

Section 11 – Future Supplement to Lake Alan Henry – Post Reservoir Option

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Summary

The Post Reservoir has been considered as an alternative to use with Lake Alan Henry for many years. The natural flows, however, don't produce enough water to justify the expense of developing the reservoir. The permit for the Post Reservoir has a 1970 permit date and provides for 5,600 acre-feet of water for municipal use. An additional 5,000 acre-feet can be used for industrial and mining purposes. However, the firm yield for the Post Reservoir is only 5,500 acre-feet without subrogation of downstream water rights like Possum Kingdom with a 1938 priority date.

In addition, a 1989 study indicated that the water quality of the natural flows is not as good as Lake Alan Henry. This study was conducted prior to the City of Lubbock further developing the storm drainage system in Lubbock and prior to the City's discharge of effluent into the North Fork. The City has an EPA grant to assist with the modeling of water quality for reuse purposes. The new study will consider the new developed water that is and will be discharged into the North Fork.

Regional cooperation is essential for the Post Reservoir project. It would help provide water for area communities as well as for the City of Lubbock. The City must first obtain the permit for the reservoir from the White River Municipal Water District in order for the project to be considered. A Letter of Intent has been developed that serves as a statement of interest to negotiate and to complete due diligence tasks prior to the City of Lubbock actually obtaining the permit.

The Post Reservoir would take advantages of most flows down the North Fork. This would provide a means to capture water from both the North Fork (Post Reservoir) and the South Fork (Lake Alan Henry) as future water supplies for the City of Lubbock. It would also provide the means to capture and use developed water.

The Lake Alan Henry water transmission line can be designed to run near the Post Reservoir site with minimal additional cost. A pump station may be able to be located at the Post Reservoir site that would serve both the Lake Alan Henry project as well as the Post Reservoir Project. The Preliminary Engineering for Lake Alan Henry will help determine some of these possible benefits in developing the two sources to work in tandem.

The City must complete its due diligence before purchasing land or developing the project. There are questions about water quality, project feasibility, land and minerals, environmental issues, archeological issues, etc., that need to be addressed. The Letter of Intent helps identify these issues that Lubbock will consider before pressing forward with the project.

**Section 11 – Future Supplement to Lake Alan Henry –
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a. Letter of Intent

DECLARATION OF INTENT
(Post Reservoir Project)

THIS DECLARATION OF INTENT ("Declaration") is executed this ____ day of March, 2007, by and between the CITY OF LUBBOCK, Texas, a Texas home rule municipal corporation ("City"), and WHITE RIVER MUNICIPAL WATER DISTRICT, a Conservation and Reclamation District created by H.B. No. 468 enacted by the 55th Legislature of the State of Texas ("District").

Recitals

WHEREAS, the District is the owner of that certain Certificate of Adjudication, No. 12-3711, issued subject to the terms, conditions and provisions of the final decree of the 39th Judicial District Court of Haskell County, Texas, Cause No. 9356, *In Re: The Adjudication of Water Rights of the Salt Fork and Double Mountain Fork Watersheds of the Brazos River Basin*, dated September 18, 1982 (the "Permit");

WHEREAS, the Permit authorizes the District to construct a dam and reservoir on the North Fork of the Double Mountain Fork of the Brazos River (the "Reservoir"), having an impoundment capacity of 57,420 acre-feet of water and authorizing the District to divert and use up to but not in excess of 10,600 acre-feet of water per year, for the purposes set forth therein;

WHEREAS, the City has an interest in acquiring such Permit from the District and constructing the Reservoir for municipal use and purposes, and the District has an interest in transferring the Permit to the City, subject to the execution of a mutually satisfactory and acceptable agreement to be negotiated by the parties;

WHEREAS, numerous preliminary activities (the "Activities") must be undertaken by the City in order for it to evaluate the feasibility and desirability of constructing the Reservoir; and

WHEREAS, due to the need to conduct the Activities, the City and District now desire to enter into this Declaration.

Declarations

NOW, THEREFORE, for and in consideration of the mutual benefits that may be derived from the construction of the Reservoir, the City and District parties hereby declare and set forth their intentions as follows:

1. As promptly as is reasonably possible after the execution of this Declaration, the parties shall negotiate and work toward the preparation and execution of formal contract documents containing mutually satisfactory and acceptable terms, covenants, conditions, and other provisions providing for the transfer of the Permit and the

construction of the Reservoir, such terms, covenants, conditions, and provisions to address, without limitation, the following:

- the consideration to be provided by the City to the District for the Permit, including the potential commitment of water to the District from the Reservoir and/or Lake Alan Henry
- the funding and construction of facilities and infrastructure necessary to transport water from the Reservoir and/or Lake Alan Henry to the District
- the conditions upon which water committed to the District will be limited, if any, including potential reduction as a result of drought or loss of yield from the Reservoir and/or Lake Alan Henry
- the period of time in which the City shall have to commence the construction of the Reservoir
- provisions for the reassignment of the Permit to the District in the event the City fails to commence construction of the Reservoir prior to the expiration of time provided (including any extensions), or otherwise determines that it no longer desires to construct the Reservoir
- the responsibility for payment of costs that may be incurred by the parties in conducting the preliminary Activities
- representations, warranties, and indemnities, if any, to be provided by and between the parties
- the degree of City support of the District in its existing contractual arrangements and cooperation with the District as water supply alternatives are considered that may affect the member cities of the District

2. Pending execution of formal contract documents, this Declaration will authorize the City to commence and undertake the following Activities for the purpose of determining the feasibility and desirability of constructing the Reservoir:

- (a) propose strategies involving the Reservoir to the Region O planning group, and/or other regional planning groups as deemed necessary by the City
- (b) negotiate with the Brazos River Authority ("BRA") regarding the subordination of the rights of the BRA to water rights authorized by the Permit and/or water rights either now owned or in the application process with the Texas Commission on Environmental Quality ("TCEQ") within the

watershed of the North Fork of the Double Mountain Fork of the Brazos River ("North Fork")

- (c) apply to the TCEQ for permits or authorizations to appropriate waters of the State of Texas ("State"), to discharge wastewater into the North Fork, authorize the reuse of water discharged by the City into the North Fork, and utilize the beds and banks of the State to transport such water to any point on or along any stretch of the North Fork
- (d) conduct studies and surveys regarding the construction and operation of the Reservoir, including without limitation feasibility reviews and studies, environmental studies, studies related to the U.S. Corp of Engineers Permits, archeological studies, and/or such other studies as the City deems necessary or advisable to investigate and document the feasibility and desirability of the Reservoir as a water supply project
- (e) negotiate and acquire such easements, licenses, privileges, leases, options, and/or titles to property that the City deems necessary or advisable for the construction of the Reservoir and related facilities
- (f) deliberate with the State legislature and the TCEQ regarding the amendment or modification of the Permit in the manner and to the extent specified in that certain e-mail transmission from the City to the District, dated February 9, 2007, a copy of which is incorporated into this Declaration as Attachment "A"

3. In the furtherance of this Declaration, and pending execution of formal contract documents, the parties agree as follows:

- (a) the District will make available to the City copies of all files and other information in the District's possession, or that the District has the right to obtain from third parties, concerning any prior engineering, feasibility, or other studies relating to the Reservoir and City may obtain further details or other information from such third parties on behalf of itself or the District
- (b) in the event the City shall conduct any additional studies regarding the Reservoir or the District's water supply, the city will provide the District with a copy of the final report received by the City
- (c) except as may be required by law, direction of the Attorney General or order of a Court of competent jurisdiction, all negotiations between the City and the District, as well as any information shared between them pertaining to any engineering, feasibility, or other study relating to the Reservoir, is to remain confidential and will not be released to the public without the mutual written consent of the parties

- (d) the District will participate in the regional planning activities now being undertaken, or to be undertaken, by the City concerning preliminary engineering relating to Lake Alan Henry as a water supply source for the City and other parties; provided, however, such participation will be without cost to the District
- (e) except as provided in Paragraph 2(f) above, the City will not sponsor or otherwise support any legislation or agency action to amend, modify or otherwise alter the Permit, without first obtaining the written consent of the District
- (f) the District will not take any action before the TCEQ regarding the Permit, excepting activity related to renewal of the Permit, without notice to and agreement of the City

4. This Declaration shall terminate without liability to either party upon the occurrence of any one of the following events:

- (a) the parties are unable to agree to mutually satisfactory and acceptable terms, covenants, conditions, and provisions providing for the transfer of the Permit and the construction of the Reservoir, and formal contract documents have not been executed within three (3) years from the date of this Declaration
- (b) either party notifies the other of its intention to abandon and terminate the proposed Reservoir project, such notice to be given in writing at least sixty (60) days in advance of the effective date of termination and shall be deemed to have been provided when deposited in the United States mail, certified mail, return receipt requested, addressed as follows:

For City:

Mayor of the City of Lubbock
 City of Lubbock
 P.O. Box 2000
 Lubbock, TX 79457

For District:

District Manager
 HCR 2, Box 141
 Spur, TX 79370

With copy to:

City Manager of the City of Lubbock
 City of Lubbock
 P.O. Box 2000
 Lubbock, TX 79457

- (c) the disapproval of the proposed Reservoir project by any State or Federal agency having jurisdiction over same

5. This Declaration is merely a guide to the preparation of a mutually satisfactory agreement. Nothing in this Declaration shall be construed to preclude other provisions from being inserted into the formal contract documents at the request of either party.

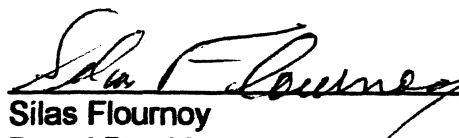
6. The Declaration does not obligate either party to execute formal contract documents. The provisions of Paragraph 1, above, shall not constitute a binding obligation on the part of District or the City other than the commitment to negotiation in good faith. It is agreed and stipulated that, notwithstanding the agreement to negotiate in good faith, the negotiations may not result in formal contract documents, in such event neither party hereunder having any responsibility, obligation or liability to the other. In the event formal contract documents be signed by the parties, this Declaration will become null, void, and of no further effect.

7. Nothing contained herein shall be construed to imply a joint venture, joint enterprise, partnership, or principal-agent relationship between the City and District.

8. Nothing contained herein shall be construed to provide or infer any rights or benefits whatsoever to any person or entity (governmental or otherwise) other than the City and District.

IN WITNESS WHEREOF, this Declaration has been executed by the duly authorized representatives of the parties as of the date first set forth above.

WHITE RIVER MUNICIPAL WATER DISTRICT



Silas Flournoy
Board President

CITY OF LUBBOCK

By: _____
DAVID A. MILLER, Mayor

ATTEST:

Rebecca Garza, City Secretary

APPROVED AS TO CONTENT:



Tom Adams, Deputy City Manager

APPROVED AS TO FORM:



Richard K. Casner
First Assistant City Attorney
m/Richard/WhiteRiver-Declaration of Intent-rdln
March 8, 2007

From: Thomas Adams
To: wrmwdgm@caprock-spur.com
Date: 2/9/2007 10:44:37 AM
Subject: Post Reservoir Permit

Would White River support Lubbock asking for legislation to amend the Post Reservoir Permit? We have some concerns about how the permit is written.

The main three points in question include the following:

1. Use of the 10,600 acre feet of permitted water is divided into municipal, industrial, and mining. We would like to amend it for flexibility. We need the ability to use the water for municipal purposes. Using it for other purposes can be optional, but the permit needs to allow for up to 10,600 acre feet to be used for municipal purposes.
2. The permit restricts the storage capacity by the siltation pool language. The capacity of 57,420 acre feet is reduced down to actual storage of 38,420 acre feet and the state maintains control over the siltation pool. We need the benefit of storage capacity for the entire reservoir.
3. Special conditions give the state unlimited control over releases once the siltation pool is filled in. We need language that provides for reasonable releases, but not open ended.

Let me know if this is agreeable. I will call soon. This is moving a little faster than our letter of agreement, but the filing deadline is March 9th.

Thanks.

Tom

"Serve with Humility, Lead with Passion, Commit to Excellence"

Thomas L. Adams
Deputy City Manager
P.O. Box 2000
Lubbock, TX 79457
(806) 775-2015
tadams@mylubbock.us

**Section 11 – Future Supplement to Lake Alan Henry –
Year 2030 - Post Reservoir Option**

b. Post Reservoir Permit

5-20
JK

same page T Waller Reservoir way 1504, Capital Statute

-6542

Austin,
78711

REGISTERED
RECORDED
INDEXED
SERIALIZED

CERTIFICATE OF ADJUDICATION

CERTIFICATE OF ADJUDICATION: 12-3711 OWNER: White River Municipal
Water District
Star Route 2
Spur, Texas 79370

COUNTIES: Garza, Crosby, Dickens PRIORITY DATE: January 20, 1970
Kent and Lubbock

WATERCOURSE: North Fork Double Mountain BASIN: Brazos River
Fork Brazos River, tribu-
tary of the Double Mountain
Fork Brazos River, tributary
of the Brazos River

WHEREAS, by final decree of the 39th Judicial District Court of Haskell County, Texas, in Cause No. 9356, In Re: The Adjudication of Water Rights in the Salt Fork and Double Mountain Fork Watersheds of the Brazos River Basin dated November 18, 1982, a right was recognized under Permit 2590 authorizing the White River Municipal Water District to appropriate waters of the State of Texas as set forth below;

NOW, THEREFORE, this certificate of adjudication to appropriate waters of the State of Texas in the Brazos River Basin is issued to the White River Municipal Water District, subject to the following terms and conditions:

1. IMPOUNDMENT

Owner is authorized to construct a dam and reservoir on the North Fork Double Mountain Fork Brazos River having an impounding capacity of 57,420 acre-feet of water at elevation 2430 feet above mean sea level to be comprised of 38,420 acre-feet of conservation storage space for authorized water supply and 19,000 acre-feet of storage space for sediment. Station 51 + 40 on the centerline of the dam bears S 83°51'E, 7285 feet from the northwest corner of the G.H. & H. RR Company Survey 73, Abstract 39, Garza County, Texas.

2. USE

- A. Owner is authorized to divert and use not to exceed 10,600 acre-feet of water per annum from the aforesaid reservoir for purposes as follows:
 - (1) Municipal purposes.....5,600 acre-feet
 - (2) Industrial purposes.....1,000 acre-feet
 - (3) Mining purposes4,000 acre-feet
- B. Owner is also authorized to divert and use an unspecified amount of water from the North Fork Double Mountain Fork Brazos River during construction of the aforesaid dam project.

3. DIVERSION

- A. Location:
At a point on the aforesaid reservoir which bears S 88°43'E, 6390 feet from the northwest corner of the G.H. & H. RR Company Survey 73, Abstract 39, Garza County, Texas.
- B. Maximum rate: 54.22 cfs (24,400 gpm).

4. PRIORITY

The time priority of owner's right is January 20, 1970.

5. TIME LIMITATIONS

Construction or installation of all works authorized herein shall commence and be completed within the time limit imposed by the Texas Water Commission.

6. SPECIAL CONDITIONS

- A. Owner shall provide gated outlets with invert elevations no higher than elevation 2373 feet above mean sea level for the passage of flows ranging from 1 to 10 cfs for sustained periods and for periodic releases of water at rates up to 100 cfs.
- B. Owner, subject to further order and directives of the Commission, shall pass normal flows and waters impounded in the authorized sediment storage space in amounts as determined by the Commission at any time for downstream domestic and livestock uses, for superior vested water rights and for maintenance of stream quality. Release of waters contained in the sediment storage space is specifically subject to call of the Commission until sedimentation of 19,000 acre-feet occurs, after which time releases will be made under such other orders as the Commission may adopt.
- C. Owner shall maintain: (1) continuous reservoir content and lake level measuring station; (2) a record of all discharges through the reservoir and (3) daily records of diversions for each authorized use. All records shall be compiled monthly and reported annually to the Commission or at any other time on request.
- D. Owner shall construct and monument an appropriate number of sediment ranges prior to impoundment of water and shall prepare and provide the Commission revised elevation-area-capacity tables based on surveys as necessary to determine initial and future capacities.

The locations of pertinent features related to this certificate are shown on Page 15 of the Salt Fork and Double Mountain Fork Watersheds Certificates of Adjudication Maps, copies of which are located in the offices of the Texas Department of Water Resources, Austin, Texas and the Garza, Crosby, Dickens, Kent and Lubbock County Clerks.

This certificate of adjudication is issued subject to all terms, conditions and provisions in the final decree of the 39th Judicial District Court of Haskell County, Texas in Cause No. 9356, In Re: The adjudication of Water Rights in the Salt Fork and Double Mountain Fork Watersheds of the Brazos River Basin, dated September 18, 1982, and supersedes all rights of the owner asserted in that cause.

This certificate of adjudication is issued subject to senior and superior water rights in the Brazos River Basin.

This certificate of adjudication is issued subject to the Rules of the Texas Department of Water Resources and its continuing right of supervision of State water resources consistent with the public policy of the State as set forth in the Texas Water Code.

TEXAS WATER COMMISSION

Paul Hopkins
Paul Hopkins, Chairman

STATE OF TEXAS
COUNTY OF TRAVIS

Mary Ann Heifner, Chief Clerk of the Texas Water Commission, do hereby certify that *the foregoing* is a true and correct copy of an instrument on file in permanent records of said Commission of the Department of Water Resources.

Given under my hand and the seal of the Texas Water Commission this the 20th day of February, A. D., 1985

Mary Ann Heifner
Mary Ann Heifner, Chief Clerk

DATE ISSUED:

Seal

FEB 20 1985

ATTEST:

Mary Ann Heifner

FILED FOR RECORD

05 MAR 7 9:14

Ann Davidson
County Clerk, Lubbock County, Texas

STATE OF TEXAS }
COUNTY OF LUBBOCK }

I hereby certify that this instrument was FILED on the
date and at the time stamped hereon by me and was duly
RECORDED in the Volume and Page of the RECORDS of
Lubbock County, Texas as stamped hereon by me. *Ann*

MAR 7 1985



Ann Davidson
COUNTY CLERK
LUBBOCK COUNTY, TEXAS

RECEIVED
MAR 14 1985
DEPT. OF
WATER RESOURCES

**Section 11 – Future Supplement to Lake Alan Henry –
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c. Post Reservoir Legislation

AN ACT

relating to the development of a water supply reservoir project at a site known as the Post Reservoir site in Garza County, Texas.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:

ARTICLE 1

SECTION 1.01. The legislature designates a site known as the Post Reservoir site on the north fork of the Double Mountain Fork of the Brazos River, northeast of Post, Texas, as a site of unique value for the construction of a dam and reservoir on the Brazos River under Section 16.051(f)(2), Water Code, to impound water derived from the unappropriated flows of the Brazos River. The White River Municipal Water District holds a current water rights permit for the site (TNRCC Certificate of Adjudication 12-3711). A permit extension was granted in 1999, with construction to begin in 2004. The legislature finds that construction and development of the Post Reservoir project, and the impoundment, diversion, and use of the unappropriated flows of the Brazos River, are in the public interest and would constitute a beneficial use of the water. The legislature further finds that conditions warrant a Texas Water Development Board waiver of the requirement that the project meet needs in a manner consistent with the state and regional water plans. The legislature further finds that the project shall receive priority for existing and uncommitted bond authorization in the state participation account.

SECTION 1.02. Using the state participation account of the Texas

Water Development Fund II to encourage optimal regional development of the Post Reservoir project, the Texas Water Development Board is authorized to acquire up to 100 percent of the undivided interest in the Post Reservoir project in partnership with local or regional interests. Purchase of the Texas Water Development Board's interest in the reservoir by such local or regional entities shall begin not later than 20 years after the Texas Water Development Board's execution of the contract with local entities for the Texas Water Development Board's participation in the project. The legislature finds that the cost of acquisition of the site for the Post Reservoir project exceeds the current financing capabilities of the area involved, and the optimum regional development of the Post Reservoir site cannot be reasonably financed by local interests without state participation. The legislature further finds that it is reasonable to expect that the state will recover its investment in the project.

ARTICLE 2

SECTION 2.01. Sections 8 and 9, Chapter 221, Acts of the 55th Legislature, Regular Session, 1957, are amended to read as follows:

Sec. 8. The District is authorized to acquire, ~~[or]~~ construct, own, or operate within or without the boundaries of the District [~~but not outside any County in which the District is located~~], a dam or dams and all works, plants and other facilities necessary or useful for the purpose of impounding, processing and transporting water to Cities and others for municipal, domestic, industrial and mining purposes. The size of the dam and reservoir shall be determined by the Board of Directors, taking into consideration probable future increases in water requirements, and the size of the dam shall not be limited by the amount of water initially authorized by the Board of Water Engineers to be impounded therein. No dam or other facilities for impounding water shall be constructed until the plans therefor are approved by the Board of

Water Engineers.

Sec. 9. The District is empowered to acquire land within or without the boundaries of the District [~~but not outside any County in which the district is located~~], and to construct, lease or otherwise acquire all works, plants and other facilities necessary or useful for the purpose of diverting, further impounding or storing water, processing such water and transporting it to Cities and others for municipal, domestic, industrial and mining purposes. Subject to the terms of any deed of trust issued by the District, the District may sell, trade or otherwise dispose of any real or personal property deemed by the Board of Directors not to be needed for District purposes. [~~The District is not authorized to develop or otherwise acquire underground sources of water.~~]

SECTION 2.02. Section 10(a), Chapter 221, Acts of the 55th Legislature, Regular Session, 1957, is amended to read as follows:

(a) For the purpose of carrying out any power or authority conferred by this Act the District shall have the right to acquire the fee simple title to land and other property and easements (including land needed for the reservoir and dam and flood easements above the probable high water line around any such reservoirs) within or without the boundaries of the District[~~, but not outside any County in which the District is located,~~] by condemnation in the manner provided by Title 52, Revised Civil Statutes, as amended, relating to eminent domain.

This District is hereby declared to be a municipal corporation within the meaning of Article 3268 of said Title 52, except that the District shall not have the right to so condemn any property which may be owned by any other political subdivision, City or Town; provided, however, that as against persons, firms, and corporations, or receivers or trustees thereof, who have the power of eminent domain, the fee title may not be condemned, but the District may condemn only an

easement. The amount of and character of interest in land, other property and easements thus to be acquired shall be determined by the Board of Directors. The District shall have the same power as is conferred upon water control and improvement districts by Section 49 of Chapter 25, Acts of the Thirty-ninth Legislature, with reference to making surveys and attending to other business of the District.

ARTICLE 3

SECTION 3.01. This Act takes effect immediately if it receives a vote of two-thirds of all the members elected to each house, as provided by Section 39, Article III, Texas Constitution. If this Act does not receive the vote necessary for immediate effect, this Act takes effect September 1, 2001.

President of the Senate

Speaker of the House

I certify that H.B. No. 3096 was passed by the House on April 20, 2001, by the following vote: Yeas 142, Nays 0, 2 present, not voting.

Chief Clerk of the House

I certify that H.B. No. 3096 was passed by the Senate on May 17, 2001, by the following vote: Yeas 30, Nays 0, 1 present, not voting.

Secretary of the Senate

APPROVED: _____

Date

Governor

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d. 2006 Region O Plan for Post Reservoir

storage, disinfection and distribution. Desalt plants encounter scaling, corrosion, and chemical challenges that require relatively highly trained and experienced treatment staff. Therefore, the smaller communities might consider contract operations rather than developing in-house expertise to operate desalt plants.

This water supply option has been compared to the plan development criteria, as shown in Table 4.4-79.

Table 4.4-79.
Evaluation of Brackish Groundwater Desalination

Impact Category	Comment(s)
a. Quantity, reliability, and cost of treated water	<ul style="list-style-type: none"> • Unknowns regarding extent and yields of brackish aquifer • Moderately high treatment cost
b. Environmental factors	<ul style="list-style-type: none"> • Disposal of concentrated brine created from process • Typically in low recharge rate aquifers or confined aquifers; use could lead to the depletion of aquifers • Extracted brackish water possibly replaced by freshwater from a higher strata aquifer, thereby removing and contaminating accessible freshwater
c. State water resources	<ul style="list-style-type: none"> • In case of brackish aquifer, improves state water resources • For freshwater aquifer having brackish lower zone, potentially contaminates fresh groundwater
d. Threats to agriculture and natural resources in region	<ul style="list-style-type: none"> • None
e. Recreational	<ul style="list-style-type: none"> • None
f. Comparison and consistency equities	<ul style="list-style-type: none"> • Same cost model used to estimate total costs
g. Interbasin transfers	<ul style="list-style-type: none"> • Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	<ul style="list-style-type: none"> • Not applicable
i. Efficient use of existing water supplies and regional opportunities	<ul style="list-style-type: none"> • Increases
j. Effect on navigation	<ul style="list-style-type: none"> • Not applicable

4.4.4.4 Post Reservoir—Raw Water at the Reservoir

4.4.4.4.1 Description of Option

The White River Municipal Water District holds TCEQ Certificate of Adjudication Number C3711 for Post Dam and Reservoir, which provides for Authorized Impoundment of

57,420 acre-feet; Authorized Diversion of 5,600 acft/yr for municipal purposes; 1,000 acft/yr for industrial purposes; and 4,000 acft/yr for mining purposes, with the Priority Date of January 20, 1970. The proposed Post Reservoir Project is located on the North Fork of the Double Mountain Fork of the Brazos River northeast of Post, Texas in Garza County (Figure 4.4-14). Preliminary data pertinent to the project were obtained from the September 1968 report entitled "Feasibility Report on Post Reservoir Site."⁴⁵ The proposed project includes a 5,800-ft rolled embankment dam with a 2,000-ft emergency spillway for passing the probable maximum flood (PMF). The project also includes a morning glory type service spillway to pass storm flows up to the 100-year return period.

4.4.4.4.2 Available Supply of Water

The conservation pool would provide approximately 56,000 acft of storage (neglecting sedimentation) and 37,000 acft (including sedimentation) with a surface area of 2,280 acres. The 1968 reservoir analysis indicates that the proposed reservoir will have a firm yield of approximately 9,500 acft/yr in the year 2020 considering runoff, depletion, and sedimentation.

4.4.4.4.3 Environmental Issues

The construction of Post Reservoir would result in the change of an estimated 3,320 acres of land from ranching to that of a reservoir site, inundating about 2,280 acres. It is estimated that the entire 3,320 acres would require wildlife habitat mitigation for which costs have been included in Section 4.4.4.4.4.

4.4.4.4.4 Costing

The following assumptions and conditions were applied in the updating of the costs of this water management strategy:

- Capital costs were updated from 1968 to the Second Quarter of 2002 using the Engineering News Record Construction Cost Index (CCI). The CCI ratio was increased by an additional 15 percent to account for more stringent requirements related to construction activities.
- Engineering, legal costs, and contingencies are calculated as 35 percent of the total capital costs associated with construction of the dam. Environmental studies, mitigation and permitting costs are calculated as 100 percent of the land acquisition cost.

⁴⁵ Freese, Nichols and Endress, 1968, "Feasibility Report on Post Reservoir Site," prepared for White River Municipal Water District, September. The 1968 cost estimate was \$2.2 million.

- Land acquisition and survey costs were based on the inundated area during PMF. Land cost was assumed as \$1,620/acre for the site.
- Interest during construction is calculated considering a 6 percent interest rate, with a 4 percent return on investments over a 4-year construction period.
- The annual cost for debt service is based on a 6 percent interest rate over a 40-year period.
- O&M costs are calculated as 1.5 percent of the estimated construction costs for the dam and reservoir.

Costs for this option include construction costs and other project costs, which include engineering costs, land acquisition for the reservoir and dam site, and interest during construction. The total project cost for this option was estimated to be \$30,456,000 (Table 4.4-80). Financing the project for 40 years at 6 percent annual interest results in an annual expense of \$2,023,000 for debt service (Table 4.4-80). Annual operating and maintenance costs total \$170,640 (Table 4.4-80). The total annual cost, including debt service and O&M cost, totals \$2,194,560 (Table 4.4-80). With an annual firm yield of 9,500 acft/yr, the resulting cost of raw water at the reservoir is \$231 per acft, or \$0.71 per 1,000 gallons, which does not include transmission pipeline, water treatment, or distribution system costs.(Table 4.4-80).

4.4.4.5 Implementation Issues

The development of the Post Reservoir will require that the local sponsor, the White River Municipal Water Authority, either proceed with development or make arrangements for another entity to proceed, and customers willing to purchase water at prices adequate to retire the debt and pay operating costs, including water treatment and conveyance to locations of use. Implementation will require the following permits and studies.

1. Permits
 - a. USCOE Sections 10 and 404 dredge and fill permits for reservoirs and pipelines impacting wetlands or navigable waters of the U. S.
 - b. TPWD Sand, Gravel, and Marl permit for construction in state owned streambeds.
 - c. NPDES Storm Water Pollution Prevention Plan.
 - d. GLO easement for use of the state-owned streambed; and
 - e. Section 404 certification from the TCEQ required by the clean water act.
2. Studies to Support Permit Applications for permits 1.b through 1.f above:
 - a. Assessment of changes in stream flows.
 - b. Habitat mitigation plan.
 - c. Environmental surveys.
 - d. Cultural resources surveys, studies, and mitigation.
3. Land will have to be acquired either by negotiation or condemnation.

**Table 4.4-80.
Cost Estimate Summary for Post Reservoir
Llano Estacado Region
Second Quarter 2002 Prices**

<i>Item</i>	<i>Estimated Cost for Facilities</i>
Capital Costs	
Dam and Reservoir (Conservation Pool of 56,000 acft, 2,280 acres, 2,430 ft msl)	
Preparation of Site	\$194,400
Core Trench Excavation (74,300 cubic yards)	168,480
Wetted and Rolled Embankment (2,317,400 cubic yards)	5,396,760
Riprap (62,400 cubic yards)	2,422,440
Blanket (25,900 cubic yards)	1,005,480
Service Spillway and Outlet	1,617,840
Mulching (22 acres)	99,360
Irrigation for Downstream Slope	97,200
Relocation ¹	<u>345,600</u>
Total Capital Cost	\$11,347,560
Engineering, Legal Costs and Contingencies (35% of Total Capital Cost)	\$3,971,160
Environmental & Archaeology Studies, Mitigation, and Permitting	5,378,400
Land Acquisition and Surveying (3,320 acres)	5,557,680
Interest During Construction (4 years)	<u>4,201,200</u>
Total Project Cost	\$30,456,000
Annual Costs	
Debt Service (6 percent for 40 years)	\$2,023,920
Operation and Maintenance	<u>170,640</u>
Total Annual Cost	\$ 2,194,560
Available Project Firm Yield (acft/yr)	9,500
Annual Cost of Raw Water at the Reservoir (\$ per acft)	\$231
Annual Cost of Raw Water at the Reservoir (\$ per 1,000 gallons)	\$0.71
¹ The bridge at FM 651 may need to be raised, widened, or relocated.	

**Section 11 – Future Supplement to Lake Alan Henry –
Year 2030 - Post Reservoir Option**

e. 1968 Post Reservoir Feasibility Report

FEASIBILITY REPORT
ON
POST RESERVOIR SITE

FOR
WHITE RIVER MUNICIPAL WATER DISTRICT

September 1968

By
FREESE, NICHOLS AND ENDRESS
Consulting Engineers
Fort Worth, Texas

FEASIBILITY REPORT
ON
POST RESERVOIR SITE

FOR

WHITE RIVER MUNICIPAL WATER DISTRICT

FRESE, NICHOLS AND ENDRESS
CONSULTING ENGINEERS
FORT WORTH, TEXAS

September 19, 1968

White River Municipal Water District
P. O. Box 265
Crosbyton, Texas 79322

Gentlemen:

Herewith find our feasibility report on the reservoir on the North Fork of the Double Mountain Fork of the Brazos River just northeast of Post. Core borings of the foundation at the dam site indicate the absence of any harmful gypsum deposits which are always suspect for a dam in that area. The topography of the proposed reservoir site permits a reservoir of relatively high average depth of water which is important from the standpoint of minimizing evaporation losses. There are no highway, pipeline or oil well conflicts in the reservoir, the remedying of which would be expensive. In order to substantially develop the runoff from the 190 square miles of effective drainage area, it is proposed that the reservoir have an initial capacity of 56,000 acre feet at service spillway level with a surface area of 2,280 acres and a maximum depth of water of 69 feet.

The estimated safe yield of the proposed reservoir, as of 2020, is 7,300 acre feet per year or 6.5 MGD (million gallons per day) after 50 years siltation and depleted runoff due to the effect of anticipated soil and water conservation practices on the watershed and after leaving

a reserve in the reservoir at the end of a recurrence of the critical drouth period equal to one year's yield (7,300 acre feet). The estimated cost of the dam and reservoir is approximately \$2,500,000 including interest during construction. Assuming a 4% interest rate from the Texas Water Development Board, the annual cost is estimated at approximately \$160,000 for interest and principal payments, operation and maintenance. In case the Water Development Board would purchase half of the capacity of the reservoir, the corresponding annual cost to the District would be approximately \$88,000. It is evident that the sale of 75,000 barrels per day (3.15 MGD) of water to oil companies for repressuring purposes would support an \$88,000 annual cost of the reservoir. This would require a charge of 7.65 cents per thousand gallons of water at the reservoir. Likewise, a sale of 37,500 barrels per day would result in a cost of the water at the reservoir of 15.3 cents per thousand gallons (0.36 cents per barrel).

As stated in the feasibility report, water from the reservoir would probably be of a quality satisfactory for municipal use. However, the available data are wholly inadequate to prove up the quality of the water and it is recommended that a quality and flow measuring station be established at the F.M. 651 crossing in cooperation with the U.S.G.S. and possibly the State, and that such measuring station be maintained in operation until the quality of the water is definitely determined.

The project is an economical project and, sooner or later, all of its

Page 3

yield will be needed in that part of the State. Water rights on the Brazos River and its tributaries are becoming more precious year by year and it is recommended that the District make application for the water rights pertaining to the proposed Post Reservoir.

Respectfully submitted,

FREESE, NICHOLS AND ENDRESS

S. W. Freese
S. W. Freese

SWF:mg

WHITE RIVER MUNICIPAL WATER DISTRICT
FEASIBILITY REPORT ON POST RESERVOIR SITE

Description of Proposed Dam and Reservoir

The yield studies show that 56,000 acre-feet of reservoir capacity are required at the reservoir site to substantially develop the potential yield of the North Fork, Double Mountain Fork of the Brazos River. The selected site has been designated the Post Site, and is shown on Sheet 1 - Reservoir and Vicinity Map. A dam located at this site will control approximately 190 square miles of effective drainage area.

One of the major problems encountered with potential dam sites in this area of the State is gypsum in the foundation. Gypsum is soluble in water and if present in the foundation of a dam can dissolve out causing piping and potential failure. To determine if gypsum is present at this site, and to evaluate the foundation in general, three continuous core borings were made in the stream valley. Sheet 2 shows the cross section of the river valley at the dam site and the logs of these borings. No significant amounts of gypsum were encountered and, from all appearances, the foundation is suitable for the proposed dam. Prior to final design, more extensive foundation and soil investigations will have to be made.

A hydrological study of the area indicates that the maximum probable storm would have a runoff of 25.2 inches, producing a peak inflow into the reservoir of 196,000 cubic feet per second. This storm would have a total volume of runoff of 236,000 acre-feet. The dam is designed to withstand this storm by use of surcharge in the reservoir and the discharge capacity of a

2000 foot long broad crest emergency spillway at Elevation 2441.0. The top of the dam is required to be at Elevation 2255.0 at which elevation the free-board is 4.7 feet during the maximum high water caused by this storm. The emergency spillway located at this elevation will not operate during the occurrence of a 100 year recurrence interval storm.

The conservation pool is maintained at Elevation 2430 and storms of 100 year frequency or less are passed through the dam by a morning glory drop inlet - conduit spillway. The morning glory inlet crest is 25 feet - 3 inches in diameter. A 7 foot square conduit carries the discharge through the dam to a hydraulic jump stilling basin at the downstream toe of the dam. Sheet 3 shows a section through the service spillway.

It is proposed that the dam be constructed of compacted earth using locally available materials, that the central section or core of the dam be made of impervious clays to minimize seepage losses from the lake, and that the shells of the dam be made from the more pervious materials. Sheet 3 shows the proposed dam section.

Pertinent data with reference to the dam and reservoir are as follows:

Stream Bed Elevation	2361.0	
Lip of Service Spillway Elevation	2430.0	
Capacity at Spillway Lip	57,421	acre-feet
Crest of Emergency Spillway Elevation	2441.0	
Capacity at Emergency Spillway Crest	86,400	acre-feet
Maximum High Water Elevation	2450.3	
Drainage Area	190	square miles
Conservation Capacity	38,421	acre-feet
Silt Storage	19,000	acre-feet
Service Spillway Crest Elevation	2530.0	
Surface Area at Spillway Elevation	2,283	acres
Length of Shoreline	27	miles
Maximum Depth of Water at Dam	61	feet
Average Reservoir Depth	25.1	feet

Elevation of Emergency Spillway	2241.0	
Width of Emergency Spillway	2,000	feet
Length of Dam	5,800	feet
Maximum Height of Dam	94	feet
Maximum Bottom Width of Dam	535	feet
Top Width of Dam	20	feet
Elevation Maximum High Water Level	2450.3	
Elevation Top of Dam	2455.0	

Cost Estimate

The cost of the dam and reservoir is estimated as follows:

COST ESTIMATE
PROPOSED POST RESERVOIR

<u>Item</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Amount</u>	<u>Total Amount</u>
Preparation of Site	L.S.	-	\$ -	\$ 30,000	\$
Core Trench Excavation	C.Y.	74,300	.35	26,000	
Wetted and Rolled Embankment	C.Y.	2,317,400	.36	834,000	
Rip Rap	C.Y.	62,400	6.00	374,000	
Blanket	C.Y.	25,900	6.00	155,000	
Service Spillway and Outlet	L.S.	-		250,000	
Mulching	AC.	22	700.00	15,000	
Irrigation for Downstream Slope	L.S.	-	-	<u>15,000</u>	
Sub-Total				\$1,699,000	
Contingencies - 15%				<u>255,000</u>	
Sub-Total				\$1,954,000	
Engineering - 8%				<u>156,000</u>	
Total Cost - Dam				\$2,110,000	\$2,110,000
Land Purchased in Fee	AC.	2,280	100.00	228,000	
Flood Easement	AC.	1,040	25.00	<u>26,000</u>	
Sub-Total				\$ 254,000	
Land Acquisition and Contingencies - 20%				<u>51,000</u>	
Total Cost - Land				\$ 305,000	\$ <u>305,000</u>
TOTAL PROJECT COST					\$2,415,000

Yield of Post Reservoir

This study analyzes the yield potential of the Post Reservoir Site. A conservation capacity of 37,000 acre-feet is required to substantially develop the drainage area above the dam. A siltation pool of 19,000 acre-feet is necessary to contain sediment material collected over a 50 year period. A total conservation and sediment pool capacity of 56,000 acre-feet is required for full watershed development. This pool capacity can be achieved at Elevation 2430.

A series of computer runs to determine maximum yield were performed using the hydrologic data described in the following paragraphs. The most critical drouth period was found to be from November 1941 to September 1953. The results of the yield study are as tabulated below:

YIELD RESULTS

Conservation Capacity in Acre Feet		2020 Yield from Historical Run-off in Acre Feet		2020 SCS Effect Acre Feet Per Year	2020 Yield from Depleted Runoff in Ac Ft Per Yr	
1970	2020	No Reserve	Yr Reserve*	Per Year	No Reserve	Yr. Reserve*
56,000	37,000	10,600	8,400	1,100	9,500	7,300

*Reserve in reservoir equal to one year's yield.

The safe annual yield of the reservoir site with an estimated drainage area of 190 square miles for the year 2020 is 7,300 acre feet or 6.5 MGD (million gallons per day). This yield is based on a conservation capacity of 37,000 acre-feet after siltation and reservoir inflows reduced for the effect of soil conservation measures.

The drainage area above the dam site considered to be contributing is bound on the south by the Cap Rock escarpment and on the north by the ridge separating the drainage of the North Fork, Double Mountain Fork, Brazos

River and the Salt Fork of the Brazos River. The area above the City of Lubbock was not considered to be contributing.

Detailed mapping which would allow an accurate determination of the drainage area is not available. The shape of the drainage area was estimated from Texas Highway Department maps of Garza, Crosby and Lubbock Counties. Scale 1-inch equals 2 miles, excluding playa lake drainage areas on the Cap Rock. The area was determined to be 190 square miles.

A reservoir map with 10 foot contour intervals was constructed from ground surveys of the site. From this map, area and capacity vs. elevation tables were computed. A tabulation of this data is given in Table 1 and Table 2. At the adopted capacity of 56,000 acre-feet the surface area of the reservoir is 2,283 acres and the water surface is at Elevation 2430.0. The depth of water at the dam would be 70 feet and the average depth of the reservoir is 25 feet. The reservoir site is favorable from the standpoint of minimizing evaporation by reason of the relatively high average depth. This is important not only from the standpoint of conserving water but also from the standpoint of minimizing the concentration of salts in the reservoir due to evaporation.

Monthly lake surface evaporation records from 1940 to 1965 are compiled in Report 64, "Monthly Reservoir Evaporation Rates for Texas 1940 Through 1965", by the Texas Water Development Board. These evaporation rates were used for the period January 1940 to December 1965. For the periods July 1939 to December 1939 and January 1966 to September 1966, gross evaporation at Lubbock after adjustment was used as the net lake surface evaporation. Table 3 shows the net evaporation rates at the Post Reservoir Site.

TABLE 1
 WHITE RIVER MUNICIPAL WATER DISTRICT
 RESERVOIR ON N. FORK-DOUBLE MTN. - BRAZOS RIVER

AREA IN ACRES

Elev.	0	1	2	3	4	5	6	7	8	9
2360	-	-	0	8	14	21	31	41	54	70
2370	84	110	145	179	205	235	260	285	310	332
2380	355	379	400	420	440	460	478	499	520	540
2390	560	590	619	648	679	709	740	770	798	828
2400	854	880	910	938	974	991	1,020	1,046	1,071	1,110
2410	1,128	1,160	1,196	1,236	1,280	1,340	1,400	1,465	1,530	1,590
2420	1,655	1,715	1,780	1,840	1,905	1,970	2,030	2,090	2,160	2,220
2430	2,283	2,350	2,410	2,475	2,540	2,600	2,660	2,725	2,790	2,850
2440	2,915									

TABLE 2
 WHITE RIVER MUNICIPAL WATER DISTRICT
 RESERVOIR ON N. FORK-DOUBLE MTN. FORK - BRAZOS RIVER

CAPACITY IN ACRE FEET

Elev.	0	1	2	3	4	5	6	7	8	9
2360	-	-	0	4	15	32	58	94	142	204
2370	281	378	505	667	859	1,079	1,327	1,599	1,897	2,218
2380	2,561	2,928	3,318	3,728	4,158	4,608	5,077	5,565	6,075	6,605
2390	7,155	7,730	8,334	8,968	9,631	10,325	11,050	11,805	12,589	13,402
2400	14,243	15,110	16,005	16,929	17,880	18,857	19,863	20,896	21,954	23,040
2410	24,154	25,298	26,476	27,692	28,950	30,260	31,630	33,062	34,560	36,120
2420	37,742	39,427	41,175	42,985	44,857	46,795	48,795	50,855	52,980	55,170
2430	57,421	59,738	62,118	64,560	67,068	69,638	72,268	74,960	77,718	80,538
2440	83,420									

TABLE 3
NET EVAPORATION RATES AT THE POST RESERVOIR SITE

(Values in Feet)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1939	-	-	-	-	-	-	.61	.41	.65	.31	.14	.09	2.21
1940	.12	.12	.47	.46	.56	.51	.97	.62	.79	.44	.12	.20	5.38
1941	.13	.12	.08	.22	-.24	.39	.52	.63	.27	-.20	.28	.17	2.37
1942	.17	.24	.40	.11	.62	.61	.69	.38	.13	.19	.38	-.03	3.89
1943	.22	.34	.38	.49	.30	.67	.54	1.06	.63	.56	.27	.06	5.52
1944	.03	.09	.34	.52	.49	.73	.45	.64	.30	.32	.16	-.01	4.06
1945	.10	.18	.38	.44	.75	.86	.39	.61	.59	.13	.38	.21	5.02
1946	.07	.29	.39	.58	.58	.72	1.00	.91	.41	.23	.29	.11	5.58
1947	.19	.25	.14	.39	.08	.69	.85	.88	.94	.59	.23	.13	5.36
1948	.17	.13	.43	.60	.45	.67	.61	.92	.71	.37	.42	.33	5.81
1949	-	.16	.31	.20	.13	.41	.66	.70	.39	.29	.44	.21	3.90
1950	.23	.24	.40	.36	.07	.49	.28	.67	.18	.59	.50	.25	4.26
1951	.29	.23	.34	.48	.41	.60	.71	.60	.73	.52	.33	.33	5.57
1952	.26	.36	.49	.40	.53	.97	.71	1.06	.65	.78	.35	.23	6.79
1953	.36	.26	.32	.52	.63	.97	.84	.68	.83	.29	.28	.32	6.30
1954	.27	.41	.49	.28	.14	.74	1.06	.79	.94	.62	.52	.40	6.66
1955	.16	.25	.56	.62	.29	.65	.52	.73	.49	.45	.41	.49	5.62
1956	.29	.22	.57	.57	.52	.73	.98	1.09	1.05	.63	.55	.28	7.48
1957	.29	.11	.42	.21	.04	.41	.81	.89	.67	.19	.09	.34	4.47
1958	.10	.14	.04	.16	.19	.64	.78	.77	.47	.33	.37	.30	4.29
1959	.24	.27	.41	.35	.27	.16	.35	.83	.80	.25	.38	.21	4.52
1960	.06	.14	.23	.41	.50	.63	.25	.91	.69	.17	.39	.06	4.44
1961	.04	.09	.25	.53	.52	.30	.24	.71	.69	.61	.15	.18	4.31
1962	.16	.32	.36	.36	.77	.54	.63	.83	.14	.42	.29	.17	4.99
1963	.20	.17	.36	.40	.03	.23	.83	.74	.53	.56	.35	.21	4.61
1964	.22	.17	.41	.60	.47	.54	.89	.72	.50	.56	.38	.23	5.69
1965	.32	.24	.34	.43	.18	.52	.90	.60	.47	.54	.37	.22	5.13
1966	.04	.11	.45	.17	.47	.49	.61	.08	.24	-	-	-	2.66
Total	4.73	5.65	9.76	10.86	9.75	15.87	18.67	20.46	15.88	10.74	8.82	5.69	136.89
Avg.	.18	.21	.36	.40	.36	.59	.67	.73	.57	.40	.33	.21	5.01

Runoff into the Post Reservoir was estimated from stream flow records of the Double Mountain Fork of the Brazos River near Aspermont for the period July 1939 to September 1966, as published by the U. S. Geological Survey. The runoff was correlated between the gage at Aspermont and the Post Site using their drainage area ratios and adjusting for a higher percentage of base-flow at the Post Site. The relationship of base-flows was determined by comparing gage flows at Aspermont with those of the U.S.G.S. Gage on the South Fork, Double Mountain Fork at Justiceburg, from November 1961 to September 1966. Correlation of mass curves of flow at the two sites gave a factor of 0.242. In other words, flows at Aspermont times 0.242 approximated the flows at Justiceburg. The ratio of the drainage area at Justiceburg to that at Aspermont is 269 to 1510 or 0.178. Therefore, the drainage area ratio times 1.392 equals the correlation factor. Since the drainage conditions above the Justiceburg gage are very similar to the one above the Post Site with respect to base-flow and the size of the drainage areas compares favorably, the same correlation factor was applied to the ratio of the drainage areas of the Post Site and Aspermont gage to determine historical runoff. Table 4 shows the estimated runoff at the Post Reservoir Site.

The volume of siltation that should be allowed for was determined from a study of sedimentation rates in Texas which was published by the Texas Board of Water Engineers in 1959 as Bulletin 5912. The siltation rate for the drainage area of the site is estimated to be 2.0 acre-feet per year per square mile. The 50 year sedimentation allowance for the 190 square mile drainage area of the Post Site is 19,000 acre-feet.

The runoff depletions expected to occur by the year 2020 are based on the report of the U. S. Bureau of Reclamation prepared for the U. S.

Table 4
ESTIMATED RUNOFF AT THE POST RESERVOIR SITE

(Values in Acre-Feet)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1939							230	2,780	-	540	10	10	3,570
1940	10	140	-	310	1,090	2,260	40	6,300	2,510	-	1,250	50	13,960
1941	-	360	2,430	12,320	29,790	8,770	4,580	2,290	4,310	22,150	990	370	88,360
1942	100	10	-	1,430	300	1,450	330	3,120	4,200	5,690	290	670	17,590
1943	280	10	250	400	1,290	1,710	1,320	-	-	-	-	10	5,270
1944	-	110	10	70	1,500	440	2,600	270	240	250	170	410	6,070
1945	40	10	230	70	90	1,550	4,910	30	900	4,460	20	-	12,310
1946	10	-	-	10	460	1,180	140	1,890	2,060	5,870	130	1,010	12,760
1947	100	-	-	20	19,190	1,120	450	40	450	220	70	930	22,590
1948	-	1,770	110	-	620	4,180	6,110	920	50	830	1,680	-	16,270
1949	20	30	10	560	4,400	5,270	110	170	4,370	510	60	-	15,510
1950	-	50	-	1,460	7,990	710	2,250	530	7,910	140	10	10	21,060
1951	-	-	-	10	1,210	3,900	370	2,210	80	-	-	-	7,780
1952	-	-	-	90	2,070	100	1,020	150	90	-	30	10	3,560
1953	-	-	70	210	2,060	260	1,150	1,840	20	9,220	400	30	15,260
1954	10	-	-	9,230	10,310	810	-	10	-	20	220	-	20,610
1955	-	640	2,770	60	18,500	5,370	9,870	360	28,080	12,890	370	180	79,090
1956	110	90	10	10	2,030	330	250	250	-	150	20	10	3,260
1957	-	2,270	40	7,080	17,640	13,660	1,620	700	1,130	2,890	2,210	60	49,300
1958	50	30	160	1,100	6,250	1,260	230	410	1,710	170	210	10	11,590
1959	-	-	-	110	950	11,920	12,510	1,710	-	2,720	100	1,490	31,510
1960	150	90	30	-	520	630	12,860	180	10	23,870	730	410	39,480
1961	450	480	320	70	20	10,510	12,330	710	240	110	840	100	26,180
1962	30	10	10	30	40	5,160	630	520	14,310	400	210	200	21,550
1963	40	20	10	1,170	3,400	13,050	230	20	1,900	360	440	70	20,710
1964	30	120	10	-	120	710	40	180	310	-	30	-	1,550
1965	-	-	-	90	12,210	2,180	10	3,660	760	4,400	30	60	23,440
1966	80	50	30	2,080	1,680	1,250	-	4,450	3,300	-	-	-	12,920
Total	1,510	6,290	6,500	37,990	145,730	99,740	76,190	35,700	78,940	97,860	10,520	6,100	603,070
Avg	56	233	241	1,407	5,397	3,694	2,721	1,275	2,819	3,624	390	226	2,208

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Study Commission "Report on Land Treatment, Pond and Minor Reservoirs, and Flood Retarding Structure Depletions", April 1960. This report shows a runoff depletion from 1958 to 2010 of 5.8 acre-feet per square mile of drainage area. This depletion amounts to 1,100 acre-feet per year for the Post Reservoir.

Quality of Water

Only two chemical analyses of flow near the reservoir site are available, one made by the U.S.G.S. of a spot sample taken at U. S. Highway 380 just below the reservoir site on June 5, 1950 and the other made by Texas State Department of Health of a sample taken by the White River Municipal Water District at F. M. Highway 651 just above the reservoir site on May 10, 1968. These analyses are as follows:

	U.S.G.S. U.S. 380 6-5-50 <hr/> PPM	Health Dept. F.M. 651 5-10-68 <hr/> PPM
Silica	14	
Calcium	61	45
Magnesium	21	48
Sodium and Potassium	182	244
Bicarbonate	107	222
Sulfate	199	320
Chloride	238	237
Nitrate	4.2	
Total Dissolved Solids	846	1120
Total Hardness	238	308

The flows at the time the samples were taken are not known; however, rainfall records in the vicinity indicate that the samples were taken at times of small freshets. The analyses indicate that, without concentration of the salts in the reservoir, the water would be barely acceptable as a municipal supply. It is anticipated that the quality of flood flows, which

contribute most of the water to a reservoir in that area, would be better than the quality at samples such as the above taken at times of small freshets. For this reason, the above analyses indicate that the reservoir water would probably be satisfactory for municipal use after concentration of salts in the reservoir by reason of evaporation. However, two analyses of spot samples of the flow are inadequate to prove up the quality of the water and it is recommended that a cooperative U.S.G.S. quality and flow measuring station be established at F.M. 651 just above the reservoir as soon as practicable and continued until the quality of the water is definitely established.



FREESE-NICHOLS

June 9, 2000

Mr. Tommy O'Brien, P.E.
White River Municipal Water District
HCR2 Box 141
Spur, TX 79370

Re: Post Reservoir
Updated Cost Estimate
WRD00378

Dear Mr. O'Brien:

As you requested we have reviewed the cost estimate for the proposed Post Reservoir. We have enclosed an updated estimate that has been revised to reflect current unit prices. No reevaluation of the project design has been made; however, the rock riprap on the upstream face of the dam was changed to soil cement. In general, soil cement is less expensive, and we have been using it on several reservoirs in your area. We have also added permitting costs and costs for mitigation, which would be required to construct the reservoir.

If you have any questions, please feel free to call.

Yours very truly,

A handwritten signature in cursive script that reads "Janis C. Murphy".

Janis C. Murphy, P.E.

Enclosure

[off00052]T:\whiteriver.DOC

**Section 11 – Future Supplement to Lake Alan Henry –
Year 2030 - Post Reservoir Option**

**f. 1989 Water Quality Evaluation of the Post
Reservoir Site**

CITY OF LUBBOCK

WATER QUALITY EVALUATION
OF POST RESERVOIR SITE

1989

Freese
AND
Nichols, INC.
CONSULTING ENGINEERS

CITY OF LUBBOCK
WATER QUALITY EVALUATION
OF
POST RESERVOIR SITE

SEPTEMBER 1989

FREESE AND NICHOLS, INC.
FORT WORTH, TEXAS

SUMMARY

The City of Lubbock authorized Freese and Nichols in June 1986 to conduct a study of dissolved minerals in the vicinity of the White River Municipal Water District's proposed Post Reservoir site, which Lubbock is considering as a source of additional water supply. The Post Reservoir site is located on the North Fork Double Mountain Fork Brazos River approximately two miles upstream from Highway 380, east of Post.

The objective of this study was to evaluate the suitability of the reservoir in terms of water quality as a source of municipal supply. The study consisted of two primary parts: (1) an evaluation of water quality sampling data and (2) an analysis of alternative operating strategies to identify and evaluate an effective means of providing usable quality water to the City on a dependable basis. The projections of chemical quality in the proposed Post Reservoir assume that the current (i.e., November 1983 through March 1988) watershed conditions will be applicable in the future. However, if a significant change in the dissolved solids contribution upstream of the Post site occurs, as would happen if the City of Lubbock implemented direct discharge of treated wastewater effluent into the North Fork Double Mountain Fork Brazos River, then the results of water quality projections under the current study would be invalidated. In such an instance, additional detailed analyses would be required to estimate the impacts of the discharge on the current projections of Post Reservoir quality, and the alternatives for using Post water as described in this study would have to be re-evaluated.

Water quality data collected by the City and by the U.S. Geological Survey (USGS) were analyzed for patterns of dissolved mineral contamination in the study area. Analyses of the City's data indicated that no statistically significant differences in dissolved salts occurred at sampling points between Buffalo Springs Lake and the proposed reservoir site. These results indicate that dissolved mineral concentrations are relatively uniform downstream of Buffalo Springs Lake, and no isolated sources of localized salt contributions were encountered.

Trend analyses were performed on total dissolved solids (TDS), chloride (Cl), and sulfate (SO₄) concentrations of samples collected by the USGS near the proposed reservoir site between 1983 and 1987. No apparent increasing or decreasing trends were detected, indicating that the sources and processes that introduce dissolved minerals into the stream during the sampling period remained fairly constant.

Total dissolved solids concentrations in Post Reservoir were simulated, using monthly streamflow and evaporation between 1940 and 1981 and the maximum authorized annual withdrawal rate of 10,600 acre-feet per year. The results indicate that TDS levels in the reservoir would be above 1,000 mg/l almost all the time and above 1,300 mg/l approximately 64 percent of the time.

Strategies for making the Post Reservoir water acceptable for municipal use were evaluated. The alternatives included diverting high-concentration low flows around the reservoir, and blending Post Reservoir water with water from White River Reservoir, Sand Hills well water, the

proposed Lake Alan Henry, or the combination of White River Reservoir and Lake Henry. The low flow diversion alternative was the least effective. Diversion of flows up to 40 cfs reduced TDS levels below 1,300 mg/l about 72 percent of the time, but resulted in 14 months when the reservoir would be empty. Blending Post Reservoir water with 3,360 acre-feet per year [3 million gallons per day (MGD)] of White River Reservoir water would provide suitable quality drinking water approximately 76 percent of the time. Blending Post Reservoir water with Sand Hills well water, with Lake Alan Henry water or with the combination of White River and Lake Alan Henry water would enable Lubbock to use nearly all the Post yield while maintaining usable quality water at all times during the 42-year simulation period. Based on present watershed conditions as reflected by the water quality sampling results from 1983 through 1987, it is concluded that the Post Reservoir project can be developed and operated, in conjunction with other sources, to provide a reliable source of additional drinking water of acceptable quality for the City of Lubbock.

**Section 11 – Future Supplement to Lake Alan Henry –
Year 2030 - Post Reservoir Option**

g. 2007 North Fork Yield Study

To: Thomas L. Adams**From:** David D. Dunn, P.E.**Project:** City of Lubbock Water Rights Permitting**CC:** Brad Castleberry
Lynn Sherman**Date:** January 3, 2007**Job No:** 34671**RE: Impacts of Proposed Post Reservoir Operations on BRA System Operations**

Per your direction following the meeting on September 19, 2006, at the offices of the Brazos River Authority (BRA) between representatives of the City of Lubbock (City) and BRA, HDR Engineering, Inc. (HDR) has prepared modeling runs that simulate operations of the proposed Post Reservoir under various assumptions concerning various sources of water that might be available. These modeling runs were completed in order to determine the effects of the proposed operations on water rights held by BRA in Possum Kingdom Reservoir and on BRA's pending System Operations Permit that is currently being reviewed by the Texas Commission on Environmental Quality (TCEQ). This memorandum summarizes these initial analyses, which will be incorporated into a larger water availability report upon completion of the remainder of our work in the near future.

Background

The City of Lubbock is evaluating various water supply alternatives to meet the City's future water needs and those of other entities in the surrounding area that may decide to purchase water from the City. One alternative the City is investigating is the potential for diverting flows from the North Fork of the Double Mountain Fork of the Brazos River (North Fork) at the location of the proposed Post Reservoir. The water right for Post Reservoir (Certificate of Adjudication No. 3711) is held by the White River Municipal Water District and authorizes the impoundment of up to 57,420 acre-feet (acft) of water and the diversion of up to 10,600 acft/year for municipal and other uses, at a priority date of January 20, 1970.

The City has requested that HDR evaluate several alternatives for diverting water at or near the site of the proposed Post Reservoir, including (1) high-flow diversions (scalping) transported and stored in Lake Alan Henry, (2) storage and diversions from a smaller configuration of Post Reservoir that would be operated in conjunction with Lake Alan Henry, and (3) storage and diversion from a full-sized configuration of Post Reservoir, possibly operated in conjunction with Lake Alan Henry to maximize the supply that might be obtained from the two reservoirs. Any utilization of the Post Reservoir water right would require an agreement between the City and White River Municipal Water District. Several sources of water are potentially available to the City at the Post Reservoir site including:

1. water appropriated by the Post Reservoir water right (at the 1970 priority date);
2. remaining unappropriated flows at the Post Reservoir location;
3. the City's wastewater treatment plant effluent discharged into the North Fork;
4. stormwater "developed" by the City that is now discharged into the North Fork; and
5. water that may be made available through an agreement with BRA regarding priority calls for water at Possum Kingdom Reservoir and by BRA's pending System Operations Permit, if granted by TCEQ.

BRA has filed a water rights permit application (System Operations Permit, Application No. 5851) with TCEQ that seeks a significant increase in BRA's overall authorized diversions from its system of water rights in the Brazos River Basin. This permit, if granted, would be senior in priority to all water rights granted after it and would necessitate that some form of priority calls agreement be entered into with BRA for virtually any new water right that is not associated with reuse of wastewater or other types of developed water that would not be subject to priority calls.

Brazos Basin Water Availability Model

TCEQ has developed water availability models (WAMs) for each river basin in Texas. These models utilize the Water Rights Analysis Package (WRAP) developed at Texas A&M University and input files developed specifically for each river basin. The WRAP model can compute water available to existing and proposed water rights under a variety of assumptions regarding water management in a river basin. This is accomplished by simulation of the water rights in the basin under a repeat of the historical period of record hydrology, and summarizing how those rights would have performed under historical hydrologic conditions and whatever management assumptions are being investigated. The Brazos River Basin WAM (Brazos WAM) includes a period of record from 1940 – 1997. For permitting of perpetual water rights, TCEQ has adopted a version of the Brazos WAM called Run 3. Basic assumptions in Run 3 include full utilization of all perpetual water rights, no term (temporary) permits, zero return flows (no discharge of treated wastewater effluent), and as-permitted reservoir storage capacities.

The WRAP model code has been continually improved by Texas A&M University since adoption by TCEQ in 1997. Each subsequent version of the model has improved modeling capabilities with new or expanded options. However, each new version of the model increases in complexity, and at times requires that existing data sets be modified in order to be utilized with the latest version. The latest WRAP version was released in September 2006 and was selected for use in this study, primarily because of a new capability added to the model that allows the model user to simulate subordination of senior rights to upstream junior rights. Note that TCEQ is reviewing the model and has not adopted the September 2006 version. Initial tests of the September 2006 WRAP version on relatively simple data sets indicated that the updated model performed the subordination computations correctly. However, after application of the model to the larger, complicated Brazos Basin, inspection of model output revealed several computational difficulties in the new code, not necessarily related to the new subordination option. HDR decided that the most expedient approach would be to adopt an earlier version of the WRAP code (February 2004) to which HDR had added the capability to simulate subordination agreements between specific water rights. These modifications were made in support of the Brazos G Regional Water Planning Group as it developed the 2006 Brazos G Regional Water Plan. The HDR-developed subordination option has not been adopted officially by TCEQ, and simulates subordination agreements using a different technique than does the September 2006 version. However, applying the two approaches on relatively simple example data sets showed that the two versions arrive at identical results with respect to subordination.

Water Availability Model Used by BRA

Freese and Nichols, Inc. (FNI) supplied data sets to HDR that contain the simulations of BRA's proposed System Operations Permit. HDR utilized these data sets as a base, to which information was added that reflects the City's proposed supplies and uses at the Post Reservoir site. The BRA data sets differ from the TCEQ Run 3 data sets by including treated wastewater effluent discharges projected to occur in year 2060, and locating all BRA diversions (both existing authorizations and proposed) at three locations: the Brazos River near Glen Rose, the Brazos River near Highbank, and the Brazos River in the lower basin near the Gulf of Mexico. No return flows from the City or Ransom Canyon were included in the BRA's version of the Brazos WAM. The modeling supporting the BRA application is designed to take advantage of the efficiency of the BRA system of reservoirs and demonstrate the maximum amount of firm supply that could be developed by the system, including BRA's existing water rights.

In developing the estimates of firm supply at the two upper diversion locations, the maximum firm supply available at the upstream location was first determined, and any remaining system supply was then determined at the Gulf diversion location. When the Gulf diversion is operated individually, no upstream diversions are taken and all BRA diversions are simulated at the Gulf location. As shown in Table 1, the maximum firm supply from the system is developed when all BRA diversions are taken in the lower basin near the Gulf of Mexico. This allows all BRA reservoirs to make releases to a common downstream diversion point, and takes advantage of the maximum drainage area available to contribute flows. When diversions are taken upstream at Glenrose or Highbank, the total supply that can be developed by the system is reduced. Table 1 summarizes the firm supply that BRA's application No. 5851 requests.

Table 1. Summary of BRA System Supplies in System Operations Application No. 5851 (acft/year)

Diversion Location	Firm Supply at Diversion Location		Additional Supply at Gulf of Mexico		Total Existing Rights	Total Additional Supply	Total Supply
	Existing Rights	Additional Supply	Existing Rights	Additional Supply			
Glen Rose	295,462	150,538	466,089	(2,089) ¹	761,551	148,449 ¹	910,000 ¹
Highbank	295,462	144,306	466,089	1,143	761,551	145,449	907,000
Gulf of Mexico	761,551	421,449 ¹	--	--	761,551	421,449 ¹	1,183,000 ¹

¹ Values for diversions at Glen Rose and the Gulf of Mexico differ from those obtained from current model data sets supplied by Freese and Nichols on behalf of BRA (see Tables 2 and 3).

Sources of Developed Water

Return Flows

Calculations of return flows from the City were based on personal communication with Ches Carthel dated November 22, 2005. HDR was instructed to assume 22.91 million gallons per day (MGD) (25,664 acft/year) of treated wastewater effluent would be returned to the North Fork and available for reuse by the City. Using this value, monthly totals of treated wastewater effluent were calculated and included in various model scenarios of the Brazos WAM. Return flows were assumed to be discharged into the North Fork at the current location of TPDES Permit No. 10353-002, near where FM 400 crosses the North Fork. The City has a reuse application pending at TCEQ (Permit No. 3985A) that would provide a total authorized indirect reuse of 32,991 acft/year.

Developed Stormwater

Estimates of water generated and discharged to the North Fork due to the operation of the City's stormwater system were developed by Parkhill, Smith & Cooper, Inc. (PSC) for the City and provided to HDR. Final values from PSC were obtained October 31, 2006. These estimates include total storm runoff volumes and peak discharges for the 2-, 5-, 10-, 25-, 50-, and 100-year 24-hour design storms, discharged at 26 outfall locations. In addition, PSC provided runoff volumes for five rainfall depths less than the 2-year design storm in order to obtain an extended relationship between rainfall depth and volume of runoff. The five additional rainfall depths include the 0.5-, 1.0-, 1.5-, 2.0-, and 2.5-inch 24-hour precipitation events.

Relationships were developed between storm event runoff volume and rainfall depth at each of the 26 outfalls. These relationships and daily rainfall data monitored at the Lubbock Airport were used to estimate monthly volumes of storm runoff from the "contributing" and "noncontributing" areas of the Lubbock stormwater system. Contributing areas correspond to those areas that TCEQ has determined naturally contribute flows to the North Fork. Noncontributing areas are those areas that contribute to North Fork flows solely due to construction of the City's stormwater system, and include primarily areas that drain to the system of playa lakes around the City.

HDR estimated channel losses (from existing Brazos WAM data) between the 26 stormwater outfalls and the location of the proposed Lake 7 identified in the City's pending developed water right application No. 5921. This location is approximately 800 feet west and upstream of where FM 835 crosses the North Fork. Using the estimated channel losses, HDR estimated the portion of the water generated by the City's stormwater system that would be delivered to the Lake 7 location. HDR compared these monthly quantities to the naturalized streamflows in the Brazos WAM and determined flows in excess of the existing naturalized flows that can be considered "developed." The result of the analyses is monthly volumes of water available to the City assuming, alternatively, that (1) all stormwater discharged by the City can be considered to be "developed" water, and (2) only that stormwater discharged that would not have been discharged without the City's stormwater system can be considered "developed" water. For these analyses, HDR utilized the first case, with the additional flows that were made available to the City as "developed" water limited to those flows in excess of the existing TCEQ naturalized flows at the Lake 7 location.

The estimates of developed stormwater and return flows were incorporated into the Brazos WAM, and were made available for use by Post Reservoir prior to other water rights in the basin.

Water Supplies at Post Reservoir

Analyses to determine the impacts of the City's proposed water supplies are limited in this memorandum to analyses of the proposed use of the Post Reservoir at its full authorized storage capacity. This will reflect the maximum impact to BRA's existing and pending water rights that could be expected due to the City developing a water supply at the Post Reservoir site. A smaller Post Reservoir and/or any scalping operation at the Post site without the full sized Post Reservoir will have lesser effects on the BRA rights. For purposes of this analysis, a series of model runs (Scenarios 1 – 6) were developed to determine the incremental water supply benefit that can be realized from each identified source of water, and the incremental effect each would potentially have on BRA's existing and pending water rights. The results of the analyses are summarized in Tables 2 and 3.

Supplies presented here are "firm yield" supplies, representing the maximum annual supply that could be diverted from Post Reservoir following a mostly municipal demand pattern. Under a firm yield analysis, the reservoir is allowed to go dry or nearly dry during the critical month of the simulation period, which occurs in the midst of the 1950's drought. These analyses utilize the 1940 – 1997 hydrologic period available in the Brazos WAM, which does not reflect the ongoing drought currently experienced in the region. The current drought has been shown to be equally or more severe than the 1950's drought.

A base case (Scenario 1) was established, which is the model run provided by FNI. In this scenario, the full Post Reservoir authorized diversion (10,600 acft/year) is simulated with no subordination of BRA rights and no additional sources of water available. Under this scenario, the Post Reservoir diversion is not firm and experiences shortages in multiple months and years. The firm yield of the BRA System was determined from which to calculate the effects of various Post Reservoir operations.

A second scenario (Scenario 2) was established in which the firm yield of Post Reservoir was determined, with no developed water and no subordination of the BRA rights. Based on the Post Reservoir priority date, the firm yield of Post Reservoir is approximately 5,500 acft/year, or 5,100 acft/year less than its authorized diversion of 10,600 acft/year. It is common for reservoirs in the western portion of the state to have authorized diversions that are significantly greater than the firm yield computed by the TCEQ Brazos WAM. The authorized diversions of many of the western reservoirs were determined by not fully accounting for the passage of inflows to downstream senior water rights, and often allow for overdrafting operations (temporarily diverting greater than the firm yield during wet times). The firm yield of 5,500 acft/year computed here for Post Reservoir assumes that the reservoir would pass all inflows to senior water rights whenever those rights would otherwise experience a shortage of either diversion or storage.

The most significant downstream senior water right affecting the yield of Post Reservoir is BRA's Possum Kingdom Reservoir, which has a priority date of 1938, making it one of the largest, most senior rights in the upper basin. Scenario 3 simulates the additional supply that could be developed in Post Reservoir by subordination of Possum Kingdom Reservoir to Post Reservoir¹. Subordination of Possum Kingdom Reservoir to Post Reservoir, i.e., Post not having to pass inflows to maintain storage in Possum Kingdom, would increase the yield of Post Reservoir to 13,680 acft/year², a yield that is 3,080 acft/year greater than the diversions currently authorized in the water right. This subordination would have a minimal effect on Possum Kingdom by reducing the minimum storage from 260,359 acft to 258,016 acft (2,343 acft reduction) during the critical month of the drought of record (April 1953). The remaining storage in the critical month is greater than BRA's currently permitted annual diversions from Possum Kingdom Reservoir. This reduction in storage would not reduce the capability of BRA to divert its full authorized diversions from Possum Kingdom.

Under Scenario 4, accounting for the City's assumed 22.91 MGD (25,664 acft/year) of return flows increases the yield of Post Reservoir to 31,700 acft/yr (assuming subordination of Possum Kingdom), an increase of 18,020 acft/year. There is not a one-to-one increase in yield from the return flows due primarily to the

¹ Under all scenarios involving subordination of Possum Kingdom Reservoir, all diversions from Post Reservoir were treated as senior to the BRA System Operation Permit diversion.

² Any diversions from Post Reservoir in excess of 10,600 acft/year assume a 2007 priority date and were simulated subject to Lyons Method instream flow requirements, which specify passage of reservoir inflows to maintain minimum flows downstream of the reservoir. The Lyons Method is the default method employed by TCEQ for determining instream flow requirements.

significant channel losses between FM 400 and Post Reservoir (28.7 percent), some evaporative losses in the reservoir, and the fact that the return flows are simulated as constant inflows and are not discharged to the stream following the same municipal demand pattern that the diversions follow. The return flows were treated as “developed” water, whereby Post Reservoir was given first and full access to them (after losses) prior to any other right in the basin.

Under Scenario 5, accounting for the City’s developed stormwater flows further increases the yield of Post Reservoir to 37,400 acft/year. While the City’s return flows were input to the model as constant monthly inflows, the stormwater flows are input as a monthly 1940 – 1997 time series of discharges, which vary widely from zero in many months to a maximum of 18,105 acft in a single month. The developed stormwater flows average 919 acft/month. Similar to the City’s return flows, the stormwater flows were treated as “developed” water by allowing Post Reservoir first and full access to them prior to any other right in the basin.

An additional scenario (Scenario 6) was investigated, wherein the City return flows and developed stormwater flows are made available to Post Reservoir, but no subordination agreement with BRA is enacted. Treated as “developed” flows, the return flows and stormwater flows would not be subject to priority calls by BRA. The modeling results indicate that a firm supply of between 32,170 and 32,700 acft/year could be developed at Post Reservoir without subordination of any BRA water rights. As the Post Reservoir supply in this case is dependent upon how Possum Kingdom Reservoir and the BRA System operate, the yield varies according to where the BRA System yield is diverted.

Impacts to Proposed BRA System Operations Permit

Potential impacts to BRA’s proposed System Operations Permit were considered at two of the three locations cited in the BRA permit application, the Brazos River near Glen Rose and at the lower basin diversion near the Gulf of Mexico (Gulf). Tables 2 and 3 show the impacts to the BRA System Operation Permit of the various scenarios investigated.

With regard to the Glen Rose diversion, the combined yields at both Glen Rose and the Gulf must be balanced as the combined BRA yield is maximized. Subordination of Possum Kingdom Reservoir (and the proposed BRA System Operations Permit) to Post Reservoir under Scenario 3 appears to increase diversions from the BRA System (combined Glen Rose and Gulf diversions) when compared to the base case (Scenario 1). This can be misleading, because when Post Reservoir is operated in an overdrafting mode, it can reduce inflows to Possum Kingdom Reservoir during certain critical times that are required to maintain the system yield at Glen Rose, which has a different critical month (April 1953) than the Gulf diversion (February 1957). Overall, subordination of Possum Kingdom Reservoir appears to have minimal effect on the combined diversions at Glen Rose and the Gulf, primarily because much of the BRA’s system benefit is reduced when diverting significant flows from the upper basin. Subordination of Possum Kingdom Reservoir to Post Reservoir would reduce BRA System diversions at Glen Rose by about 500 acft/year. However, this reduction in Glen Rose diversions could subsequently increase available diversions at the Gulf.

With regard to the Gulf diversion by itself, the largest impact the proposed Post Reservoir operations would have would be due primarily to subordinating Possum Kingdom Reservoir to Post Reservoir. The storage reductions caused by subordination would limit the capability of Possum Kingdom Reservoir to make releases to the Gulf diversion during critical months. The net effect BRA might recognize from the above operations would be about a 3,950 acft/year reduction in the firm diversions at the Gulf when BRA’s diversions are concentrated in the lower basin only. Note that the Gulf diversion amounts shown here are greater than those that BRA has applied for in the System Operation Permit Application. The model data sets provided by FNI indicate a firm Gulf diversion that is 4,000 acft/year greater than stated in the System Operation Permit Application. Conversely, the combined Glen Rose and Gulf diversions in the data sets provided by FNI are about 5,000 acft/year less than requested in the BRA’s application (Tables 1 and 2).

**Table 2. Summary of Supplies with BRA System Operations Focused at Glen Rose (acft/year)
(All diversions are firm yield supplies unless otherwise noted.)**

Scenario	Post Diversion	Glen Rose Diversion	Gulf Diversion	Total BRA Diversion	Change in Glen Rose Diversion	Change in Gulf Diversion
1. Original Data from FNI (base)	10,600 (not firm)	446,800	459,400	906,200	--	--
2. No PK Subordination, No Stormwater, No Return Flow	5,500	446,800	461,600	908,400	0	2,200
3. PK Subordination Only	13,680	446,300	461,700	908,000	(500)	2,300
4. PK Subordination plus Return Flows	31,700	444,300	464,100	908,400	(2,500)	4,700
5. PK Subordination plus Return Flows plus Stormwater	37,400	443,700	463,800	907,500	(3,100)	4,400
6. <u>No PK Subordination</u> plus Return Flows plus Stormwater	32,170	446,800	461,600	908,400	0	2,200

**Table 3. Summary of Supplies with BRA System Operations Focused at the Gulf of Mexico (acft/year)
(All diversions are firm yield supplies unless otherwise noted.)**

Scenario	Post Diversion	Gulf Diversion	Change in Gulf Diversion
1. Original Data from FNI (base)	10,600 (not firm)	1,187,250	--
2. No PK Subordination, No Stormwater, No Return Flow	5,500	1,187,100	(150)
3. PK Subordination Only	13,680	1,183,600	(3,650)
4. PK Subordination plus Return Flows	31,700	1,183,300	(3,950)
5. PK Subordination plus Return Flows plus Stormwater	37,400	1,183,300	(3,950)
6. <u>No PK Subordination</u> plus Return Flows plus Stormwater	32,700	1,187,100	(150)

Options to Increase Supply from Post Reservoir

In order to access additional (unpermitted) yield in Post Reservoir, a new or amended water right will be required. This could include one or a combination of the following options:

1. Amend Certificate of Adjudication No. 3711 to increase authorized diversions from Post Reservoir. This amendment would be for unappropriated flows, and/or flows made available at Post through a subordination agreement with BRA. The current diversions authorized from Post Reservoir (10,600 acft/year) are not firm. Without subordination of Possum Kingdom Reservoir, 5,500 acft/year of firm supply could be developed at Post Reservoir out of the 10,600 acft/year of authorized diversions. Subordination of Possum Kingdom Reservoir to Post would make firm the remaining 5,100 acft/year of existing authorized diversions, and make available an additional 3,080 acft/year for a total increase in firm supply of 8,180 acft/year. In other words, subordination would make firm the existing authorized diversions of 10,600 acft/year, plus increase the yield by an additional 3,080 acft/year to a total of 13,680 acft/year, as shown in Table 4.

Table 4. Summary of Supplies at Post Reservoir (acft/year)

Supply	Description
5,500	Firm yield supply from existing authorization
<u>5,100</u>	Existing authorization made firm through subordination
10,600	Total existing authorized diversions
<u>3,080</u>	Additional firm supply made available through subordination
13,680	Total supply at Post Reservoir

Any diversions from Post Reservoir in excess of 10,600 acft/year would need to be permitted at TCEQ and would be assigned a junior priority. This would also require some form of subordination agreement with BRA so that inflows would not need to be passed to Possum Kingdom Reservoir. It may be possible to include the developed stormwater and return flows in this amendment by treating a portion of the additional diversions from Post Reservoir as developed water that is not subject to downstream priority calls.

2. Amend the pending reuse permit No. 3985A to add a diversion point at Post Reservoir so that the additional return flows can be diverted at the Post site. This would likely not require an amendment to the Post Reservoir water right as the additional diversions at the site would be associated with the reuse permit.
3. Amend the pending developed water application No. 5921 to add a diversion point at Post Reservoir so that the developed stormwater flows can be stored and accessed at the Post site.

Both options 2 and 3 would not make any additional "unappropriated" flows available at Post, but would provide the means to access the reuse and developed stormwater flows at the Post site. Neither option 2 or 3 would require a subordination agreement with BRA, as the reuse and developed stormwater flows are not subject to priority calls by senior rights, including BRA's (assuming acceptance by TCEQ that these flows can be treated as developed water). With no subordination agreement with BRA, the combined reuse and developed stormwater flows would increase the firm yield of Post Reservoir by about 27,200 acft/year (Table 3). In comparison, with a subordination agreement, the combined reuse and developed stormwater flows would increase the firm yield of Post Reservoir by a lesser amount of 23,700 acft/year. These analyses indicate that while a subordination agreement with BRA would increase the Post Reservoir yield by 8,180 acft/year, the increased water availability due to subordination reduces the effectiveness of the combined return and stormwater flows by about 3,500 acft/year (27,200 minus 23,700) because Post Reservoir would be more full more often and would not be able to capture as much of the developed water flows. Under both options, an accounting plan would need to be established that would apportion the water stored in Post and subsequently diverted between reuse, developed stormwater, and water appropriated under the Post Reservoir priority.

If no equitable subordination agreement can be reached with BRA, the City (in coordination with White River Municipal Water District) could realize an increase of about 27,200 acft/year in firm supply from Post Reservoir due to the City's return flows and developed stormwater discharges alone. With a subordination agreement, an additional 3,500 acft/year increase in firm supply could be realized in addition to the supply made available from return flows and developed stormwater discharges.

**Section 11 – Future Supplement to Lake Alan Henry –
Year 2030 - Post Reservoir Option**

**h. BRA Subrogation Agreement and Impact
Report**

To: Thomas L. Adams, City of Lubbock	
From: David D. Dunn, P.E.	Project: City of Lubbock Water Rights Permitting
CC: Brad Castleberry, Lloyd-Gosselink Lynn Sherman, Winstead Consulting	
Date: March 28, 2007	Job No: 34671

RE: Impacts of Proposed City of Lubbock Water Development Activities on Current and Proposed BRA Water Rights

This memorandum is intended to summarize the water rights modeling performed thus far by HDR Engineering, Inc. (HDR) with respect to the City of Lubbock's (the City) pending water right application for developed water (Application No. 5921), and to provide information regarding the potential impacts to the water rights held by the Brazos River Authority (BRA) in Possum Kingdom Reservoir (PK) or contemplated by the BRA in its pending System Operations Permit (Application No. 5851). **Based on the analyses completed by HDR, the City's contemplated actions will have no negative effect on either Possum Kingdom Reservoir or the BRA's System Operations Permit.**

On October 17, 2005, the City submitted Application No. 5921 to the Texas Commission on Environmental Quality (TCEQ). This application applied for water to be supplied at the proposed Lake 7 and Lake 8 of the Jim Bertram Lake System on the North Fork of the Double Mountain Fork of the Brazos River (North Fork). Water impounded at these two locations would be available through three primary sources:

1. unappropriated flows from the North Fork (minimal amounts are available),
2. stormwater flows originating from the playa lake system within the City that are now discharged into the North Fork ("developed" water stormwater), and
3. return flows discharged upstream from the lakes, excluding those flows sought by other City water right applications.

The City is considering several options to amend the developed water application, including:

- remove Lake 8,
- utilize the developed water at the location of the proposed Post Reservoir, and
- divert the developed water into Lake Alan Henry.

The City is also considering alternatives for joint operation of the proposed Post Reservoir and Lake Alan Henry to maximize the supply that could be developed.

Both the return flows and stormwater flows are considered to be "developed" water, in that they would not have been present in the North Fork except for the actions of the City. The return flows originate from groundwater sources or surface water supplied through interbasin transfer. These flows have traditionally not been discharged into the North Fork. The City has a pending water right application (Application No. 3985A), for which a draft permit has been issued by TCEQ for indirect reuse of historical and future City return flows up to 32,991 acre-feet per year (acft/yr). For purposes of HDR's analyses, volumes of return flows potentially available to the City were estimated to be 25,664 acft/yr, and would be discharged at the location of the outfall permitted by TPDES Permit No. 10353-002, near where FM 400 crosses the North Fork.

The stormwater flows have been historically captured by the playa lake system and never discharged to the North Fork. The City has recently begun stormwater system improvements to discharge to the North Fork the stormwater flows captured in the playa lakes. In addition, development within the City of Lubbock has increased runoff to the North Fork beyond that which would have occurred naturally.

Volumes of stormwater discharged to the North Fork vary with rainfall. Estimates of water generated and discharged to the North Fork due to operation of the City's stormwater system were developed by Parkhill, Smith & Cooper, Inc. (PSC) for the City and provided to HDR. These estimates include total storm runoff volumes for the 2-, 5-, 10-, 25-, 50-, and 100-year 24-hour design storms, discharged at 26 outfall locations. In addition, PSC provided runoff volumes for five rainfall depths less than the 2-year design storm in order to obtain an extended relationship between rainfall depth and volume of runoff. The five additional rainfall depths include the 0.5-, 1.0-, 1.5-, 2.0-, and 2.5-inch 24-hour precipitation events.

Relationships were developed between storm event runoff volume and 24-hour rainfall depth at each of the 26 outfalls. These relationships and daily rainfall data monitored at Lubbock International Airport were used to estimate monthly volumes of storm runoff from the "contributing" and "noncontributing" areas of the Lubbock stormwater system for the 1940 – 1997 period of record covered by the TCEQ's Brazos Water Availability Model (Brazos WAM). Contributing areas correspond to those areas that TCEQ has determined naturally contribute flows to the North Fork. Noncontributing areas are those areas that contribute to North Fork flows solely due to construction of the City's stormwater system, and include primarily areas that drain to the system of playa lakes around the City.

HDR estimated channel losses (from existing Brazos WAM data) between the 26 stormwater outfalls and the location of the proposed Lake 7. This location is approximately 800 feet west and upstream of where FM 835 crosses the North Fork. HDR estimated the portion of the water generated by the City's stormwater system that would be delivered to the Lake 7 location. HDR compared these monthly quantities to the naturalized streamflows in the Brazos WAM and determined flows in excess of the existing naturalized flows that can be considered "developed." These additional flows were made available to the City as "developed" water and were limited to those monthly discharges in excess of the existing TCEQ naturalized flows at the Lake 7 location.

The estimates of developed stormwater and return flows were incorporated into the Brazos WAM, and were made available for use by Post Reservoir prior to other water rights in the basin having access.

HDR obtained from Freese and Nichols, Inc. (FNI) the latest version of the Brazos WAM model that contains the proposed System Operations configuration. This version utilizes the dual simulation approach to limit streamflow depletions by existing BRA rights to what those rights would have appropriated without System Operations. This ensures that the proposed System Operations will not impact any other existing rights in the basin. The System Operations diversions contained in the model obtained from FNI are greater from those additional diversions requested in the original System Operations Permit (Application No. 5851), and HDR analyzed changes to diversions contained in the model data sets, not what was requested in Application No. 5851.

This memorandum focuses on the analyses related to Post Reservoir, as it fully demonstrates that the City's utilization of its developed water sources will have minimal impact on the BRA's existing or pending water rights.

No changes were made in the data sets related to the modeling of the BRA's existing water rights or the modeling of Application No. 5851. The water right for Post Reservoir (Certificate of Adjudication No. 3711) is held by the White River Municipal Water District and authorizes the impoundment of up to 57,420 acft of water and the diversion of up to 10,600 acft/year for municipal and other uses, at a priority date of January 20, 1970. A special condition sets aside 19,000 acft of the storage in the reservoir for sediment reserve, and allows the TCEQ to utilize the water stored in the sediment pool until such time as 19,000 acft of sedimentation has occurred.

The Post Reservoir water right was modeled in two steps in HDR's analyses. The existing senior portion was modeled as it currently is in the Brazos WAM, with the exception that the dual simulation approach was used to ensure that additional demands modeled at the junior priority do not cause the reservoir to appropriate more streamflow at the 1970 priority than it would have without the additional demands. Any additional diversions from the reservoir were then modeled at a priority junior to Possum Kingdom and junior to the proposed BRA System Operations. No subordination of Possum Kingdom or BRA System Operations to Post Reservoir was simulated in the analyses presented herein. Developed water return and stormwater

discharges were made available to Post Reservoir using Type 7 (negative streamflow depletion) rights, discharging to the North Fork at the locations discussed above, at a priority date one day senior to the junior diversions from Post Reservoir. With this modeling technique, the priorities of all existing and proposed BRA rights were honored prior to the diversions of the Post Reservoir. The effects on BRA System Operations were evaluated using the combined Glen Rose/Gulf diversion scenario and the Gulf diversion-only scenario. Table 1 presents the results of the analyses.

**Table 1. Summary of Supplies Available from Post Reservoir and BRA System Operations (acft/year)
(All diversions are firm yield supplies unless otherwise noted.)**

Scenario	Post Diversion	Glen Rose Diversion	Gulf Diversion	Total BRA Diversion	Change in Glen Rose Diversion	Change in Gulf Diversion
BRA System Operations Diverting only at Gulf						
Original Data from FNI	10,600 (not firm)	n/a	1,187,250	1,187,250	n/a	--
Post with Developed Water	32,700	n/a	1,187,100	1,187,100	n/a	(150)
BRA System Operations Diverting at Glen Rose and Gulf						
Original Data from FNI	10,600 (not firm)	446,800	459,400	906,200	--	--
Post with Developed Water	32,170	446,800	461,600	908,400	0	2,200

When the BRA's diversions are taken solely at the Gulf location, the model results indicate that operation of Post Reservoir in conjunction with the City's developed water supplies might have a small (150 acft/yr) impact on the BRA's System Operation. However, this difference is likely an artifact of the complexity of modeling the BRA's system and could probably be eliminated with additional fine tuning of the system model parameters. When a Gulf diversion is paired with an upper basin diversion, such as at Glen Rose, supplies available from BRA's System Operations might actually increase due to spills of developed water from Post Reservoir. This result is partly due to the fact that the Gulf diversion included in the original data from FNI is less than the firm supply that could be diverted, but also due to the fact that the developed water flows increase storage in Post Reservoir during many months and cause streamflow depletions by Post Reservoir at its 1970 priority date to be reduced. This leaves additional flows available to be appropriated by the BRA rights.

The forgoing analyses assume no subordination agreements between the BRA and the City, including the existing agreement related to Lake Alan Henry and Possum Kingdom. Considering this agreement in the model would decrease the supply available from Possum Kingdom Reservoir (and BRA System diversions), but would have a consistent effect across all simulations and was therefore not necessary to include in these analyses.

These analyses indicate that operation of the proposed Post Reservoir utilizing the City's developed water sources (return flows and stormwater discharges) would have essentially no negative impact on the BRA's System Operations. An accounting plan would likely need to be developed whereby the City can differentiate between naturally-occurring inflows available to Post Reservoir at its 1970 priority date, inflows which the City would not have right to impound that would have to passed downstream to senior rights, and developed water flows owned by the City.