yr.

7.10.3 Environmental Factors

Scouring flows, which increase with land clearing and over-grazing, can cause enough sedimentation to eliminate the habitat of mussels, minnows and other sensitive organisms. The control of sediment by NRCS structures and BMPs can have water quality benefits for downstream streams and lakes.

7.10.4 Engineering and Cost

The capital costs for BMP 1 include $174.61 per acre for establishment of a perennial hay crop plus $16.50 per acre compensation for foregone income from crop production during the first year. The operation and maintenance costs for BMP 1 include annual payments of $26.54 per acre to compensate participants for lost income plus $21.06 per acre as incentive to convert cropland to grassland. The capital costs for BMP 2 include $15,797 every five years for educational programming and $133.75 per 21 acres every five years for seedbed establishment throughout the 50 year planning period. These costs are converted to present value assuming an interest rate of 2.11% [7]. The operation and maintenance costs for BMP 2 include annual payments of $43.39 per 21 acres to compensate participants for lost income plus $21.06 per 21 acres as incentive for implementing this BMP.

The total project cost for the implementation of these two BMPs is estimated to be over one millions dollars (Table 7.10-2). The project is expected to prevent 59 acft of sediment per year from entering Lake Limestone, which translates to an increase in firm yield of 888 acft/yr by 2070. Given these assumptions, the annual cost of water is $324 per acre-foot (Table 7.10-2). The analysis presented here provides planning-level estimates of yields and costs for a hypothetical sediment reduction program in the Lake Limestone watershed. Prior to implementation, any sediment reduction program would need a more in-depth analysis involving site-specific modeling and costs to gain more confidence in the estimates. The uncertainties associated with this strategy make it difficult to perform a more meaningful analysis at this time.

[7] Evaluating the Economics of Best Management Practices for Tarrant Regional Water District's Eagle Mountain Lake Watershed. By J. Johnson. Texas Water Resources Institute Technical Report No. 407. September 2011.

[8] Lee, T., M.E. Rister, B. Narashimhan, R. Srinivasan, D. Andrew, M.R. Ernst (2010). Evaluation and Spatially-Distributed Analyses of Proposed Cost-Effective BMPs for Reducing Phosphorous Level in Cedar Creek Reservoir, Texas. Transactions of the ASABE. Vol 53(5): 1619-1627.

Funding opportunities for agricultural BMPs include the Environmental Quality Incentives Program (EQIP) administered by the NRCS, the Water Quality Management Plan (WQMP) Program administered by the TSSWCB, and the Federal Clean Water Act Section 319(h) Nonpoint Source Grants.

Table 7.10-2 Cost Estimate Summary for Lake Limestone Sediment Reduction Strategy (2013 Prices)

Item	Estimated Costs
Capital Costs	
Conversion of Cropland to Grass/Hay	$558,000
Establishment of Filter Strips	$225,000
Total Capital Cost	**$783,000**
Engineering, Legal Costs and Contingencies	$274,000
Interest During Construction (6 months)	$18,000
Total Project Cost	**$1,075,000**
Annual Costs	
Debt Service (5.5 percent, 20 years)	$90,000
Operation and Maintenance	$148,000
Program Coordination	$50,000
Total Annual Cost	**$288,000**
Available Project Yield (acft/yr)	**888**
Annual Cost of Water ($ per acft)	**$324**
Annual Cost of Water ($ per 1,000 gallons)	**$1.00**

7.10.5 Implementation Issues

The control of sediment by NRCS structures and BMPs can have water quality and yield benefits for downstream reservoirs.

There is some concern that implementation of erosion and sedimentation control measures would reduce net farm incomes[9], but this can be addressed through a properly designed compensation scheme. Appropriate annual compensation payments to farmers for lost productivity need to be considered in cost estimates for BMP implementation.

[9] White and Pantenheimer (1980). Economic impacts of erosion and sedimentation control plans: case studies of Pennsylvania dairy farms. Journal of Soil and Water Conservation 35(2): 76-78.

Further analyses need to be conducted to identify priority areas of implementation within Region G. Measuring the effectiveness of BMP implementation can be difficult in watersheds with large drainage areas. Other implementation issues include maintaining stakeholder participation and financing BMP implementation and control structure rehabilitation. As shown in Table 7.10-3, this water management strategy has been compared to the plan development criteria. It is likely that a robust and vigilant implementation effort would be needed to adequately address sedimentation concerns in Region G and prolong the life of BRA reservoirs.

Table 7.10-3 Comparison of BRA Sediment Reduction Program to Plan Development Criteria

Impact category	Comment(s)
A. Water Supply	
1. Quantity	1. Uncertain.
2. Reliability	2. Uncertain. Varies depending on area.
3. Cost	3. Reasonable
B. Environmental Factors	
1. Environmental Water Needs	1. Low impact.
2. Habitat	2. Positive impact.
3. Cultural Resources	3. Low impact.
4. Bays and Estuaries	4. Low impact.
5. Threatened and Endangered Species	5. Low impact.
6. Wetlands	6. Low impact.
C. Impact on Other State Water Resources	Positive impacts on state water resources and navigation.
D. Threats to Agriculture and Natural Resources	Low to none.
E. Equitable Comparison of Strategies Deemed Feasible	Done.
F. Requirements for Interbasin Transfers	Not applicable.
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None.

This page intentionally left blank