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December 17, 2014

Office of General Counsel
Attn: Les Trobman
Texas Water Development Board
P.O. Box 13231
Austin, TX 78711-3231

Re: Region D's Response to Region C's Analysis and Quantification of the Impacts of Marvin Nichols Reservoir Water Management Strategy

Dear Mr. Trobman:

As designated by the Region D Planning Group and requested by the Texas Water Development Board, I am submitting Region D's Response regarding the above-referenced matter. I am sending you the Response by U.S. Mail and email and am also sending it by U.S. Mail and email to all other persons on the mailing list in your letter of November 6, 2014.

Very truly yours,

Jim F. Thompson

cc: w/enc
Jim Parks
Jody Puckett
Russell Laughlin
Bret McCoy
Richard LeTourneau
Walt Sears
Joe Reynolds
Linda Price
Richard Lowerre
Molly Cagle

The Interim Order of the Board of August 8, 2014 directed Region C to conduct and submit

> an analysis and quantification of the impacts of the Marvin Nichols Reservoir Water Management Strategy on the agricultural and natural resources of Region D and the State.

Region C did not conduct or submit such an analysis and quantification of the impacts. Its report, "Analysis and Quantification of the Impacts of the Marvin Nichols Reservoir Water Management Strategy on the Agricultural and Natural Resources of Region D and the State" (hereinafter referred to as the "Region C report"), failed in at least three ways.

1. The Region C Report does not analyze or quantify the impacts on the forest wetlands or bottomland hardwoods downstream of the proposed reservoir, despite the fact that
    a. the TWDB staff prepared a study documenting such impacts;
    b. USFWS has declared these as priority areas;
    c. significant areas of these forested areas are part of the White Oak Mitigation Creek WMA, which are mitigation lands for Jim Chapman Reservoir; and
    d. The Region C report admits that the reservoir will eliminate the significant flooding of these lands that is needed to protect these forested areas.
2. The Region C report fails to use the current methodology of the U.S. Army Corps of Engineers to analyze the extent and location of mitigation that will be required for lands inundated by the reservoir and completely fails to analyze the mitigation that will be required as a result of the impacts downstream of the reservoir. As a result
    a. the Region C report grossly underestimates the amount and type of lands that will be required for mitigation; and
    b. the Region C report fails to explain that these mitigation lands must be located within the Sulphur River Basin or analyze whether there are even enough such lands for mitigation.
3. The Region C report also fails to analyze the impacts of the loss of bottomland hardwoods on the timber industry and the economy of Region D. It fails to

a. address the impacts that the loss of hardwood timber supplies would have on the timber industry in Northeast Texas and Region D;

b. address any impacts that would result from the loss of agricultural/timber land for required mitigation; and

c. submit an analysis and quantification of the impacts to the agricultural/timber sector of Northeast Texas and Region D.

By failing to provide the information required by the Interim Report, Region C has also failed to meet the requirements of the Board's rules for approval of regional plans. As a result, the Board should reject the Marvin Nichols Reservoir Strategy from the 2011 Region C regional water plan.

The Board cannot make the required findings that

> *Region C's 2011 regional plan meets the requirements of the Interim Order or the TWDB rules and Texas law on which that Order is based, and
>
> *the inclusion of Marvin Nichols Reservoir in the Region C Regional Water Plan is consistent with the long-term protection of the State's agricultural and natural resources, a clear requirement for Board approval of a regional water plan pursuant to Section 16.053 of the Texas Water Code.

Legal Requirements:

The Interim Order of the Board of August 8, 2014 provides sufficient legal basis for rejecting the Region C plan. That order is, however, based on clear language in Board rules, both those rules that existed at the time of the initial Board approval of the Region C plan and as those rules are currently in effect for approval of regional plans and amendments.

Pursuant to Sections 16.051 and 16.053 of the Texas Water Code, the Board adopted the following rules, which were applicable when the Board initially approved the Region C plan in 2011:

§357.7. Regional Water Plan Development

(a) Regional water plan development shall include the following...
(8) evaluations of all water management strategies the regional water planning group determines to be potentially feasible by including:
(A) a quantitative reporting of...
(ii)environmental factors including effects on environmental water needs, wildlife habitat, cultural resources,
(iii) impacts on agricultural resources...
(C) for each threat to agricultural and natural resources identified pursuant to paragraph(1) of this subsection, a discussion of how that threat will be addressed or affected by the water management strategies evaluated;

Those rules were repealed and replaced in 2012. The current rules repeat the requirements that were also set out in the Board's Interim Order in this matter. The rules provide:

§357.34. Identification and Evaluation of Potentially Feasible Water Management Strategies

(d) Evaluations of potentially feasible water management strategies shall include the following analysis:
(3) A quantitative reporting of...
(B) Environmental factors including effects on environmental water needs, wildlife habitat, and cultural resources...
(C) Impacts to agricultural resources...
(5) A discussion of each threat to agricultural or natural resources identified pursuant to §357.30(7) of this...including how that threat will be addressed or affected by the water management strategies evaluated...
(7) Consideration of third-party social and economic impacts resulting from voluntary redistributions of water including analysis of third-party impacts of moving water from rural and agricultural areas...

and

§357.40. Impacts of Regional Water Plan

(b)RWPs shall include a description of the impacts of the RWP regarding:
(1)Agricultural resources pursuant to §357.34(d)(3)(C) of this title (relating to Identification and Evaluation of Potentially Feasible Water Management Strategies)...
(3) Threats to agricultural and natural resources identified pursuant to §357.34(d)(5) of this title

These rules are a clear recognition by the Board of its responsibility under Section 16.053 of the Texas Water Code, which states:

> (h)(7) The Board may approve a regional water plan only after it has determined that:
>
> > (C) the plan is consistent with long-term protection of the state's water resources, agricultural resources, and natural resources as embodied in the guidance principles adopted under Section 16.051(d).

Section 16.051(d) required coordination with the Texas Department of Agriculture and Texas Commission on Environmental Quality to assure interests of the state in agricultural and natural resources are balanced.

Board rules emphasize that provision by requiring that prior to approval of any regional water plan, the Board must make such a finding. (See, the Board's prior rules at 357.14(2)(C) and the current rules at 357.41.)

Thus, both Texas law and Board rules are clear. The Board is responsible for assuring a balancing of the State's interests, which clearly include statewide and regional interests in a strong economy and healthy natural resources on which the economy is based.

Board rules then require regions to provide data and analysis by which the Board can do that balancing and consistency determination. These are requirements under Texas law that all regions **must** meet.

It is compliance with these rules that Region D is requesting in this current process to resolve the interregional conflict.

Were Region C to properly comply with Board rules and provide what the Interim Order requires, the Board would be free to resolve the interregional conflict. Region D may disagree if the Board decides that the Marvin Nichols Reservoir should stay in the Region C plan, but, at least, the Board and the public will have, for the first time, a reasonable description of the impacts on Region D and the state of the proposed reservoir.

By failing to comply with the Interim Order, Region C's proposal to include the Marvin Nichols Reservoir must be rejected.

Failure of the Board to require any region to meet the requirement to identify impacts beyond the region would create a terrible precedent and significant limitation on the Board's future decisions. The Board needs to be able to require the preparation of regional and state water plans that can be used by the Board to determine how it will use the limited state funds it has to help the state meet its future water needs. A bad precedent here will also limit the ability of the Texas Commission on Environmental Quality to focus its work on applications for water rights that both are needed and meet the balancing test required in the water planning process.

The Failures of the Region C Report

As summarized above, the Region C report, in response to the Interim Order, fails to comply in three significant ways: it lacks 1) a quantification of impacts downstream of the project, 2) a proper analysis of the mitigation that will be required, and 3) an assessment of the impact the loss of hardwood timber will have on the timber industry and economy of Region D. In each case, Region C could have provided the level of analysis and quantification of impacts of the Reservoir needed by the Board. Region D recognizes that the Board's rules do not require the level of detail as required in an environmental impact statement. The level of work required for regional plans is tied to the consistency finding that the Board must make to approve any regional water plan. Greater detail is required during the permitting process by TCEQ.

Still, the basic information needed by Region C to respond to the Interim Order is readily available. For example, in 2004, TWDB staff prepared for the Board and the U.S. Army Corps of Engineers a report entitled "Analysis of Instream Flows for the Sulphur River: Hydrology, Hydraulics & Fish Habitat Utilization," which is discussed in more detail in the attached report by Trungale Engineering and Science, et al. In that Report, TWDB staff did a significant amount of work identifying, quantifying and analyzing the impacts of a Marvin Nichols Reservoir on downstream wetland forests and bottomland hardwoods. While the site of the dam for that proposed reservoir was somewhat downstream, it is clear from the report that there will be very significant loss of bottomland hardwoods and other wetland forests from any reservoir in this area. Moreover, this study provides a basic approach that Region C could have used to provide the information that the Board requested in its Interim Order. Region C did not even attempt to evaluate these or other types of losses downstream of the currently proposed reservoir configuration.

Likewise, the Region C report simply is incorrect in its methodology for analyzing the likely extent and location of the mitigation that will be required as a result of the inundation of lands in the reservoir footprint. In the intervening years since the U.S. Army Corp of Engineers published its 2008 Mitigation Rule, methods have developed to allow the quantitative assessment of impacts and mitigation. While it may be justified to defer full application of those methods until a project is nearer the permitting process than the Marvin Nichols Reservoir is at this time, these methods could be utilized in a simple form to produce the required quantitative estimates and analysis.

Moreover, the Region C report does not mention the possibility of mitigation for important forested areas downstream of the proposed reservoir, a substantial portion of which are in the White Oak Creek Wildlife Management Area. Nor does the Region C report identify the types of mitigation, extent of mitigation lands possibly needed, or where such lands could be found.

Even on the issue that has been at the heart of Region D's concern, loss of the economic value of timber, the Region C report is fatally flawed. The Report omits from its analysis the impacts that would occur from the removal of significant amounts of hardwood resources from the Sulphur River Basin. The proximity of these hardwood supplies to the numerous paper mills and hardwood sawmills in the area are extremely important to the viability of the timber industry in Northeast Texas and Region D.

The Region C report completely omits from its analysis any discussion of the agricultural/timber impacts that will result by the removal of lands from production for required mitigation. These lands, together with the lands that would be inundated by the proposed reservoir, would be lost from production forever.

Detailed Analysis in Attached Reports

Attached to this Summary are three reports produced in response to Region C's Report which include detailed examinations of the following: 1) impacts to natural resources by Marvin Nichols Reservoir; 2) impacts to agricultural resources by Marvin Nichols Reservoir; and 3) mitigation impacts and requirements for Marvin Nichols Reservoir. These reports establish the failure of the Region C report to provide an analysis and quantification of the impacts of the Marvin Nichols Reservoir Water Management Strategy on the agricultural and natural resources of Region D and the State.

Response to Region C's Analysis and Quantification of the Impacts of Marvin Nichols Reservoir Water Management Strategy on Natural Resources

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December 15, 2014

CONTENTS

FIGURES

TABLES

INTRODUCTION

A proposal to include the Marvin Nichols Reservoir Project in the Texas Water Planning Process (SB1) has resulted in an interregional conflict between the Region C Water Planning Area, which includes the Dallas-Fort Worth Metropolitan area, and the Region D Water Planning Area, which includes part of North East Texas, including the site of the proposed reservoir. In response to this conflict, and at the direction of the Texas Water Development Board (TWDB), the Region C planning group has produced a report entitled *Analysis and Quantification of the Impacts of the Marvin Nichols Reservoir Water Management Strategy on the Agricultural and Natural Resources of Region D and the State.*

While the Region C report contains limited quantitative data, including a table of different habitat types that would be inundated by the footprint of the reservoir, and a table and figure representing streamflows without and with the proposed project, the report provides no evaluation of the significance of these impacts Further, the report does not include any quantification or assessment of downstream impacts.

Development of the Marvin Nichols Reservoir project as proposed in the Region C water plan would permanently flood a large proportion of the last remaining intact bottomland hardwoods in East Texas. It would also result in a massive reduction in flows remaining in the river downstream of the proposed reservoir project which would result in significant, likely catastrophic, harm to an even larger bottomland hardwood forest area. As the plan acknowledges "Marvin Nichols Reservoir will have significant environmental impacts." (Region C 2011, p 4D.11)

Large, intact, bottomland hardwood forests (BLH) are valuable and rare natural resources, which provide numerous ecological and economic benefits. These forests require regular inundation resulting in high flow events for seed dispersal and growth, and exclusion of upland species encroachment. Analysis of results generated by the water availability modeling (WAM), developed to evaluate this reservoir project, indicate that the flows needed to maintain these forests would be severely diminished, if not entirely eliminated. Data and methodologies to perform this type of analysis, even at a planning level, are readily available, and examples of these approaches are provided within this report.

The clearest problem with the Region C report is that it contains no analysis or quantification of downstream impacts. By completely ignoring the largest and most significant impacts to natural resources resulting from the Marvin Nichols Reservoir Water Supply project, the Region C report does not meet the requirements of the TWDB order.

1 BOTTOMLAND HARDWOOD FORESTS

The proposed Marvin Nichols Reservoir would be located in East Texas in Red River, Titus and Franklin counties. The Sulphur River basin downstream of the proposed reservoir supports the largest, relatively undisturbed bottomland hardwood forest remaining in Texas (USFWS 1985 and 2000, see Figure 1)).

Floodplains with BLH and other ecologically important habitats are one of most altered and imperiled ecosystems on Earth (Opperman et al. 2010). The unique importance of this BLH ecosystem is largely based on its extensive swamp communities sustained by an active regime of high and overbank flows. More than any other factor, the sustainability of ecosystem processes within floodplains depends upon the longitudinal and lateral hydrologic connections that would be severed by the proposed reservoir. As currently modeled, the proposed Marvin Nichols I reservoir will not provide sufficient frequency and duration of high and overbank flows to sustain downstream BLH forest.

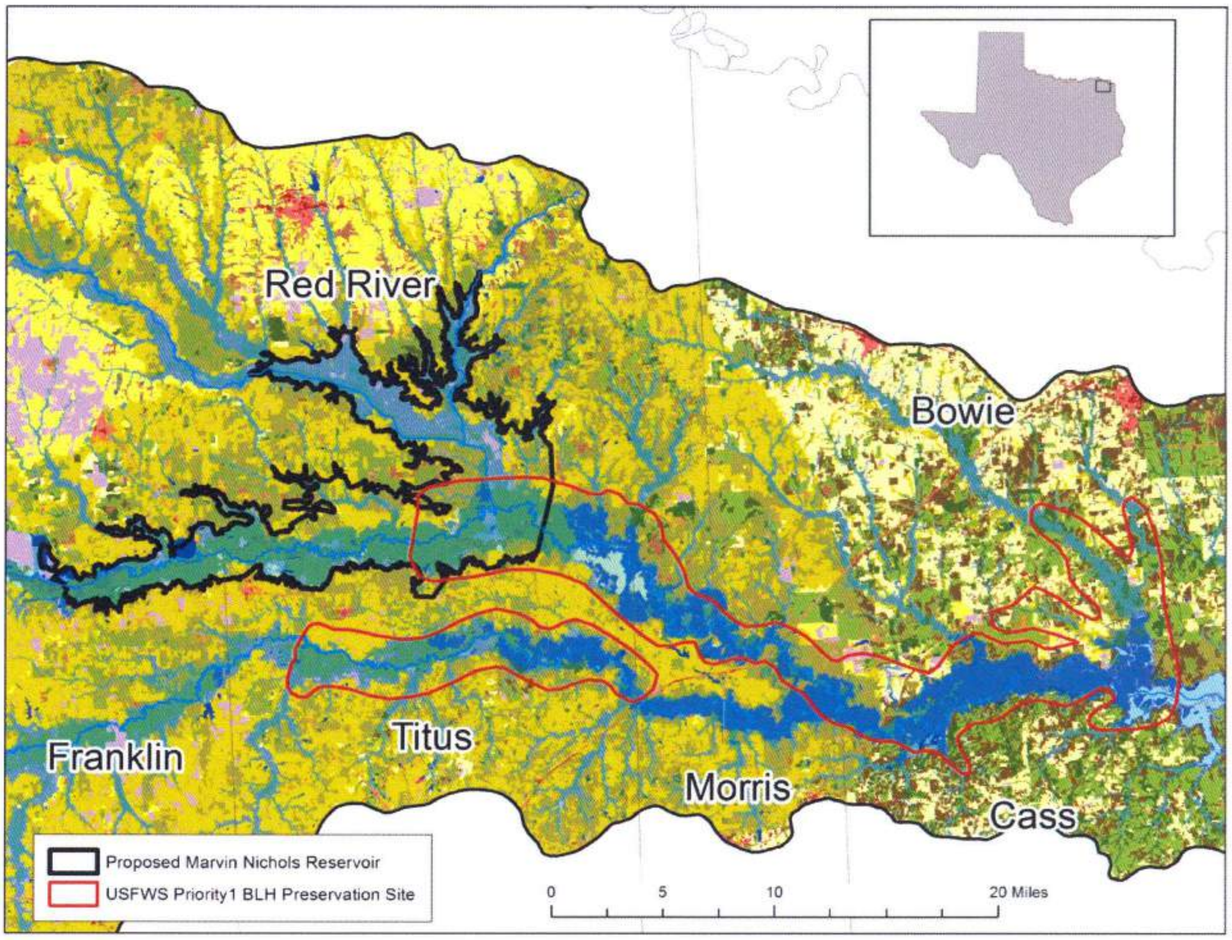


Figure 1 Location of proposed Marvin Nichols Reservoir in relation to USFWS designated Priority Bottomland Hardwood Preservations Site.

The bottomland hardwood forest habitat diversity within the Sulphur River basin is high (USFWS 1985 and 2000). Primarily due to environmental variability, these floodplain forest communities exhibit a high diversity of tree species, unlike upland forests, which are often dominated by one or two tree species (McKnight et al. 1981). The interaction of a changeable inundation regime with the geomorphologic patchwork of microtopography and soil types also leads to high between-habitat diversity (Junk et al. 1989). As a consequence of this ongoing interplay between hydrology and geomorphology, the biodiversity of BLH forests is usually double that of nearby upland forests (Gosselink et al. 1981).

Though tolerance to water saturation of an individual species will vary according to interspecies competition, soil texture, soil nutrients, and available light, the presence of a particular BLH community consisting of many dominant and co-dominant species is defined by the characteristics of the flow regime (Huffman and Forsythe 1981b). Incorporating east Texas BLH habitat types (TPWD 2009), Figure 2 is a schematic presentation of the interdependence of landscape context (relative elevation), tree species, and flow regime (adapted from Diamond 2009 and Huffman and Forsythe 1981a).

The major riparian forest types within the overall project area are summarized in terms of species composition, relative elevation context, and flow regime in Figure 2. Flood frequency and duration (adapted from Huffman and Forsythe, 1981a) are also tabulated for these forest types in Figure 2. In this manner, Figure 2 is a schematic presentation of the interdependence of landscape context (relative elevation), tree species, and flow regime (adapted from Diamond 2009 and Huffman and Forsythe 1981a), for East Texas riparian forest types.

1.1 Forested Wetland

Forested wetlands (swamps) are often dominated by monocultures of bald cypress. At relatively low surface elevations, these forests flood essentially every year and are only intermittently exposed. Slightly higher elevations support upper and backwater swamps, which are semi-permanently flooded (more than two months during the growing season) and receive flood inflows ranging from every year to every other year. In addition to bald cypress, upper swamps are characterized by admixtures of water elm, overcup oak, and sweetgum, while in backwater swamps, tupelo gum and green ash may become co-dominant with bald cypress.

1.2 Bottomland Hardwood Forest

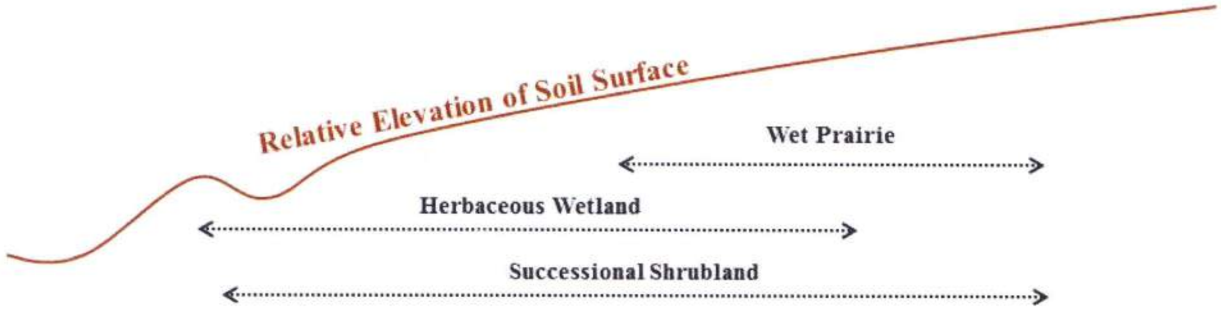
1.2.1 Seasonally Flooded Forests

As depicted in Figure 2, the probability of seasonally flooded BLH forests being flooded in a given year is 51-100 percent. With the natural hydrologic regime relatively undisturbed, these forests are flooded a total of 1-2 months (12.5-25 percent) during the growing season. Species composition is diverse and dominated by various combinations of willow oak, water oak, sweetgum, and overcup oak, with water hickory, laurel oak, and green ash often as co-dominants.

1.2.2 Temporarily Flooded Forests

With an annual flood probability of 11-50 percent, these forests experience a total flood duration during the growing season of 5-30 days or 2-12.5 percent. Tree species diversity is high, and is currently characterized by water oak, sweetgum, loblolly pine, and cedar elm, along with sugarberry, ironwood, and other red oaks such as willow oak.

Though currently uncommon in northeast Texas and the study area, temporarily flooded forests that are undisturbed and approaching maturity are dominated by elms, ashes, and sugarberry, along with some red oaks (Hodges 1997). The now very uncommon, final successional stage for this community type is characterized by the addition of white oaks and hickories (Hodges 1997). Agriculture and altered hydrologic regimes have all contributed to the loss of this somewhat drier BLH forest type in east Texas. Such disturbances lead to invasion by sweetgum and red oaks in remaining forests.



Bottomland Habitat Types:	Stream & Other Open Water	Forested Wetland: Lower Swamp	Forested Wetland: Upper Swamp	Bottomland Hardwood Forest: Seasonally Flooded Forest	Bottomland Hardwood Forest: Temporarily Flooded Forest	Transition to Uplands
Dominant Tree Species:	None	Bald cypress	Bald cypress Water elm Overcup oak Sweetgum	Willow oak Water oak Sweetgum Overcup oak	Water oak Sweetgum Loblolly pine Cedar elm	Sugarberry Sweetgum Water oak White oak
Hydrologic Regime [2]:	Permanently Flooded	Intermittently exposed	Semipermanently flooded	Seasonally flooded	Temporarily flooded	Intermittently flooded
Flood Frequency- percent of years [2]:	100%	~ 100%	51-100%	51-100%	11-50%	1-10%
Growing-Season Inundation- total duration [2]:	100% (~ 8 mos.)	~ 100% (~ 8 mos.)	>25% (> 2 mos.)	12.5-25% (1-2 mos.)	2-12.5% (5-30 days)	< 2% (< 5 days)

Footnotes: [1] Diamond, D. 2009. FIA Bottomland Summary: East Texas. Unpub. document, Missouri Resource Assessment Partnership, School of Natural Resources, U. Mo. - Columbia.

[2] Huffman, T., and S.W. Forsythe. 1981. Bottomland hardwood forest communities and their relation to anaerobic soil communities. in: Clark, J.R., and J. Benforado. Wetlands of Bottomland Hardwood Forests, Elsevier Scientific Pub. Co., New York, N.Y., pp. 187-196.

Figure 2 Bottomland Habitat Types in the Marvin Nichols Project Area, Northeast Texas: Landscape Context, Tree Species, and Hydrology

2 ENVIRONMENTAL FLOW REGIMES

The most important component of environmental variability, and the factor most directly affected by water development decisions, such as a new reservoir, is the flow regime. A river's flow regime is characterized by flow magnitude, duration, frequency, and timing. Recognition of the importance of maintaining critical components of the natural flow regime has now been firmly established in Texas (SAC 2009, TIFP 2008) and incorporated into the state environmental planning program (SB3). The process of developing a full-scale environmental flow recommendation has not been undertaken or even scheduled for the Sulphur River Basin. The Region C water planning group has, per TWDB rules, employed a default, desktop approach for determining the pass through requirements for environmental flow protection. Inclusion of this approach in the reservoir water availability analysis does not relieve the planning group of the responsibility of performing a qualitative assessment of the effects of a new project and, in doing so, to consider current environmental science regarding environmental flow needs. This consideration is completely lacking in Region C's quantitative analysis report.

2.1 Flows Needed to Maintain Bottomland Forests

River-floodplain landscapes consist of continuously changing environments and habitats. In undisturbed floodplains, habitats are dominated by a diversity of bottomland hardwood forests, along with shrub and herbaceous wetlands, and both lentic (still) and lotic (flowing) aquatic habitats. The different habitat patches naturally connect with each other via water level fluctuations (Thoms et al. 2005). In this manner, a floodplain is a highly dynamic "aquatic-terrestrial transition zone" (Junk et al. 1989).

Through its effect on habitat availability, the flow regime is the strongest determinant of BLH species composition for both plant and animal populations (King and Allen 1996). This is due to the evolutionarily-tuned correspondence among species distributions and hydrologic cycles (Bedinger 1981). Wetland forests are maintained by episodic high flow events defined by the site-specific flow regimes. If the Marvin Nichols project is constructed, downstream river flows, especially critical high flow events, will be significantly reduced.

The temporal distribution of repeated overbank flows is not only the primary determinant of habitat types, but also drives biogeochemical processes in floodplain soils, such as decomposition, sedimentation, and nitrogen (N) cycling (Hunter et al. 2008). Variable river levels trigger switches between biological production within floodplain habitats and the exchange of the resulting organic matter and nutrients among different terrestrial, aquatic, and estuarine habitats (Amoros and Bornette 2002). These inputs from productive floodplains are essential to the sustainability of downstream and other habitats linked by variable river flows. In east Texas floodplain forests, Dewey et al. (2006) pinpointed flood duration as the single most important component of the flow regime, in terms of influence on wetland vegetation and soil characteristics

Hydrologic variability produces spatial and temporal variability of habitats that increases biodiversity. Hydrologic connectivity is multi-dimensional and encompasses longitudinal, lateral, vertical, and temporal variables (Amoros and Bornette 2002). Various species and life cycle stages depend upon the complementary habitats provided by this connectivity. For example, fish migration between spawning and nursery habitats is evolutionarily adapted to floodplain variability.

During their research in floodplain hardwood forests of the southeastern United States coastal plain, Burke and Chambers (2003) conducted regression analyses that compared the annual durations of surface flooding and soil saturation. The analysis indicated the swamp and temporarily flooded forest, on average, flooded 61% and 3% of the year, respectively, compared to soil saturation in the upper 30 cm of soil lasting 84% and 20% of the year, respectively. In the swamp, the depth to the water table normally remained within 30 cm of the surface, while in the temporarily flooded forest the water table receded to a depth of more than one meter every summer.

The depth to persistent soil saturation strongly influences which tree species are sustained within a floodplain. In their study of relationships among hydrology and soil variables in a floodplain forest, Bledsoe and Shear (2000) determined tree species distributions to be most significantly correlated with depth to mottling ($r2 = 0.75$), which is a measure of the average depth of soil saturation. This finding may be compared to their other significant correlations of tree species distributions to flooding frequency ($r2 = 0.57$) and surface elevation ($r2 = 0.70$).

Rood et al. (2005) describe the "flood pulse" as a natural disturbance that revitalizes floodplain habitats. For many BLH tree species, seed germination and seedling establishment must follow floods severe enough to remove existing vegetation and create new seedbeds from bare soil. In addition to providing new substrates in different configurations, floods distribute seeds and vegetative propagules to reestablish plants across the floodplain (Bendix and Hupp 2000). The timing of forest-regeneration floods is important, since not only do the flood-induced erosion and deposition of bare seedbeds need to occur before seed dispersal (Hughes and Rood 2003), but the timing of subsequent seed germination varies by tree species. The spatial configuration and timing of vegetation destruction and renewal during floods causes BLH forests to consist of mosaics of vegetation of different ages and species compositions.

Hughes and Rood (2003) list the most important considerations as: (1) timing inundation to coincide with the phenology (seed dispersal and germination) of target tree species, (2) varying the interannual timing of floods to increase plant diversity, (3) adjusting the rate of flood-water recession, and (4) promoting channel movement and new sedimentation sites to create regeneration sites. A distinctive characteristic of regeneration flows is their requirement for between-year variability of overbank events on a decadal scale, which are superimposed on annual "maintenance flows" that depend on within-year variability for seedling survival.

In addition to their importance in maintaining BLH species diversity, the frequency and duration of overbank flows need to be sufficient to exclude upland species. Extended flooding during extremely wet years has the strongest control on BLH species composition (Townsend 2001), largely due to its adverse impact on upland species. Figure 2 lists flood duration and frequency targets to maintain each BLH habitat type in the proposed project area.

The seasonal timing of flooding largely determines the tree species regenerating within floodplain forests. The high flow and overbank components of the flow regime are consequential determinant of the long-term survival of bottomland species and, thus, species dominance within mature floodplain forests (Townsend 2001). The species-specific effects of extreme flood events, in particular, maintain high species diversity. When flow variability is reduced, floodplain forests are degraded by artificially homogenous species composition with lower productivity.

Both terrestrial and aquatic species benefit from periodic inundation and nutrient exchange caused by floodwater. Proposed water development projects that have the potential to alter the flow regime also have the potential to alter the inundation frequency of low-lying flood-prone areas. Since native species could be affected by such an alteration to their regime, an analysis of inundation extent has been performed to quantify the flooded area for typically recurring floods. (See Section 3.2.1 below)

2.2 Environmental Flows in the Regional Plan

The environmental flow requirements used to evaluate the Marvin Nichols Reservoir Water Supply Project are based on an approach developed in the 1990's called the "Consensus Criteria". Under this approach, the flows passed through the reservoir for instream protections are dependent on reservoir levels. The specific target flows are based on statistics calculated based on daily-naturalized inflows. When the reservoir is greater than 80% full, the project is supposed to pass the median flows; when greater than 50% full, the project is supposed to pass the 25th percentile flows. Otherwise the project is supposed to pass the 7Q2 flows. Unlike the more recent environmental flow criteria developed as part of SB3, there are no requirements, under the consensus criteria, to pass any high flow pulse flows. The maximum pass through for the proposed Marvin Nichols Reservoir Project, as required by consensus criteria, would be 514 cfs in May and then only if the reservoir is greater than 80% full.

Table 1 Consensus Criteria for Environmental Flow Needs for Marvin Nichols I Reservoir.

Month	Median		25th Percentile		7Q2	
	acft/mo	cfs	acft/mo	cfs	acft/mo	cfs
Jan	13,621	221.5	3,351	54.5	79	1.3
Feb	20,928	373.5	6,192	110.5	72	1.3
Mar	30,522	496.4	8,753	142.4	79	1.3
Apr	17,947	301.6	5,712	96.0	76	1.3
May	31,613	514.1	6,019	97.9	79	1.3
Jun	11,488	193.1	2,748	46.2	76	1.3
Jul	2,524	41.1	530	8.6	79	1.3
Aug	906	14.7	211	3.4	79	1.3
Sep	943	15.8	111	1.9	76	1.3
Oct	1,550	25.2	242	3.9	79	1.3
Nov	4,687	78.8	943	15.9	76	1.3
Dec	11,488	186.8	2,173	35.3	79	1.3

Unless the reservoir is full and spilling flows in the river downstream of Marvin Nichols will be less than 514 cfs. During most times, flows passed through the reservoir will be much lower. The impact on flows is evident from the flow frequency figure included in the Region C report, which shows the significant differences in flows with and without the reservoir.

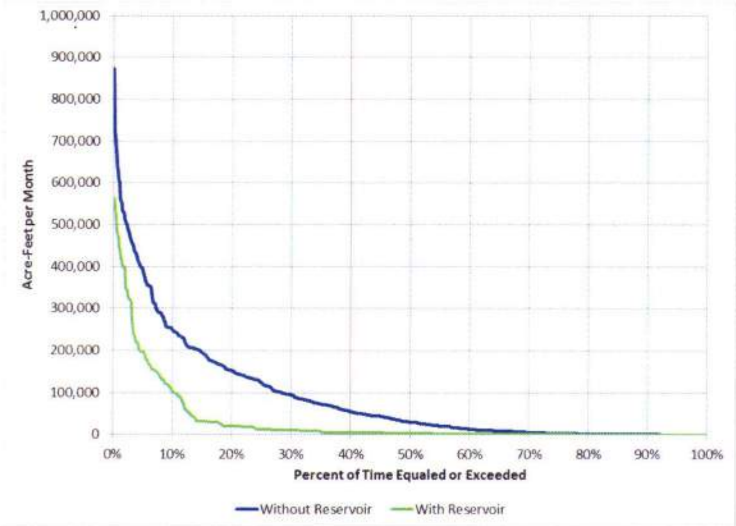


Figure 3 Flow-Frequency Relationship of Sulphur River at Marvin Nichols Dam Site with and without the Reservoir

While the Region C report presents this flow frequency curve and a table of monthly flow frequency relationship with and without Marvin Nichols I reservoir, the report provides no interpretation of these results or any context with which a reviewer might evaluate their importance.

The changes depicted in Figure 3 are massive. The entire flow regime is impacted and the resulting flows would be only a small fraction of the natural regime. Components of this natural flow regime are critical to the maintenance of a sound environment. As discussed above, the most important components of the flow regime for the protection of BLH forests are the occurrence and frequency of high flow pulse and overbank events.

In 2004, the TWDB and the U.S. Army Corps of Engineers (USACE) conducted a study on the Sulphur River (TWDB 2004). Direct observations and technical evaluations reported in this study indicate that flows in the range of 862 cfs (approximately 50,000 ACFT per month) are transitional between in-channel and overbank flow. Figure 3 suggests that the occurrence of these events would shift from happening close to 40-50% of the time to happening less than 15% of the time.

An analysis of the outputs from the water availability model, developed by Region C to evaluate the Marvin Nichols project, show that under existing conditions, there is only one year, out of the 57-year record, in which flows did not exceed this threshold volume in at least one month. When the proposed reservoir is included in the simulation, this number jumps to 29 years (more than half of the time) when no overbank events occur. The longest duration of time in which no over bank event occur under the without project scenario is 16 months; the flow regime resulting from the proposed reservoir indicates that at two separate times in the record, the river would go 80 months (almost 7 years) without overbank flow events. Figure 4 shows the 82month period between 1961 – 1968, during which releases from the project would rarely have exceeded 2 acft per month (1 cfs) flows. These flow rates, based on the 7Q2 water quality target, are intended to sustain the river during brief, infrequent and severe droughts, but with the Marvin Nichols project as proposed and modeled by Region C, these extremely low flows would occur much more frequently.

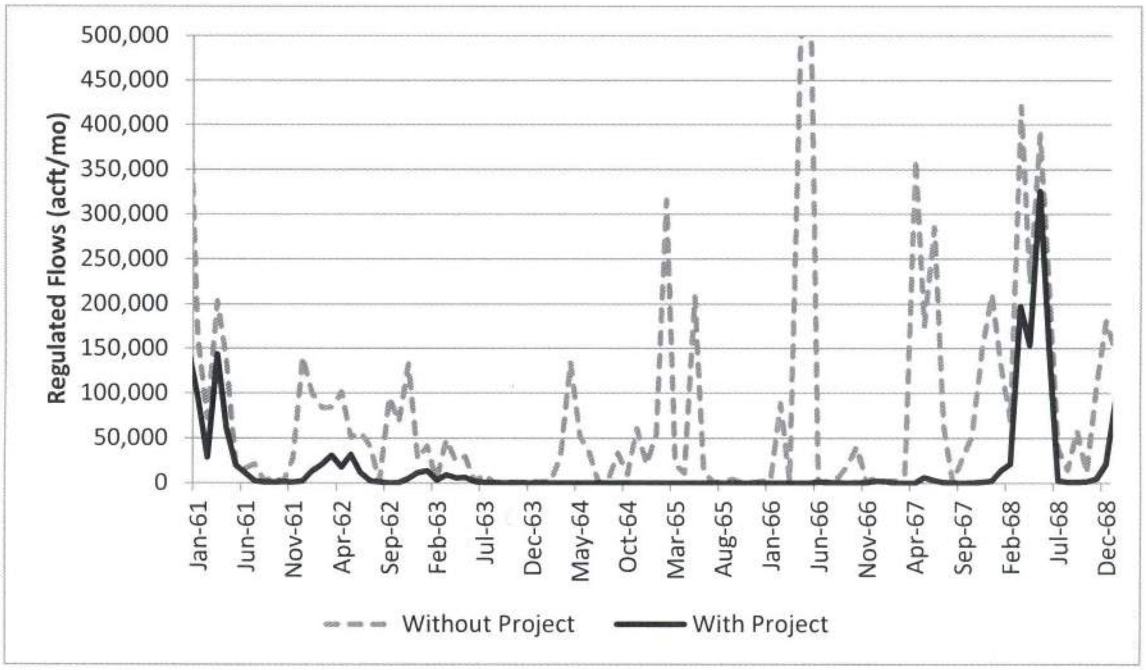


Figure 4 Regulated flows with and without the Marvin Nichols I Reservoir Project (1961-1968)

The lack of seasonal flooding identified in the water availability results indicates BLH forests cannot be maintained downstream of the proposed Marvin Nichols reservoir.

3 IMPACT ANALYSIS

The Region C report includes an estimate of the area of bottomland hardwoods that would be inundated by the reservoir itself. This analysis, while an important initial step, is incomplete in terms of providing even a preliminary or planning level assessment of the impacts of the proposed project. The Region C report makes no attempt to address the impacts to bottomland hardwood areas located immediately downstream of the reservoir.

3.1 Inundation within the Reservoir Footprint

The inundation analysis provided in the Region C report includes a table showing the acres of different land classification types both within the entire Region D planning area and within the reservoir footprint of the proposed Marvin Nichols Reservoir Project. These areas were determined based on land cover datasets.

The primary data set came from the Texas Vegetation Classification Project (TVCP) (TPWD 2009). The TVCP performed vegetation mapping of East Texas. TPWD, along with private and agency partners, conducted a multi-year effort to create a new vegetation map of Texas, using the NatureServe Ecological System Classification System (Comer et al. 2003). The basic method was to determine ecological sub-systems or community types, then collect satellite data and aerial photos to initiate a supervised classification. Supporting data regarding ecosystems, soils (SSURGO), elevation (DEM), and hydrology were then gathered into a geographic information system (GIS), in order to incorporate the ecological context of mapped sub-systems. Next, plot-based field data were gathered to quantify primarily vegetation variables describing mapping units. Modeling was then employed to implement a decision tree combining remotely sensed biotic and abiotic data into a land-cover classification with a resolution of ten meters. Region C grouped classifications from the TVCP into broader and more general categories based on the EPA's Level I National Land Cover Data (NLCD).

The Region C study then merged the dataset from TVCP with older U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) data within each alternative reservoir site. This merging presents a number of challenges given the different scales, objectives and descriptions provided by the different datasets. No documentation is provided as to how merging was performed. It does appear from a review of maps provided in the report (see Figure 4 in Appendix H) that data classified by NWI as Freshwater Emergent Wetland was classified by Region C as Bottomland Hardwood Forest, and data classified by NWI as Freshwater Forested/Shrub Wetland was classified by Region C as Forested Wetland. However, according to NWI type definitions (USFWS 1992), these NWI types are herbaceous (marsh and wet prairie, pp. 19-20) and woody (successional shrub or forest, pp. 20-21), respectively. NWI Freshwater Forested/Shrub Wetland includes both swamp and BLH forests.

The result of this attempt to merge these datasets was that close to 200,000 acres that the TVCP would classify as Bottomland Hardwood Forest was classified by Region C as Forested Wetland. Since Forested Wetland is an important consideration in the designation of Priority 1 habitat this reclassification actually makes the reservoir project appear worse, however this appears to have been an error. For the present report only the TVCP database is used. Figure 2 presents the values calculated by Region C and the recalculated values based solely on the more recent TVCP land cover dataset. This table also includes areas within the Sulphur basin, which is the more appropriate geographic area for consideration of this impact.

Table 2 Areas of Vegetation types for Sulphur basin, Region D and the Marvin Nichols Reservoir according to the Region C report and the analysis conducted as part of this study.

	Region C Report			Region D Response Report				
	RegionD	Marvin Nichols	Marvin Nichols as % of Reg D	Sulphur	RegionD	Marvin Nichols	Marvin Nichols as % Sulphur	Marvin Nichols as % of Reg D
Bottomland Hardwood Forest	417,265	10,156	2.4%	232,007	643,330	31,241	13.5%	4.9%
Forested Wetland	414,573	21,444	5.2%	47,053	90,639	529	1.1%	0.6%

When only the reservoir footprint is included in the analysis, as is the case with the Region C report, this project would impact 13% of the Bottomland Hardwood Forests in the Sulphur River Basin and 5% of the Bottomland Hardwood Forests area in Region D. These are very significant impacts, but the impacts to the forests downstream, due to the reservoirs impacts on the flow regime, would be even greater.

3.2 Downstream Impacts Due to Changes to Flow Regime

Unlike the FNI report, which ignores the downstream impacts of the proposed reservoir project, the TWDB and USACE conducted a study in 2004 that recognized critical need for overbank flow events to protect the BLH forests downstream of the proposed reservoir site. As discussed above, the loss of the high flow pulse and overbank flow events would have significant detrimental effects on the BLH forest located downstream of the proposed reservoir site. A quantitative assessment of these impacts can be made by determining how much of the existing forest would be lost because flows no longer will inundate these areas. An inundation analysis conducted as part of the TWDB/USACE study reported results based on an earlier configuration of the proposed reservoir, one which sited the dam about 10 miles further downstream. In this current report, the data and methodology used by TWDB/USACE are used to estimate areas of inundation based on the currently proposed reservoir site. The following sections mimic the TWDB/USACE report.

3.2.1 Floodplain Inundation Model

The TWDB determined inundation areas for six frequently occurring flood events listed in Table 3, which includes a description of the recurrence frequency of each of these flows based on application of a hydrologic statistics software program developed by TPWD (SAC 2009).

Table 3 Flow rates for flood inundation analysis in TWDB report (2004).

Flows (cfs)	Recurrence Description (HEFR)
362	Within bank, base flow condition
862	Trnsition from in bank to out of bank, occur multiple times in most years
3,000	Flows in these ranges occurre on average once per season in each of the
7,130	winter, spring and fall seasons
18,300	Occurrs once a year or once every two years on average
32,000	Occurs once every three or four years

Following the same approach and data used by TWDB, flood surfaces were developed for each of these flow rates and overlaid upon National Elevation Dataset (NED) digital elevation models to determine the area of inundation at each flow rate. Figure 5 shows the flood inundation areas produced by lowest (326 cfs) and highest (32,000) flow rates modeled.

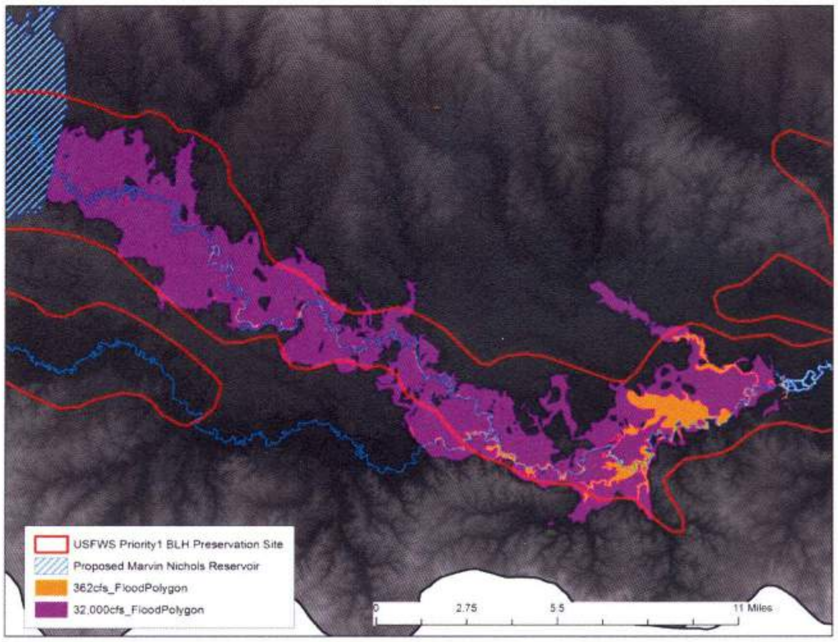


Figure 5 Flood inundation areas produced by lowest (326 cfs) and highest (32,000) flow rates modeled.

Consistent with the finding reported by TWDB, the lower flow rates are mostly confined to the river channel, while the highest flow rates inundate much of the Bald Cypress Swamp area. These area polygons were then used to determine the areas for the most flow dependent Texas Vegetation Classification Project Cover Types.

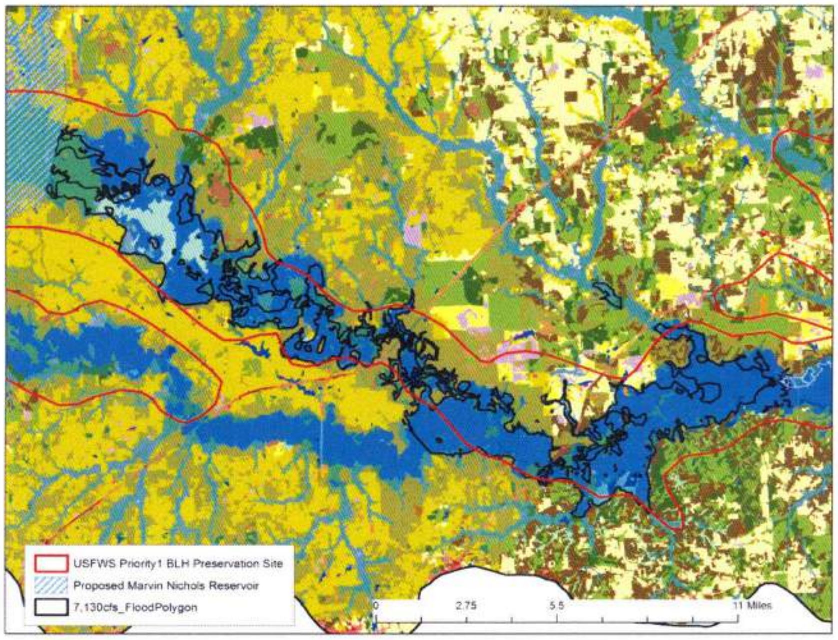


Figure 6 Inundated area and vegetation map for 7,130 cfs flows.

As can be seen in Figure 6, the 7,130 cfs inundation area closely tracks the outline of the Forested Wetland (Bald Cypress Swamp) vegetation type, which is such a critical factor in the USFWS determination to designate this area a Priority 1 Bottomland hardwood. This correlation is consistent with the scientific literature that identifies these overbank events as a primary factor in maintaining the health of these forests. With the Marvin Nichols Reservoir Project in place, flow might exceed 7,000 cfs very rarely, if at all, and flow between 1,000 -7,000 cfs, which currently occurs several times in most years, would become a rare event, putting the ecological soundness of these forests at significant risk.

Figure 7 show the acres inundated at each flow rate for Forested Wetland and Bottomland Hardwood Forest types. Table 4 shows the total areas that would be impacted due to the loss of inundation by overbank flows.

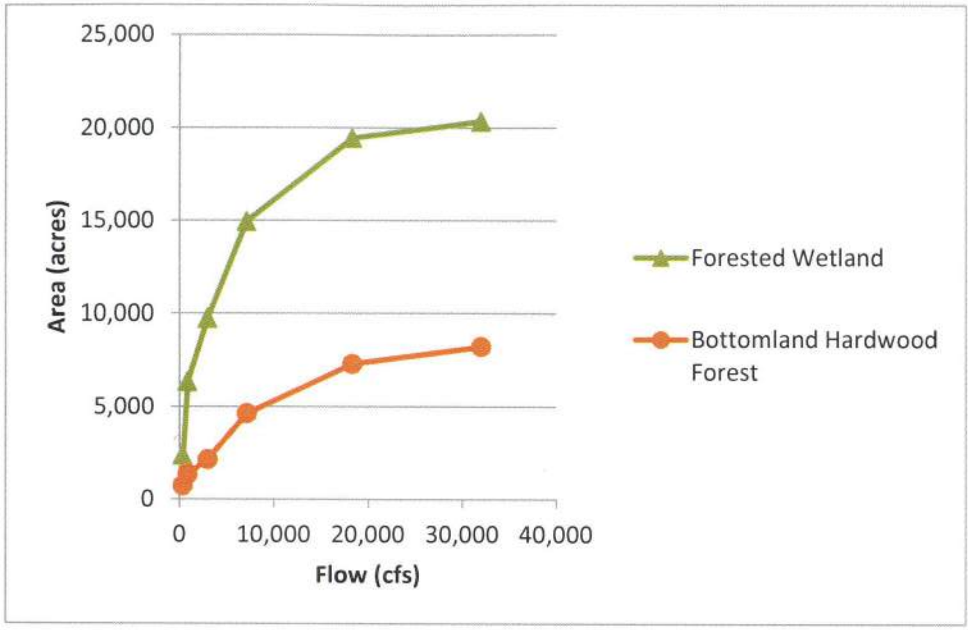


Figure 7 Vegetation areas downstream of the proposed Marvin Nichols project, main stem Sulphur River.

Table 4 Vegetation areas downstream of the proposed Marvin Nichols project, main stem Sulphur River.

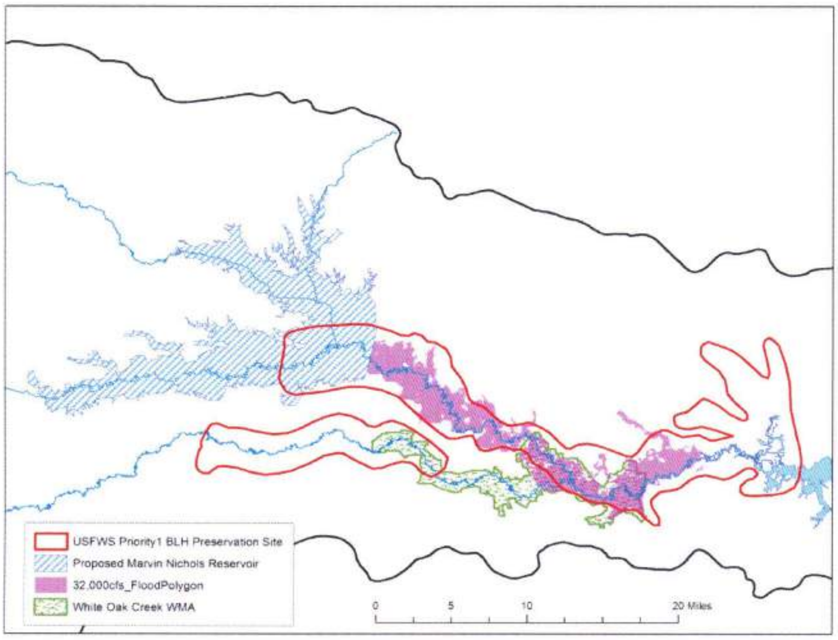
						Flows (cfs)				Reservoir Foot Print Only		Reservoir Footprint plus loss of indudated area at 32,000 cfs	
	Sulphur	RegionD	Marvin Nichols	362	862	3,000	7,130	18,300	32,000	Sulphur	RegionD	Sulphur	RegionD
Bottomland Hardwood Forest	232,007	643,330	31,241	732	1,341	2,151	4,626	7,308	8,231	13%	5%	17%	6%
Forested Wetland	47,053	90,639		529	2,366	6,335	9,743	14,938	19,426	20,339	1%	1%	44%	23%

When the effect on flows and the loss of episodic inundation are added to the impacts resulting within the reservoir footprint, the impacts from the Proposed Marvin Nichols Reservoir Project are huge. In the Sulphur basin 44% of the Forested Wetland area and 17% of the Bottomland Hardwood Forests would be at significant risk.

3.3 Downstream Impacts to Existing Mitigation Property

Finally, it is also important to note that a substantial portion of the existing White Oak Creek Wildlife Management Area (WMA) would be put a risk by the development of this reservoir project. The White Oak Creek WMA was created as part of the mitigation for Cooper Lake. A significant portion of the BLH within this protected WMA would be negatively impacted by the loss of flow resulting from the construction of the Marvin Nichols Reservoir Project.

The direct effects of the elimination of high and overbank flows downstream from the proposed dam are likely to be extremely detrimental to the long-term viability of the WMA. In addition to reducing the primary production of plant communities, King and Allen (1996) found that a diminished flow regime also adversely impacts downstream ecosystems by (1) shifting plant species composition to that of drier communities, (2) preventing river-floodplain connections leading to reduced sedimentation and water quality, and (3) causing failures in fish and herpetological reproduction. Less soil moisture prevents seed germination and slows tree growth, which alters the course of plant succession through the introduction of invasive and maladapted species (Kozlowski 2002). Direct effects of dams as biological barriers include depletion of woody debris, impeded dispersal of plant seeds and vegetative reproduction, and genetic fragmentation within riparian animal and plant populations (Rood et al. 2005).



4 BIOLOGICAL SIGNIFICANCE

The Sulphur River basin covers a large area that produces highly significant benefits, largely due to relatively undisturbed high and overbank flows that perform many important ecosystem and societal functions. Many important BLH ecosystem services peak with annual flooding, including primary production, plant diversity, animal habitat use, and organic matter export (Gosselink et al. 1981, Hunter et al. 2008, Opperman et al. 2010). Spanning several counties, the Sulphur floodplain is large enough to provide substantial amounts of such services.

Examples of the ecological importance of hydrologic connections within floodplains abound. The reduction in overbank flows results in the loss of backwater areas that comprise a primary source of labile carbon, which forms an essential foundation of riverine and estuarine food chains (Thoms et al. 2005). Where river and floodplains remain connected, freshwater fishery yields are consistently higher (Bayley 1995).

In addition to ecosystem processes, hydrologically-intact floodplains provide important economic benefits, increased biodiversity, and stable environmental services (Bayley 1995). BLH forests function as the foundation of local and regional food chains; supply critical nesting microhabitats, spawning, rearing, and resting areas for aquatic and upland species; and reduce storm and flood damage within adjacent and downstream areas (Gosselink et al. 1981). Though highly vulnerable to flow reductions, temporarily flooded BLH forests near the upland edge of the floodplain offer supplemental water storage, which is especially important during extreme flood events. These forests also serve as buffer-traps for pollution.

4.1 Water Quality

One of the most important ecosystem functions of BLH forests to society is improving water quality through the removal of high N concentrations. The wet-dry fluctuations of floodplain soils create successive aerobic and anaerobic environments. Nitrification is an aerobic process, which through microbial oxidation basically converts ammonia compounds to nitrate compounds. During the succeeding wet period, anaerobic soil conditions are created, which promote denitrifying bacteria that, in turn, convert the nitrate compounds to N gases such as nitrous oxide. In this fashion, high N concentrations in river flows are reduced. Healthy BLH forests have high and long-term capacities to remove N and retain phosphorous (P) from floodwaters (Ardon et al. 2010).

4.2 Bottomland Forests

King and Allen (1996) showed that reductions in natural flow regimes harm BLH forests by: (1) reducing the growth and primary production of plant communities, (2) shifting plant species composition to that of drier communities, (3) preventing river-floodplain connections leading to reduced sedimentation and water quality, and (4) causing failures in fish and herpetological reproduction. To be most effective, both in terms of maintaining BLH tree species and discouraging invasive upland species, early spring floods following leaf emergence should last a total of two to four weeks (Rypel et al. 2009).

Kozlowski (2002) found that reductions in the variability of river flows reduced groundwater levels, which in turn lowered BLH ecosystem productivity and species diversity. In many areas of the southeastern United States, including east Texas, where high and overbank flows have been reduced due to dams and water extraction, the composition of BLH forests is shifting to species adapted to drier environments (Stallins et al. 2009). This widespread successional change of BLH forests to increased dominance by upland species is first apparent in the understory, including tree seedlings and saplings.

4.3 Primary Productivity

The enhancement of primary productivity due to overbank flows allows river floodplains to achieve the highest biomass per area of any temperate ecosystem (Gosselink et al. 1981). An extensive literature review by Conner et al. (1990) shows that primary production of BLH forests with natural hydrology is greater than 1000 g/m2/y, which ranks these forests among the most productive wetland ecosystems. Recent research in northeast Louisiana found the range of carbon storage in BLH forests to be 90-124 Mg C/ha (Hunter et al. 2008). The potential role of BLH forests in mitigating climate change is substantial.

Variable river levels trigger switches between biological production and transfer phases within floodplain habitats, which initiate the exchange of organic matter and nutrients among different terrestrial, aquatic, and estuarine habitats (Amoros and Bornette 2002). The temporal distribution of repeated overbank flows not only is the primary determinant of habitat types, but also drives biogeochemical processes in bottomland soils, such as decomposition, sedimentation, and N cycling (Hunter et al. 2008).

4.4 Fish and Wildlife Productivity

Decreased flood frequency reduces bird, mammal, and fish densities in riparian ecosystems (Gosselink et al. 1981). Access to floodplain resources during overbank flows is critical, since almost all animal biomass within riverine systems is produced within floodplains rather than rivers (Junk et al. 1989, Smock et al. 1992). Consequently, for animals the primary function of the main river channel is not production, but to act as an access route for fish and other biota to adjacent floodplain resources. A strongly positive relationship exists between fish production and the amount of accessible floodplain (Junk et al. 1989). Bayley (1995) documented that earlier and briefer overbank events disrupt the evolutionarily-synchronized timing of fish spawning and invertebrate prey availability.

CONCLUSION

The Region C report *Analysis and Quantification of the Impacts of the Marvin Nichols Reservoir Water Management Strategy on the Agricultural and Natural Resources of Region D and the State* contains very little analysis or qualification of the impacts of the Marvin Nichols Reservoir on Natural Resources. In the brief sections devoted to impacts on wildlife habitat and environmental water, the Region C report appears to contain errors in merging and reclassifying underling data and contains no meaningful interpretation of the impacts it does identify. More importantly, the report completely ignores the downstream impacts that the Marvin Nichols Reservoir Project would have on the last remaining Priority 1 Bottomland Hardwood Forest in the Sulphur River Basin.

In contrast to the Region C report, the analysis presented this report substantiates concerns expressed in USFWS comments on the Regional plan (USFWS 2000) "that there is not enough additional high valued bottomland hardwood habitat or lands suitable for habitat improvements available in the Sulphur River Basin to compensate for the large amount of habitat that would be lost due to the construction of the Marvin Nichols I reservoir." While USFWS comments were directed at an earlier reservoir configuration, the absence of any requirements to maintain flows essential to maintain habitat areas downstream of the newly proposed site means that habitats within both the reservoir footprint and priority conservation areas downstream are at significant risk. Consequently, neither mitigation nor compensation is a viable means of reducing environmental impacts due to the proposed Marvin Nichols I Reservoir.

REFERENCES

Amoroso, C., and G. Bornette. 2002. Connectivity and biocomplexity in waterbodies of riverine floodplains. Freshwater Biology 47: 761–776.

Ardon, M., J.L. Morse, M.W. Doyle, and E.S. Bernhardt. 2010. The water quality consequences of restoring wetland hydrology to a large agricultural watershed in the southeastern Coastal Plain. Ecosystems 13:1060-1078.

Bayley, P.B. 1995. Understanding large river-floodplain ecosystems. BioScience 45(3): 153-158.

Bedinger, M.S. 1981. Hydrology of bottomland hardwoods in southeastern United States. In: Clark, J.R., and J. Benforado (eds.). Wetlands of Bottomland Hardwood Forests. Elsevier Scientific Publishing Co., New York, N.Y.

Bendix, J., and C.R. Hupp. 2000. Hydrological and geomorphological impacts on riparian plant communities. Hydrological Processes 14: 2977-2990.

Bledsoe, B.P., and T.H. Shear. 2000. Vegetation along hydrologic and edaphic gradients in a North Carolina coastal plain creek bottom and implications for restoration. Wetlands 20(1): 126-147.

Burke, M.K., and J.L. Chambers. 2003. Root dynamics in bottomland hardwood forests of the southeastern United States coastal plain. Plant and Soil 250: 141–153.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia.

Connor, W.H., R.T. Huffman, and W. Kitchens. 1990. Composition and productivity in bottomland hardwood forest ecosystems: The report of the vegetation workgroup. In: Gosselink, J.G., L.C. Lee, and T.A. Muir (eds). Ecological Processes and Cumulative Impacts: Illustrated by Bottomland Hardwood Wetland Ecosystems. Lewis Publishers, Inc., Chelsea, Michigan.

Dewey, J.C., S.H. Schoenholtz, J.P. Shepard, and M.G. Messina. 2006. Issues related to wetland delineation of a Texas, USA, bottomland hardwood forest. Wetlands 26(2): 410-429.

Diamond, D. 2009. FIA Bottomland Definition Summaries. Unpublished manuscript, Missouri Resource Assessment Partnership (MoRAP), School of Natural Resources, University of Missouri, Columbia, MO.

Freese and Nichols, Inc. Environmental Evaluation Interim Report - Sulphur River Basin - Comparative Assessment. 2013.

Freese and Nichols, Inc. Analysis and Quantification of the Impacts of the Marvin Nichols Reservoir Water Management Strategy on the Agricultural and Natural Resources of Region D and the State. 2014.

Gosselink, J.G ., S.E. Bayley, W.H. Conner, and R.E. Turner. 1981. Ecological factors in the determination of riparian wetland boundaries. In: Clark, J.R., and J. Benforado (eds.). Wetlands of Bottomland Hardwood Forests. Elsevier Scientific Publishing Co., New York, N.Y.

Gosselink, J.G., B.A. Touchet, J. Van Beek, and D. Hamilton. 1990. Bottomland hardwood forest ecosystem hydrology and the influence of human activities: The report of the hydrology workgroup. In: Gosselink, J.G., L.C. Lee, and T.A. Muir (eds). Ecological Processes and Cumulative Impacts: Illustrated by Bottomland Hardwood Wetland Ecosystems. Lewis Publishers, Inc., Chelsea, Michigan.

Hodges, J.D. 1997. Development and ecology of bottomland hardwood sites. Forest Ecology and Management 90: 117-125.

Huffman, T., and S.W. Forsythe. 1981a. Bottomland hardwood forest communities and their relation to anaerobic soil communities. in: Clark, J.R., and J. Benforado. Wetlands of Bottomland Hardwood Forests, Elsevier Scientific Pub. Co., New York, NY.

Huffman, R.T., and S.W. Forsythe, 1981b. Ecological factors in the determination of riparian wetland boundaries. In: Clark, J.R., and J. Benforado (eds.). Wetlands of Bottomland Hardwood Forests. Elsevier Scientific Publishing Co., New York, NY.

Hughes, F.M.R., and S.B. Rood. 2003. Allocation of river flows for restoration of floodplain forest ecosystems: A review of approaches and their applicability in Europe. Environmental Management 32(1): 12-33.

Hunter, R.G., S.P. Faulkner, and K.A. Gibson. 2008. The importance of hydrology in restoration of bottomland hardwood wetland functions. Wetlands 28(3): 605-615.

Junk, W.J., P.B. Bayley, and R.E. Sparks. 1989. The flood pulse concept in river-floodplain systems. In: Dodge, D. P. (ed.). Proceedings of the International Large River Symposium. Can. Spec. Publ. Fish. Aquat. Sci. 106.

King, S.L., and J.A. Allen. 1996. Plant succession and greentree reservoir management: Implications for management

Kozlowski, T.T. 2002. Physiological-ecological impacts of flooding on riparian forest ecosystems. Wetlands 22(3): 550-561.

McKnight, J.S., D.D. Hook, O.G. Langdon, and R.L. Johnson. 1981. Flood tolerance and related characteristics of trees of the bottomland forests of the southern United States. In: Clark, J.R., and J. Benforado (eds.). Wetlands of Bottomland Hardwood Forests. Elsevier Scientific Publishing Co., New York, N.Y.

Opperman, J.J., R. Luster, B.A. McKenney, M. Roberts, and A.W. Meadows. 2010. Ecologically functional floodplains: connectivity, flow regime, and scale. J. American Water Resources Assoc. 46 (2): 211-226.

Rood, S.B., G.M. Samuelson, J.H. Braatne, C.R. Gourley, F.M.R. Hughes, and J.M. Mahoney. 2005. Managing river flows to restore floodplain forests. Frontiers in Ecology and the Environment. 3(4): 193-201.

Rypel, A.L.,W.R. Haag, and R.H. Findlay. 2009. Pervasive hydrologic effects on freshwater mussels and riparian trees in southeastern floodplain ecosystems. Wetlands 29(2): 497-504.

Science Advisory Committee (SAC). 2009. Use of Hydrologic Data in the Development of Instream Flow Recommendations for the Environmental Flows Allocation Process and the Hydrology-Based Environmental Flow Regime (HEFR) Methodology, Report # SAC-2009-01-Rev1. Austin, TX.

Stallins, J.A., M. Nesius, M. Smith, and K. Watson. 2009. Biogeomorphic characterization of floodplain forest change in response to reduced flows along the Apalachicola River, Florida. Published online in Wiley InterScience (http://dx.doi.org/10.1002/rra.1251).

TIFP (Texas Instream Flow Program). 2008. Texas Instream Flow Studies: Technical Overview. Prepared by Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, and Texas Water Development Board. TWDB Report No. 369, May 2008, Austin, Texas.

Texas Parks and Wildlife Department and Texas Natural Resources Information System. 2009. Texas Ecological Systems Classification Project Phase II. http://www.tpwd.state.tx.us/landwater/land/maps/gis/tescp/index.phtml#Comer

TWDB (Texas Water Development Board). 2004. Analysis of Instream Flows for the Sulphur River: Hydrology, Hydraulics & Fish Habitat Utilization. July 2004, Austin, Texas

Thoms, M.C., M. Southwell, H.M. McGinness. 2005. Floodplain-river ecosystems: Fragmentation and water resources development. Geomorphology 71: 126-138.

Townsend, P.A. 2001. Relationships between vegetation patterns and hydroperiod on the Roanoke River floodplain, North Carolina. Plant Ecology 156: 43-58.

USFWS. 1979. Department of Interior. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79/31, December 1979.

USFWS. 1985. Department of Interior. Final Concept Plan: Texas Bottomland Hardwood Preservation Program. USFWS, Albuquerque, NM, May 1985.

USFWS. 2000. Department of Interior. Letter from T.J. Cloud (USFWS) to W. Sears (Planning Group D): Draft Water Plan, NETWPG-Region D, 9/27/2000.

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FIELDS OF EXPERIENCE

Mr. Trungale is a professional engineer and the principal of Trungale Engineering & Science in Austin, Texas. He has over 15 years of experience working in water resource planning and environmental flow studies, including work for the river basin commission responsible for raw water supply for Washington D.C., as a consultant with HDR Engineering managing regional water planning and availability modeling and as the surface water hydrologist for the Texas Parks and Wildlife River Studies program. Mr. Trungale is currently an independent consultant with expertise in conducting instream flow studies to quantify the effects of changing flow regimes on aquatic habitat. His expertise extends to groundwater-springflow studies, freshwater inflows for bays and estuaries, and regional and state water planning including water availability analysis and water rights review. Mr. Trungale has an MS degree in Engineering from the University of Washington and has completed course work in pursuit of a PhD candidacy at Texas State University in Aquatic Biology.

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- Texas State Board of Professional Engineers – Professional Engineer No. 92040
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TECHNICAL REPORTS, PUBLICATIONS AND CONFERENCE PRESENTATIONS

- Trungale Engineering and Science (February, 2012), Instream Flow-Habitat Relationships in the Upper Rio Grande River Basin, URGBBEST, Austin, Texas.
- Trungale Engineering and Science and the River Systems Institute (June, 2012), Instream Flow-Habitat Relationships in the Nueces River Basin, Nueces BBEST, Austin, Texas.
- Trungale Engineering and Science (October, 2011), Effect of Diversions from the Guadalupe San Antonio River Basins on San Antonio Bay, The Aransas Project, Austin, Texas.
- Colorado Lavaca Basin and Bay Expert Science Team (March, 2011), Environmental Flows Recommendations Report, Austin, Texas.
- Trungale Engineering and Science (August, 2010), Environmental Flows Regime Analysis and Recommendations Report, Cypress Flows Project, Austin, Texas.
- Trungale Engineering and Science (April, 2010), Flows Atlas - Senate Bill 3 (2 separate reports - Trinity-San Jacinto and Sabine-Neches), National Wildlife Federation, Austin, Texas.
- Trinity San Jacinto Basin and Bay Expert Science Team (December, 2009), Environmental Flows Recommendations Report, Austin, Texas.
- Espey Consultants, Inc. and Trungale Engineering and Science (August, 2009), Galveston Bay Salinity Zonation Analysis for the Trinity-San Jacinto and Galveston Bay Basin and Bay Expert Science Team, Austin, Texas
- Texas Commission on Environmental Quality (August, 2008), Review of Desktop Methods for Establishing Environmental Flows in Texas Rivers and Streams, Austin, Texas

- BIO-WEST, Inc. (March, 2008), Lower Colorado River, Texas Instream Flow Guidelines, Colorado River Flow Relationships to Aquatic Habitat and State Threatened Species: Blue Sucker, Round Rock, Texas. Lower Colorado River Authority and San Antonio Water System.
- Trungale Engineering and Science (July, 2007), Instream Flow Needs for the Brazos River Near Glen Rose, Texas, Friends of the Brazos River, Austin, Texas.
- Trungale, J.F., Mayes, K.B., Moss, R.E., and Kleinsasser, L.J. (October, 2003), Using Water Availability Models to Assess Alterations in Instream Flows. River Studies Draft Report Texas Parks and Wildlife Department, Austin, Texas.
- Kleinsasser, L.J., Jurgensen, T.A., Bowles, D.E., Boles, S., Aziz, K., Saunders, K.S., Linam, G.W., Trungale, J.F., Mayes, K.B., Rector, J., Renee Fields, J., Portis, K., Steinmetz, G., and Moss, R.E.(February, 2004), Status of Biotic Integrity, Water Quality, and Physical Habitat in 16 of 30 Wade-able East Texas Streams. River Studies Report No. 19, Texas Parks and Wildlife Department, Austin, Texas.
- Saunders, K.S., Mayes, K.B., Jurgensen, T.A., Trungale, J.F., Kleinsasser, L.J., Aziz, K., Fields, J.R., and Moss, R.E. (August, 2001), An Evaluation of Spring Flows to Support the Upper San Marcos River Spring Ecosystem, Hays County, Texas. River Studies Report No. 16. Texas Parks and Wildlife Department, Austin, Texas.
- HDR Engineering, Inc. (January, 2001), South Central Texas Regional Water Plan, Texas Water Development Board, Austin Texas.
- HDR Engineering, Inc. (December 1999), Water Availability in the Guadalupe-San Antonio River Basin, Texas Natural Resource Conservation Commission, Austin, Texas.

Owner and Principal
2004 - Present Trungale Engineering & Science — Austin, Texas

In 2004, Mr. Trungale established Trungale Engineering & Science and began working as an independent consultant. While continuing to conduct state of the science studies, he has brought his expertise in engineering and ecological science to into broader contexts within the public policy and legal arenas. He works with diverse groups of stakeholders and scientists to develop innovative solutions to natural resource challenges that balance growing human needs for water with the need to protect and maintain sound ecological environments. In addition to addressing the needs of individual clients, he has also served on several science committees and testified as an expert witness in a number of precedent settling decisions.

Analysis of the Lower Colorado River Authority Water Management Plan - Colorado Water Issues Committee of the Texas Rice Industry Coalition for the Environment

In response to the historic drought currently underway in central Texas the LCRA has applied for a number of emergency orders that allow them to completely curtail releases of water for rice irrigators. Mr. Trungale was retained by CWIC to analyze the proposed emergency order and develop alternatives that would achieve a more equitable balance among all of the water users in the basin. He reviewed the proposed, current and past water management plans, used LCRA's stochastic model to forecast future combined storage in the highland lakes assuming the proposed and alternative emergency orders and produced a technical report. Mr. Trungale testified as an expert witness testimony (TCEQ Docket No. 2-14-0124-WR / SOAH Docket No. 582-14-2123 (LCRA WMP Emergency Order)) describing his conclusions that the same a level of protection for upstream interests could be achieved with a more moderate order.

Learning from Drought: Next Generation Water Planning for Texas – Texas Center for Policy Studies

Under a grant from the Meadows Foundation, Mr. Trungale co-authored a report that analyses the Texas regional and state planning process. The report includes an analysis of the assumptions and methods employed to develop forecasts for municipal, irrigation and stream electric water demands, calculations water available from existing supplies including estimates of additional supplies that could be made available if drought contingency plans are incorporated, and a discussion of the need to provide water for the protection of a sound environment. The report includes several policy recommendations to develop a more sustainable water plan.

Effect of Diversions from the Guadalupe San Antonio River Basins on San Antonio Bay - The Aransas Project

Mr. Trungale produced a technical report on behalf of The Aransas Project an alliance of citizens, organizations, businesses, and municipalities seeking responsible water management of the Guadalupe River Basin and bays. In 2011, TAP filed a federal lawsuit in the United States District Court for the Southern District of Texas, Corpus Christi Division, against several officials of the Texas Commission on Environmental Quality (TCEQ) in their official capacities for illegal harm and harassment of Whooping Cranes at and adjacent to Aransas National Wildlife Refuge in violation of the Endangered Species Act. Mr. Trungale testified as an expert witness in this trial describing how future changes in inflow are expected to alter salinity patterns in San Antonio Bay. His analysis focused on salinity thresholds for Blue Crabs, an important for source for the cranes, in the vicinity of the Aransas National Wildlife Refuge.

Caddo Lake/Cypress Basin Environmental Flows Study - Caddo Lake Institute

Since 2005, Mr. Trungale has worked with local, state and federal agencies and the Nature Conservancy to develop flow recommendations to protect the rivers and wetland surrounding Texas' only natural lake. Mr. Trungale conducts and reviews scientific studies related to wetland connectivity and instream habitat to determine ecosystem flow needs for Caddo Lake and associated wetlands. Implementing a consensus based decision-making process; he has led a science based stakeholder process to develop recommendations for subsistence, base and high flow targets and conducted field studies to address priority research issues. He worked closely with the U.S Army Corps of Engineers and the local water supply organization to develop approaches to implement environmental flow recommendations and is currently developing a monitoring and adaptive management program to assess the efficacy of these recommendations on maintaining the ecological health of this system.

Instream Flow – Habitat Relationships for the Nueces River Basin and the Upper Rio Grande Basin

Mr. Trungale conducted extensive field data collections and developed instream habitat simulation models for selected locations in the Nueces and Upper Rio Grande River basins in order to develop predictive relationships which describe the response of instream available habitat over a range of flows. These relationships will be used to evaluate the flows that may be recommended by the Bay and Basin Expert Science Teams as part of their charge under the Senate Bill 3 Environmental Flows mandate.

Brazos River Instream Flow Study - Texas Rivers Protection Association & Friends of the Brazos River

Mr. Trungale analyzed the Brazos River Authority systems operation permit application and evaluated effects on instream flows to support environmental and recreation flow needs. Mr. Trungale characterized flow regimes under pre-development and currently modified management scenarios using a Water Availability Model (WAM) developed for the Brazos River Systems Operations Permit application which seeks to appropriate water from the Brazos River. He provided expert testimony in support of protestants (Friends of the Brazos River) in the matter of the application by Brazos River

Authority for Water Use Permit No. 5851 (SOAH Docket No. 582-10-4184; TCEQ Docket No. 2005-1490-WR).

Llano River Sand and Gravel Mining Protest

Mr. Trungale conducted analysis of potential impacts from sand and gravel operations in the Llano River specifically with respect to compliance with 31 TEX ADMIN. CODE § 69.108 (c) including the evaluating sediment budget, erosion rates of the river segment to be mined, and the effect on coastal and receiving waters. He provided expert report and testimony in support of protestants (Peron and others) in the matter of an application of Joe B. Long and Mark L. Stephenson for a Sand and Gravel Permit (SOAH Docket No. 802-09-4552).

Colorado and Lavaca River Basins and Matagorda Bay and Basin Expert Science Team (BBEST) and Trinity and San Jacinto River Basins and Galveston Bay and Basin Expert Science Team (BBEST)

As a Texas Senate Bill 3 Expert Science Team member, Mr. Trungale developed science based flow recommendations for rivers and freshwater inflows. This included analysis of hydrology and hydraulics, biology, water quality and geomorphology to refine and validate hydrology based instream flow recommendations. He applied a salinity zonation approach to predict ecologically relevant salinity response to changes in freshwater inflows.

Lower Colorado River Instream Flow Study – Lower Colorado River Authority/San Antonio Water System

Mr. Trungale developed models to evaluate the effects of flow alterations, specifically related to a proposed water development project to provide water from the Colorado River to the City of San Antonio. He was responsible for several components, which included performing reconnaissance to determine study sites, developing conceptual study flow charts, collecting physical and hydrologic data to model and characterize hydraulic habitat, analyzing results, recommending flow targets and preparing a final report.

Review of Desktop Methods for Establishing Environmental Flows in Texas Rivers and Streams – Texas Commission on Environmental Quality

Mr. Trungale provided technical support to the workgroup tasked with evaluating the current default method for determining instream flow needs, primarily for the purpose of defining special conditions within water rights permits. This included making comparisons between naturalized and gauged flows and between Lyons method and values derived from Indicators of Hydrologic Alteration (IHA) software as well as comparing estimates from desktop methods and recommendations from a comprehensive site specific study.

Kinney County Groundwater Management – Kinney Country Farmers and Ranchers Association

Mr. Trungale supported the coalition of ranchers and farmers to protect local wells and springs from excessive groundwater diversions and transfers. He evaluated previous and current studies, including Groundwater Availability Modeling (GAM) and provided support recommendations for springflow needs and approaches to meet these needs. Mr. Trungale provided affidavits to the Kinney County Groundwater Management District.

San Marcos River Foundation Instream Flow Permit Application – San Marcos River Foundation

Mr. Trungale provided technical guidance to the San Marcos River Foundation, a local non-profit which had applied for a permit for the protection of instream and freshwater inflows in the Guadalupe River. He also performed Water Availability Modeling (WAM) to support permit application, evaluated completed applications, and researched the TCEQ permitting policy to evaluate precedence and authority of the agency to grant such permits. Finally, Mr. Trungale evaluated state methodology to determine freshwater inflow needs for San Antonio Bay and continues to monitor activities to the Commission on Environmental Flows and their Science Advisory Committee. He provided affidavits in the matters of water rights applications from the San Marcos River Foundation and the Canyon Regional Water Authority.

Surface Water Hydrologist
1999 - 2004 Texas Parks and Wildlife Department San Marcos, Texas

Mr. Trungale's work at TPWD encompassed a large scope of projects including collecting and analyzing field data and developing hydraulic and habitat models to determine instream flow needs to support healthy ecosystems. In addition, he collected physical and biological data which included surveying stream cross sections and benchmarks with levels, total stations and GPS, measuring discharge with flow meters, collecting bathymetry with digital transducer and echosounder connected to GPS units, characterizing and mapping stream cover and substrate, collecting biological data, primarily fish, using seines, boat and backpack shockers, and also some limited collecting of chemical data primarily using automated data loggers. He performed statistical and time series analysis on hydrologic and hydraulic data, specifically calculating watershed and stream channel and flow statistics that have biological significance, e.g. Indicator of Hydrologic Variability (IHA) (central tendency, recurrence intervals, frequency and duration) and that may be used to develop or refine instream flow standards and requirements. Also Mr. Trungale developed and ran 1D and 2D hydrodynamic models including PHABSIM, River2D and SMS/RMA2, water quality models (SNTEMP and BASINS). He developed spreadsheet and GIS tools to analyze outputs of habitat preference and utilization. At TPWD, Mr. Trungale served as an agency expert on issues related to surface water hydrology in statewide permitting and planning including a review of major water rights applications, water availability modeling, reservoir yield calculations and departmental and state water planning processes.

Water Availability Models to Assess Alterations to Instream Flows

Mr. Trungale used water availability models to assess alterations to instream flows under current conditions and full authorized use assumptions. He developed monthly benchmark flow values at 72 sites throughout Texas based on a percentage of daily naturalized median flow (similar to the regulatory default method) and calculated the frequency of meeting or exceeding these benchmarks under natural and modeled assumptions. Finally, Mr. Trungale characterized the level of alteration based on the difference in percent of time targets met between natural conditions and full authorized use.

Guadalupe Instream Flow Study

Mr. Trungale was responsible for characterizing flow regime at three sites on the Guadalupe River by reviewing and comparing historical stream flow records, calculating flow statistics, and producing cumulative frequency graphs. He also collected physical and biological data at three sites on the Guadalupe River by several methods, including surveying cross section depths and water surface elevations, taking velocity measurements according to USGS protocol and calculating discharge, collecting bathymetry data using a boat mounted Echosounder/GPS system, and making substrate and cover calls and fish collections. Mr. Trungale developed 1D (PHABSIM) and 2D (SMS/RMA2 and River2D) hydraulic-habitat models including calculating stage-discharge relationship (rating curve), running and calibrating models and producing maps of model depths, velocities and habitat.

Regional Environmental Monitoring Assessment Program (REMAP)

Mr. Trungale's involvement in REMAP included collecting physical and biological data for small streams in East Texas including surveying cross section depths and water surface elevations, measuring velocity according to USGS protocol and calculating discharge. He also made substrate and cover calls, and developed spreadsheets to calculate summary statistics for more than 200 sites. The calculated statistics for each cross section included calculation of wetted width, maximum and median depth for current water surface elevations, bank full and flood prone areas. Mr. Trungale also summarized fish species collected at each site. Using GIS Software, Mr. Trungale calculated drainage areas for more than 200 sites using digital elevation models and land use density for each site according to Anderson scale and land use land cover data sets. Finally, Mr. Trungale developed programs to calculate the regionalized Index of Biotic Integrity (IBI) for fish and benthic macroinvertebrate metrics.

Evaluation of Spring Flows to Support the Upper San Marcos River Spring Ecosystem, Hays County, Texas

Mr. Trungale characterized flow regime by reviewing and comparing historical stream flow records, calculating flow statistics, and producing cumulative frequency graphs. He also developed a 1-D hydraulic-habitat model (PHABSIM) including calculating stage-discharge relationship (rating curve), by performing log-log regression between observed stage and discharge pairs at 28 cross sections, calculating velocities at each station within each cross section at a range of discharges using Manning's equation to solve for "n" at each station (in this context "n" acts as a roughness distribution factor across the cross section), calculating weighted usable area as a function of flow for target species (in this case five native plant species) by relating habitat suitability indices to modeled depths and velocities, and performing time series analysis to calculate weighted usable area over period of record to access historical variable and duration of "good" habitat conditions. In addition, Mr. Trungale developed a stream temperature model (SNTEMP) using results from hydraulic modeling and additional observed data to create inputs for a stream temperature model including latitude, elevation, travel time, stream width, shading data, and historical meteorological data (used for alternative scenarios). Finally, he modeled net heat flux = solar radiation + atmospheric radiation + vegetative radiation + evaporation + convection + conduction + friction-water's back radiation on a monthly time step, validated results against observed water temperatures, and predicted flow rates at which temperature thresholds might be violated.

Project Engineer
1997 - 1999 HDR Engineering, Inc. ***Austin, Texas***

As a Project Engineer for HDR Engineering, Inc., Mr. Trungale developed water availability models and regional water plans. He was a principle programmer for state water availability models for the Guadalupe and San Antonio River Basins. Mr. Trungale was a project manager for new reservoir alternatives in the South Central Texas Regional Planning Study. He integrated long-range water supply plans for state sponsored regional planning studies based on demand projections, availability of new supplies, cost and environmental impacts. He modified reservoir yield simulation models for analysis and assessment of water supply alternatives on a daily time step. Models were evaluated for both the reliability of these alternatives to supply water as well as their impact on natural and aquatic resources downstream. Other projects included sizing and laying out potential pipeline routes and accessing costs for municipal water, sewer and drainage structures.

Guadalupe River Basin Water Availability Model

Serving as a Principle Modeler for the Guadalupe San Antonio Water Availability Model (GSA WAM), Mr. Trungale built a GSA water rights dataset which included reviewing permits, assigning priority dates and a diversion location to a geographical coordinate. He calculated monthly distribution factors, created storage area curves, and estimated historical evaporation rates. Mr. Trungale modified naturalized flow sets including updated spring flow sets. Basin specific modifications were made to the WAM source code to calculate daily operations for Canyon Reservoir to meet FERC and hydropower daily flow requirements, including modifications to handle special permits (Braunig/Calveras/Victoria), and Medina/Diversion Lake leakage. Alternative scenarios were devised to evaluate changing return flow assumptions, exclusion of cancelable and term permits, and accounting for reservoir sedimentation. Model runs were performed to validate and present results.

South Central Texas (Region L) Water Planning

Mr. Trungale was a Project Manager for the SB1 Region L planning study for five new reservoir alternatives in the GSA. He managed a $20,000 budget and supervised the work of other project engineers. He calculated availability for water diversion into storage facilities with the constraints of meeting downstream senior water rights and bay and estuary flow requirements. He calculated reservoir yields subject to local evaporation and meeting a three-tiered environmental flow pass through, the impact of diversion at the site and at the mouth of the bay and the unit cost of water for the project. Mr. Trungale summarized yield estimates, costs and implementation/feasibility issues.

Environmental Criteria Refinement Study

Mr. Trungale modified the Texas Water Development Board's reservoir yield model (SIMDLYYD) to accept monthly flows, pass throughs for senior downstream water rights, bay and estuary flows, daily flows from a nearby reference gage, and to convert the daily values to monthly values. The model performs a mass balance on a proposed reservoir, passing flows to meet environmental targets based on triggers and iterating on storage to calculate evaporative losses. He calculated reservoir yield by increasing diversions until reservoir volume goes to zero. Options were also included for "stacking" pass throughs for instream flows on top of flows for bays and estuaries. Mr. Trungale performed this analysis on 7 proposed reservoirs in the South Central region. At one site, Sandies Creek, he made additional model runs to examine the effects of changing pipeline capacity. He compared resulting flows at the diversion site and the bay inflow with pre-project flow by calculating cumulative exceedence and monthly medians. Mr. Trungale ran fish production and salinity models to evaluate bay and estuary impacts.

Water Resource Systems Engineer
1996 - 1997 Interstate Commission on the Potomac River Basin Rockville, Maryland

During this period, Mr. Trungale managed raw water supply sources and planned for future water supply needs for the Washington, D.C. metropolitan area. He designed and maintained a hydrologic computer simulation model of the Potomac River Basin for use in long term planning of water supply needs. He issued monthly water supply outlook forecasts to alert Washington area water suppliers as to the likelihood of drought. He was responsible for scheduling water supply releases from storage facilities in the event that natural stream flow in the Potomac would be insufficient to meet current water supply demands. Mr. Trungale provided technical support and participated in planning efforts related to a range of water supply issues including yield analysis of current and future projects, management of water supply agreements across state lines, development of alternatives to meet future water supply needs, maintenance of historic flow and demand databases, development of local watershed groups and investigation of threats to future safety of area water supply.

Engineering Technician

1994 - 1996 ACT-ACF Comprehensive Water Resource Study ***Seattle, Washington***

Serving as an Engineering Technician, Mr. Trungale developed a user-friendly computer simulation model to develop and analyze alternatives to manage water resources shared between three states and a wide range of stakeholders. He designed and programmed an object oriented computer simulation model using Stella™ software for use by local and regional stakeholders, Alabama-Coosa-Tallapoosa (ACT) river basin. Mr. Trungale incorporated surface and ground water resources as well as findings from 14 concurrent studies. He met with public and private contractors and with representatives of environmental and planning departments from Georgia, Alabama, Florida and the federal government. Mr. Trungale consulted with these and other groups and developed measures of performance for municipal, industrial, and agricultural demands, hydro and thermal power production, environmental impacts on streams and reservoir lakes, and navigation and economic impacts. As a working group member, he had an extensive role interacting with stakeholders and making public presentations.

COMPUTER EXPERIENCE

- Surface Water Modeling (TxBLEND, WRAP, HEFR, RMA-2, River-2D, HEC-RAS)
- Statistical Software Packages (S-Plus, R, Conoco, Primer)
- Productivity (MS Excel, Word, Power Point)
- GIS (ArcView/ArcInfo, Spatial Analyst, 3D Analyst)
- Database (Access, SQL)
- HTML, FORTRAN, VB, C

THOMAS DAVID HAYES, Ph.D.
Executive Director and Senior Scientist, Environmental Conservation Alliance
Mailing address: P.O. Box 685039, Austin, TX 78768
Email: Tom@ECAscience.org; Telephone: 512-439-9597 (office/cell)

PROFESSIONAL SUMMARY:

Tom Hayes earned his B.A. in biology from Rice University, Masters of Forest Science in ecosystem biology from Yale University, and Ph.D. in landscape conservation and forest biogeochemistry from the University of California, Berkeley. He has authored over 100 publications and technical papers, plus conference and workshop presentations. Since 2011, Dr. Hayes has been employed by Environmental Conservation Alliance (ECA), a 19-year old nonprofit [501 (c) (3)] corporation. This nonprofit model provides scientific and technical services (consultation and implementation) to public agencies, the conservation community, and private businesses and landowners, in the areas of land and water stewardship, biodiversity and ecosystem management, rare species conservation, and sustainable development.

For 35 years, Dr. Hayes has worked as a land-water resource manager, landscape ecologist, conservation biologist, and administrator. His direct experience encompasses ecological restoration, rare species conservation, habitat management plans (writing and evaluation), wetland determination, ecological and environmental monitoring, impact and mitigation assessment, reserve design and implementation, regulatory compliance, and issue-oriented research. His conservation and adaptive-management experience encompasses a broad range of animal and plant species and biotic communities; and their terrestrial, wetland, and aquatic habitats.

Starting with a 2009 National Wildlife Federation grant to study East Texas (Sabine, Neches, San Jacinto, and Trinity river basins), Dr. Hayes has developed tools to quantify environmental-flow requirements to sustain floodplain habitats and their downstream benefits to fisheries and ecosystems. Since 2010, he has worked with the Caddo Lake Institute, Austin TX, and other collaborators in the Cypress-Caddo basins of northeast Texas, to continue the analyses. With state funding, Dr. Hayes is currently expanding the Texas floodplain research network with additional long-term stations in the Guadalupe, Brazos, and Trinity river basins.

Dr. Hayes' technical experience includes:

- Biogeochemistry: nutrient cycling and ecosystem processes
- Conservation easements and other permanent-protection planning and implementation
- Ecological and environmental studies: baseline inventory and impact analyses
- Flow analyses to sustain and restore riparian, wetland, and estuarine habitats
- Environmental forestry: urban and rural management plans, implementation, and policy
- Expert testimony: judicial and administrative, hearings and proceedings
- GIS and remote-sensing: project management, habitat analysis, and environmental assessment
- Habitat conservation plans: endangered species and sustainable landscapes
- Habitat management and trend analyses: endangered and rare species, and biotic communities
- Land and wildlife management, including related agricultural tax valuations
- Low-impact development, including best management practices
- Species inventories and monitoring, including adaptive management
- Water resource analyses: surface and ground water, rural and urban, land-use effects on water quality
- Wetland determination: implementation, permitting, mitigation

EDUCATION:

Ph.D.	Biogeochemistry and Conservation Biology, Dept. of Integrative Biology, Univ. of California, Berkeley, CA, 2002.
M.For.Sci.	Ecosystem Biology, School of Forestry and Environ. Studies, Yale Univ., New Haven, CT, 1977.
B.A.	Biology, Cum Laude, Rice Univ., Houston, TX, 1975.
Diploma	McClellan High School, Mabelvale, AR, 1971.
Diploma	Marine Biology and Higher Mathematics, National Science Foundation Summer Fellow, Humboldt State Univ., Arcata, CA, 1970.

WORK EXPERIENCE:

Executive Director and Senior Scientist, Environmental Conservation Alliance, Austin, TX, 2011-present.
Science Director, Greater Edwards Aquifer Alliance, Austin, TX, 2008-11.

WORK EXPERIENCE: concluded

Research Ecologist (3-mo grant), Lower Colorado River Habitat Conservation Project, Marine Sciences Institute, U. of California, Santa Barbara, 2008.

Vallier Resident Ecologist & Associate Scientist (3-year grant), Treehaven Environmental Learning Center, Tomahawk, WI, & College of Natural Resources, U. of Wisconsin - Stevens Point, 2005-08.

Project Manager (post-doc), Flambeau Experiment, Forest Landscape Ecology Laboratory, Dept. of Forest Ecology & Management, U. of Wisconsin, Madison, 2003-05.

Research Faculty (adjunct), Dept. of Forest Science, Oregon State U., Corvallis, 1996-2003.

Ph.D. Candidate (part time), Dept. of Integrative Biology, U. of California, Berkeley, 1993-2002.

State Stewardship Ecologist, The Nature Conservancy of Texas, San Antonio, 1989-92.

Biologist III, Habitat Assessment, Resource Protection Div., Texas Parks & Wildlife Dept, Austin, 1986-89.

Biologist II, Resource Management, Parks Div., Texas Parks & Wildlife Department, Austin, 1985-86.

Project Manager/Conservation Biologist, Espey, Huston & Associates, Austin, TX, 1978-84.

Research Assistant, Hubbard Brook Exp. Forest, USDA Forest Service, in cooperation with School of Forestry & Environmental Studies, Yale U., New Haven, CT, 1976-77.

Research Assistant, Biology & Environmental Engineering Depts., Rice U., Houston, TX, 1972-75.

Biological Technician, Southwest Research Institute, Houston, TX, 1973-74.

OTHER QUALIFICATIONS:

Technical Skills:

Environmental and ecological inventory and monitoring, environmental-flows analysis, estuarine bioaccumulation and bioassay, forestry, habitat typing and restoration, invasive species control, project coordination and consensus building, regulatory compliance, land protection (reserve design, conservation easements), wetland determination.

Selected Honors/Committees:

Urban Forestry Board, Vice Chair, City of Austin, TX. 2011-14.

Biological Advisory Team, Member, Southern Edwards Plateau Habitat Conservation Plan, US Fish & Wildlife Service, San Antonio, TX, 2010-12.

Science Advisory Board, Member, Hill Country Alliance, Austin, TX, 2009-present.

Vallier Foundation Fellowship, Treehaven Field Station, UW-Stevens Point, Tomahawk, WI, 2005-2008.

Post-Doctorate Fellowship, Forest Landscape Ecology Laboratory, Department of Forest Ecology and Management, University of Wisconsin-Madison, 2003-2005.

STAR Graduate Fellowship, Environ. Sci. Res. Div., US Environ. Protection Agency, 1997-2000.

National Network for Environ. Manag. Studies, Fellow, US Environ. Protection Agency, 1994-96.

Texas Organization for Endangered Species, Communities Committee Chair/Steering Committee, 1991-92.

Texas Academy of Science, Conservation Section Chair, 1989-1990.

Texas Organization for Endangered Species, Plant Committee Chair/Steering Committee, 1982-1984.

Phi Beta Kappa, Rice University, Houston, TX, 1975.

President's Honor List, Rice University, Houston, TX, 1971-1975.

National Science Foundation Fellowship, Humboldt State University, Arcata, CA, summer 1970.

PRIOR WORK HISTORY:

Throughout his undergraduate and graduate studies at Rice and Yale, respectively, Dr. Hayes was at the same time employed in environmental and ecological studies of stream runoff, aquatic and estuarine ecosystems, and biogeochemical processes within disturbed landscapes. Upon earning his Master's degree in 1977, he worked for Espey, Huston, and Associates, Austin, Texas, first as manager of an estuarine bioassay/bioaccumulation laboratory in Galveston, and subsequently as senior biologist and project manager for aquatic and terrestrial impact assessments and mitigation, wetland determinations, habitat restoration, and Section 404/10 and water-rights regulatory compliance.

In 1985, Dr. Hayes gained employment as Biologist II with the Resource Management Section, Parks Division, Texas Parks & Wildlife Department (TPWD), Austin. He primarily trained and organized resource-management teams throughout the State Park System, to lessen human impacts and proactively restore native terrestrial and aquatic habitats. He also completed special projects, including large volunteer restoration efforts, regulatory and endangered-species assessments, and water-rights testimony.

Upon his promotion to the Resource Protection Division (Wetlands Program, 1986-89), TPWD, Austin, Dr. Hayes continued to oversee regulatory assessments (Sec. 404/10, etc.), water-rights studies, community outreach,

PRIOR WORK HISTORY: concluded

and related mitigation implementation. Notable projects included wetland determinations and in-stream flows analyses in support of regulatory hearings for floodplain and coastal development and of state water rights, including Proposed wetland development and reservoir projects. He was the primary TPWD liaison to the U.S. Forest Service, coordinating and writing the formal State responses to 10-year plans and other activities concerning all National Forests and Grasslands in Texas. Dr. Hayes was also the lead expert witness for TPWD in several federal cases that achieved permanent protection on federal lands in 17 states for the endangered Red-cockaded Woodpecker.

Later, as the first State Stewardship Ecologist for The Nature Conservancy of Texas (TNC), his projects included acquisition and restoration of coastal and inland habitats, such as the Mad Island Marsh Preserve and WMA near Palacios, the Diamond Y Springs Preserve near Fort Stockton, Dolan Falls Preserve in Val Verde County, Caddo Lake WMA near Jefferson, and many other conservation projects.

Returning in 1993 to academic research at the University of California-Berkeley (UCB) and Oregon State University (OSU), Dr. Hayes managed a long-term field and lab study of the biogeochemical impacts of landscape-scale old-growth forest disturbance. Upon completing concurrent Ph.D. (UCB) and research-faculty (OSU) appointments in 2003, he continued his research on disturbed ecosystem processes, along with teaching duties, at two University of Wisconsin campuses: Madison and Stevens Point. In 2008, Dr. Hayes accepted a 3-month grant with the Marine Sciences Institute, University of California-Santa Barbara, to help design a wetlands and riparian restoration project, spanning the Mojave Desert in southern Nevada and portions of three adjacent states.

In October 2008, Dr. Hayes returned to applied conservation and impact assessment in Texas (see above).

PUBLICATIONS AND TECHNICAL REPORTS:

During his career, Dr. Hayes has authored over 100 publications and technical papers, as well as numerous conference and workshop presentations. The following abbreviated publication list is representative:

Hayes, T., and R. Reid, 1979, "Fish, Wildlife, and Recreation Resources of the Matagorda Bay System," prepared for U.S. Fish and Wildlife Service, Albuquerque, NM, Espey, Huston, and Associates (EH&A) Doc. No. 79240.

Sexton, C., and T. Hayes, 1980, "Biological Assessment of the Impact of Florida Gas Transmission Company's Proposed Trans-Gulf Pipeline Construction and Conversion Project on Threatened and Endangered Species of the Apalachicola River Basin," prepared for Federal Energy Regulatory Commission, Environmental Evaluation Branch, Washington, D.C., EH&A Doc. No. 80131.

Reid, R., T. Hayes, and C. Perino, 1980, "Vegetation and Wildlife Resources of the Black Mesa and Kayenta Mine Sites," prepared for Peabody Coal Company, Flagstaff, AZ, EH&A Doc. No. 8071.

Hayes, T., P. Jensen, and C. Green, 1981, "Critical Area Mapping and Spill Probability Evaluation of the Houston Ship Channel," prepared for The Clean Channel Association, Houston, TX, EH&A Doc. No. 81149.

Hayes, T., and EH&A staff, 1981, "Acid Deposition in Texas: Technical Summary and Perspective," prepared for Texas Energy and Natural Resources Advisory Council, Austin, TX, Energy Dev. Act Project 80-L-11-6, EH&A Doc. No. 81305.

Hayes, T., P. Price, and B. Stewart, 1982. "Ecological Baseline Studies of the Shell Vanderrick Mine Facilities Area, Vanderburgh County, Indiana," prepared for Shell Oil Company-Mining, Houston, TX, EH&A Doc. No. 82367.

Hayes, T., 1984, "Remote Sensing Analysis: Impacts to Forest Vegetation Due to Cooling Plume Drift, Farley Nuclear Power Plant," prepared for Alabama Power Company, Birmingham, Alabama, EH&A Doc. No. 83775.

Hayes, T., 1984, "Vegetation and Wetland Inventory, Proposed Bosque Reservoir," prepared for Paul Price Associates, Austin, TX, Hayes Environmental Science Doc. No. 1984-01.

Hayes, T., and D. Riskind, 1985, "Instream-Flows Impact Assessment of Proposed Paluxy Reservoir upon Dinosaur Valley State Park," Testimony Preparation, TWDB Water Rights Hearing; Resource Protection Div., Texas Parks and Wildlife Dept., Austin, TX.

Hayes, T., D. Riskind, and W. Pace, 1987, "Patch-Within-Patch Restoration of Man-Modified Landscapes Within Texas State Parks," Chapter 10, pp. 173-198, in M. Turner (editor), Landscape Heterogeneity and Disturbance, Springer-Verlag Publisher, New York, NY.

Hayes, T., 1987, "Downstream Impacts of the Proposed Little Cypress Reservoir upon Bottomland Hardwood Forests and Swamps," Special Report and Expert Testimony, TWDB Water Rights Hearing; Resource Protection Div., Texas Parks and Wildlife Dept., Austin.

Riskind, D., R. George, G. Waggerman, and T. Hayes, 1987, "Restoration in the Subtropical United States," Restoration and Management Notes 5(2): 80-82.

Pace, W., III, D. Riskind, and T. Hayes, 1988, "Restoration and Management of Native Plant Communities on Texas Parklands: The Mixed-prairie Experience," in Proceedings of the Tenth North American Prairie Conference, Native Prairies Association of Texas, Dallas.

PUBLICATIONS AND TECHNICAL REPORTS: continued

Hayes, T., 1990, "Reclamation Plan and Surface Use Agreement for Oil and Gas Operations at Diamond Y Spring Preserve, Pecos County, Texas," The Nature Conservancy of Texas, San Antonio.

Hayes, T., 1992, Endangered, Threatened, and Watch List of Natural Communities of Texas, Publication # 8, Texas Organization for Endangered Species, Austin, TX.

Hayes, T., 1993, "Long-term Integrated Monitoring Plan, Diamond Y Spring Preserve, Pecos County, Texas," The Nature Conservancy of Texas, San Antonio, Texas.

Hayes, T., 1993, "Invited Written and Oral Testimony Before Congress in Support of H.R. 1164, Forest Biodiversity Act of 1993," U.S. House of Representatives, Committee on Agriculture, Washington, DC, October 28, 1993.

Hayes, T., 1994, "Standard Operating Procedure 5.1: Litter Decomposition," Environmental Research Laboratory, US Environmental Protection Agency, Corvallis, OR.

Hayes, T., R. Griffiths, and C. D'Antonio, 1997, "Biogeochemical Attributes of Old-growth Forest-Clearcut Edges," Bulletin of the Ecological Society of America 78 (4):105.

Hayes, T., R. Griffiths, and C. D'Antonio, 1999, "Nitrogen and Carbon Cycling in Fragmented Old-growth Forest," oral paper, Ecological Society of America annual meeting, Spokane, WA.

Hayes, T., A. Swanson, C. D'Antonio, and R. Griffiths, 2002, "Biogeochemical Edge Effects on Nitrogen and Carbon Retention in Fragmented Old-growth Forest," invited oral paper, Forest Edges Symposium, Ecological Society of America annual meeting, Tucson, AZ.

Hayes, T., 2002, Ecosystem Consequences of Forest Fragmentation in the Pacific Northwest: Biogeochemical Edge Effects within Oldgrowth Forest Remnants, Ph.D. Dissertation, Dept. of Integrative Biology, U. Calif.-Berkeley.

Hayes, T., 2005, "Field and Laboratory Manual for the Flambeau Experiment: Methods for Examining Canopy Gaps and Coarse Woody Debris to Determine the Mechanisms of Sustainable Forest Management," Forest Landscape Ecology Laboratory, Dept. of Forest Ecology & Management, U. Wisc.-Madison.

Hayes, T., 2006, "Strategic Plan for Integrating Research, Education, and Outreach at Treehaven Center," NSF Proposal Number 0627273, awarded to U. Wisc.-Stevens Point.

Hayes, T., 2007, "Treehaven Land Management Plan," Treehaven Field Station, U. Wisc.-Stevens Point.

Hayes, T. 2008. "Lower Colorado River Habitat Conservation Project: Monitoring and Restoration Database for Riparian and Spring Habitats," U. Calif.-Santa Barbara, with Clark County, NV, and USGS, Henderson, NV.

Hayes, T. 2010, "Selected Spatial Data for Bexar County: Endangered Species, Conservation, and Land Use," submitted to Biological Assessment Team, Southern Edwards Habitat Program, San Antonio, TX. Greater Edwards Aquifer Alliance, San Antonio. TX.

Hayes, T., 2010, "Data Analyses in Support of Out-of-Bank Stream Flow Recommendations for the Maintenance of East Texas Bottomland Hardwoods: Thematic-Mapper Inundation-Area and Hydrologic Results," Greater Edwards Aquifer Alliance, report to National Wildlife Federation, Austin, TX.

Hayes, T,, and J. Trungale, 2010, "Sustainable Rivers Project, Phase 1: Floodplain Forest Inundation – Data Analysis and Monitoring Design, Cypress-Caddo Watershed," Greater Edwards Aquifer Alliance, report to Caddo Lake Institute, Austin, TX.

Hayes, T., 2011, "Wildlife Management Plan," Bingham Creek Ranch, Travis County, TX, ECA project # 2011-02.

Hayes, T. 2011, "Environmental Analysis of the White Stallion Energy Center: Sections 10/404 Permit Application," prepared for Glenrose Engineering, Austin, TX, ECA project # 2011-06.

Hayes, T., and J. Trungale, 2011, "Cypress Flows Project: Floodplain Inundation Analysis Interim Report, Phase 2," Caddo Lake Institute, Austin, TX, December 2011, ECA project # 2011-05.

Hayes, T., and S. Ramirez, 2012, "Southern Segment of the Proposed Keystone XL Pipeline Project, Impact Assessment: Wetlands, Jurisdictional Waters, and Endangered Species," Sierra Club, Boulder, CO, ECA project # 2011-07.

Hayes, T, 2012, "Proposed Post Oak Landfill Project, Impact Assessment: Rare and Endangered Species." Lowerre, Frederick, Perales, Allmon, and Rockwell, Austin, TX, ECA project # 2011-08.

Hayes, T., 2012, "Proposed 460-Acre Post Oak Landfill Project, Impact Assessment: Wetlands and Jurisdictional Waters," Lowerre, Frederick, Perales, Allmon, and Rockwell, Austin, TX, ECA project # 2011-08.

Hayes, T., 2012, "Big Cypress Bayou Monitoring Report, High-Flow Release: May 7-17, 2012," Caddo Lake Institute, Austin, TX, December 2011, ECA project # 2011-09.

Diaz, P., K. Anderson, S. Ramirez, and T. Hayes, 2013, "Land Use Data for the Central Texas Urban Intensity Index, Phase 1," US Fish and Wildlife Service, San Marcos, TX, and Save Barton Creek Association, Austin, TX, ECA project # 2011-10.

Heger, N., and T. Hayes, 2013, "Change in available Golden-cheeked warbler habitat through time: An assessment of change in mature Central Texas juniper-oak woodlands." Golden-cheeked Warbler Symposium, Lady Bird Johnson Wildflower Center, Univ. of Texas, Austin, January 25, 2013.

PUBLICATIONS AND TECHNICAL REPORTS: concluded

Hayes, T. 2013. "Urban Forest Carbon-Offsets Protocol," submitted to Watershed Protection Department, City of Austin, Texas, September 12, 2013.

Hayes, T. 2014. "Proposed Austin Urban Forest Plan: Updated Review," submitted to City Council, Austin, TX, February 21, 2014.

Hayes, T. 2014. "Strategy and Cost Estimate to Revise Austin's Urban Forest Plan as a Comprehensive Plan including Private and Public Trees," submitted to City Council, Austin, TX, February 25, 2014.

SELECTED SPECIAL PROJECTS: Geography Dept., Texas State U.-San Marcos

"Analysis of Golden-cheeked Warbler Habitat Change from 2005 to 2010, Twelve Central Texas Counties," Fall 2010 semester, Four-student class project (GEOG 4427, Prof. A. Giordano), Advisor: T. Hayes (GEAA).

"Mapping Wastewater Pipelines on the Recharge Zone of the Southern and Barton Springs Segments of the Edwards Aquifer, TX," Spring 2011 semester, Four-student class project (GEOG 4427, Prof. Y. Lu), Advisor: T. Hayes (GEAA).

"Determination of Tree-Shade Indices for Streets and Trails, City of Austin, TX," Fall 2011 semester, Six-student class project (GEOG 4427, Prof. A. Giordano), Advisors: A. Hanson (City of Austin) and T. Hayes (ECA).

"Watershed analysis: Spatial Correlations Among Tree-Canopy Cover, Land Use, and Water Quality, City of Austin, TX," Spring 2012 semester, Four-student class project (GEOG 4427, Prof. Y. Lu), Advisors: A. Hanson (City of Austin) and T. Hayes (ECA).

Response to Region C's Quantitative Analysis of Marvin Nichols Reservoir On Agricultural Resources

Prepared By:

Jim Thompson
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December 12, 2014

ISSUES PRESENTED

1) Does the report presented by Region C comply with the Interim Order of August 8, 2014 requiring Region C to conduct an "analysis and quantification of the impacts" of the Marvin Nichols Reservoir Water Management Strategy on the agricultural resources of Region D as required by TWDB and pursuant to Sections 16.051 and 16.053 of the Texas Water Code?

2) Does the report satisfy the requirement that Region C show that the inclusion of Marvin Nichols Reservoir in the Region C Regional Water Plan is consistent with the long term protection of the State's agricultural resources?

ISSUE #1

The Report submitted by Region C does not comply with the requirements of the Interim Order and TWDB rules with respect to impacts to agricultural resources.

The Region C report contains inaccurate and cursory data. More importantly, it does not provide TWDB with the required analysis and quantification of the impacts.

The report either ignores or intentionally omits from its discussion the required analysis and quantifications of impacts on the agricultural/timber industry of Northeast Texas and Region D that would result from removal of significant amounts of vitally important hardwood resources from the Sulphur River Basin. The Sulphur River Basin, where the proposed Marvin Nichols Reservoir would be located, is a primary source of hardwood timber inventories for three (3) paper mills in the area, as well as numerous hardwood sawmills, one of which is largest hardwood sawmill in Texas.

If Region C had asked Region D, or any of the timber companies in Region D for the information necessary to do this analysis, Region D and these industries would readily have assisted in the required analysis and quantification. That work is relatively straight forward. Region C would need to identify the lands to be inundated or otherwise impacted by the operations of the reservoir, and provide a reasonable estimate of the location and amount of land that would be required for mitigation in Region D. The result of a proper analysis would make it clear that the removal of the productive value of this timberland, which lies in close proximity to the timber markets, would have very significant impacts on the timber industry in Northeast Texas and Region D. TWDB would then have the information it needs to resolve the issue before it, which would include the impacts the Marvin Nichols Water Management Strategy would have on the agricultural resources of Region D.

The fact that there are potentially other hardwood supplies located in distant areas of the State of Texas, as referenced in the Region C Report, has no relevance to the impacts to Region D's and Northeast Texas' timber industry. The key factor is the proximity of the hardwood supplies to the location of the paper mills and hardwood sawmills. The impacts of loss of the hardwoods will be on these mills. The existence of other hardwoods, such as those located in Southeast Texas, is not a viable replacement given the transportation costs.

The paper mills in our area utilize a mixture of hardwood and pine to manufacture their products. It is essential that hardwood supplies be a component of this manufacturing process in order to produce the type of paper products produced by these paper mills. The hardwood sawmills use only hardwood for the production of their products. The very reason these mills are located where they are is due to the location of the hardwood supplies. If these hardwood timber lands are inundated, their productive value would be lost forever, as will all production value of hardwood timberlands lost by mitigation. To jeopardize the availability and affordable cost of the raw material supplies of hardwood timber would imperil the ability of these mills to remain viable in the regional, national and international markets in which they operate.

These hardwood supplies are not only threatened by the loss of timber through inundation of the Reservoir and required mitigation, but also by the loss of hardwood supplies due to the operation of the Reservoir. According to the Response to Region C's Analysis and Quantification of the Impacts of Marvin Nichols Reservoir Water Management Strategy on Natural Resources filed with this Report, Marvin Nichols Reservoir "would also result in a massive reduction in flows remaining in the river downstream of the proposed reservoir project which would result in significant, likely catastrophic, harm to an even larger bottomland hardwood forest area." (Page 1)

The Region C report failed to analyze or quantify these impacts, or to provide a reasonable basis for TWDB to do so.

The clearest example of the failure of the Region C Report to address agricultural impacts is the complete lack of assessment of the impacts of the mitigation lands that will be required for the proposed Marvin Nichols Reservoir. Region C limits any significant discussion in its report to the lands inundated by the proposed Reservoir. The Report does mention in its discussion that farming and timber production on mitigated lands will probably be impossible (Section 4, Page 24), but does not give TWDB any quantitative reporting or analysis of the impacts this loss of farmland and timberland would have on the agricultural resources of Region D, and of the State, as required by the Interim Order and TWDB rules.

Like the lands that are inundated, the loss of the farmland and timberland set aside for mitigation would be lost from production forever. This would create even greater loss of hardwood supplies in close proximity to the market places of Northeast Texas and Region D, further crippling the agricultural/timber economy of the area. The methodology and amount of mitigation which would be required as set forth in the Region C Report are extremely inaccurate and misleading and will be discussed in greater detail by a separate study submitted with this response.

Table 9 of the Region C Report, regarding the estimated impact of Marvin Nichols Reservoir on Timber Harvest Values (page 22), is also laden with errors and inaccurate assumptions. The estimated stumpage value for the Marvin Nichols area, using Region C's figures, would be $423,000 annually, not $423 as contained in the table. The 8.2% percentage used in the table is also inaccurate and misleading. As can be seen from the table, 57% of the total timber production from the 3 counties listed is hardwood production. The vast majority of this hardwood production is derived from the Sulphur River Basin, where hardwoods thrive, and where the proposed Marvin Nichols Reservoir would be located. Using the total acreage of the timberland in the counties involved, much of which does not produce hardwood, results in an underestimation of the impacts that Marvin Nichols Reservoir would have on agricultural/timber production of the area. It is apparent from Table 9, despite its inaccurate and misleading components, that a full 18% of the total hardwood volume harvested from Region D is from the 3 county area of Franklin, Red River and Titus County, the counties where Marvin Nichols Reservoir would be located. In addition, pursuant to the Texas A&M Forest Service Report cited in the Region C Report, 24% of all hardwood saw logs produced in Region D in 2013 came from Franklin, Red River, and Titus Counties.[1] Since some of the land in Region D is outside the supply zones of the hardwood mills in the area, the impact of inundating so much land within the mill's supply zones would be even more significant. Again, these figures reflect only lands inundated and not the additional impacts and loss of production resulting from required mitigation.

It should be further noted that the prices used to compile stumpage value of the harvest were derived from 2013 prices. Hardwood prices in Northeast Texas have risen 50% - 60% in 2014, so a more accurate number, even using the misleading data contained in the Region C Report, will be substantially greater in 2014. This represents annual losses from a renewable resource. Region C's figures also do not include the economic value to the Northeast Texas and Region D areas from logging and transportation of hardwood timber which are certainly an additional value to the Northeast Texas and Region D areas, nor does it include any enhanced valuation from the manufacturing and production of paper supplies and lumber supplies that result from this harvesting of timber. The Harvest Trends 2013 Report reflects that delivered prices are more than double the stumpage prices.[2]

In addition, the Region C Report is apparently basing its analysis and reporting on a different concept of the Reservoir than the one that is listed in the 2011 Region C Plan (see page 11 of the Report). While Region C apparently sees no problem with making this analysis based on a different concept, it reverses its opinion with respect to previous analysis done regarding impacts of Marvin Nichols Reservoir to the timber and agricultural industries of Northeast Texas

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[1] Texas A&M Forest Service. Harvest Trends 2013. Texas A&M Forest Service. Sept. 2014 Table 2

[2] Texas A&M Forest Service. Harvest Trends 2013. Texas A&M Forest Service. Sept. 2014 Figure 2

and Region D. The report states "because these studies analyze a different project, they are not considered to be relevant for the current analysis. " (See Report at pages 17-18). It is not consistent for Region C to base its current analysis and reporting on a different concept of the Reservoir while ignoring useful previous work based on that concept.

Prior studies are relevant. Region C should not be able to state that prior studies are no longer relevant. Much of the footprint of the current proposal for the reservoir is in the same location as the prior proposals. As set forth in the Region D Plan and prior briefs submitted to this Board, the independent study of this issue (one not paid for either by the entities seeking to build this reservoir or the opponents of the Reservoir) was done by the Texas Forest Service. "The Texas Forest Service Study estimated forest industry losses based on three (3) separate mitigation options. The low end impacts where estimated to be an annual reduction of $51.18 million output, $21.89 million value-added, 417 jobs and $12.93 million labor income. The high end impacts were estimated to be an annual loss of $163.91 million industry output, $70.10 million value-added, 1334 jobs and $41.4 million labor income."[3] These studies and others identify the important impacts, and provide quantification and analysis of those impacts that should have been used by Region C in doing its work under the Interim Order.

In summary, the Report submitted by Region C does not satisfy the Interim Order, the TWDB rules in effect at the time of the original approval, or the rules currently in effect. That Order and those rules clearly require Region C to do much more to conduct an analysis and quantification of the impacts of Marvin Nichols Reservoir on the agricultural resources of Region D and the State than is presented in Region C's report.

ISSUE #2

The Region C report does not satisfy the requirement that Region C show that the inclusion of Marvin Nichols Reservoir in the Region C Regional Water Plan is consistent with the long-term protection of the State's agricultural resources pursuant TWDB rules and Section 16.053 Texas Water Code.

TWDB rules and the Interim Order require the analysis and quantification of impacts because its rules and Texas law require the Board to determine whether a given water management strategy, such as the Marvin Nichols Reservoir, can be developed in a way that is consistent with other significant needs of the State, including a healthy agricultural sector. That determination is required by TWDB's prior rules at 357.14(2)(C) and the current rules at 357.41.

It is the position of Region D that because Region C did not provide the analysis and other information required by the rules, the Board cannot make the consistence determination required by Texas law. Therefore, the Board cannot now approve the Region C plan.

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[3] 2011 Region D Water Plan §7.6.2

The Board needs to make it clear that no region can take shortcuts in the planning process or take any steps to downplay the impacts of a strategy, especially when doing so will have such significant impacts outside that region.

Expert Analysis and Opinion Concerning "Analysis and Quantification of the Impacts of the Marvin Nichols Reservoir Management Strategy on the Agricultural and Natural Resources of Region D and the State."(Hereinafter the 'Report')

By: Sharon Mattox, PhD, JD
December 16, 2014

I. Introduction

I was asked to provide my expert opinion on the following question:

Is the quantification of impacts contained in the Report reasonable?

This question is important because without a reasonable quantification of impacts that will result from the MNR Strategy it is not possible to translate accurately the physical impacts to service losses to natural resources and agricultural resources in Region D. My conclusion is that the Report fails to provide a reasonable quantification of impacts.

The Texas Water Development Board (TWDB) has directed Region C "to conduct an analysis and quantification of the impacts of the Marvin Nichols Reservoir Management Strategy [(MNR Strategy)] on the agriculture and natural resources of Region D and the State. . . ." The Report limits its assessment of impacts to natural and agricultural resources on the area of inundation, ignoring secondary impacts and treating impacts to waters of the United States and the attendant requirement for mitigation separately and without any grounding or reasonable explanation. Mitigation is an integral part of the MNR Strategy and the impacts of the MNR Strategy on Region D and the State can be neither analyzed nor quantified without considering the required mitigation. The reservoir cannot be constructed, and the hoped-for benefits cannot be secured, without significant mitigation as required under the Clean Water Act. Although the Report states that mitigation "may increase the impacts to agriculture," it says no more. Report at 25. Simply recognizing a potential impact is neither an analysis of nor a quantification of that impact.

On its face, the Report underestimates jurisdictional waters by failing to make any quantification of streams and excluding likely jurisdictional wetlands.

That error is compounded when the underestimated acreage is used to project the land that will be needed for mitigation, mitigation that will necessarily be located in Region D. The underestimated jurisdictional area is simply multiplied by an arbitrary factor of two that bears no relationship to the current regulatory framework for mitigation. Critically, the Report contains no consideration of a truly major change in the way mitigation is determined for projects such as the MNR Strategy. On April 10, 2008 the U.S. Army Corps of Engineers (USACE) and the USEPA published their final rule, "Compensatory Mitigation for Losses of Aquatic Resources," better known as the "2008 Mitigation Rule." The policies and procedures laid out in the 2008 Mitigation Rule render it improper and utterly illogical to conduct an analysis of a future project based solely on historical information (even if Region C had gathered accurate and relevant historical data). Under well-developed tools and practices stemming from the 2008 Mitigation Rule, losses of functions and values are the emphasis and simple ratios are not the touchstone. If a ratio is used, that ratio should be in the range of 3:1 to 10:1. The quantification is so erroneous as to be unreasonable because it drastically underestimates the lands that will be needed as mitigation and then uses a baseless multiplier. As a result, the impacts to Region D are underestimated. Vastly underestimated impacts are worthless as a basis for any meaningful analysis.

Further, the Report is purely an adoption, with very limited repackaging, of portions of an earlier USACE report that was designed to make a *qualitative* comparison of projects in the Sulphur River Basin and, without additional analysis, does not properly form the basis for a *quantitative* analysis of impacts on resources in Region D.

As a result of these flaws, neither the Report's estimates of impacted waters nor the amount of required mitigation, is supported by the data. Simply put, the Report fails to provide a quantitative backbone so that impacts to natural resources and agricultural resources of Region D and the State can be determined.

II. The 2008 Mitigation Rule Shifts the Focus to Functions and Values of the Waters Lost and Resulted in the Development of Tools for Estimating Mitigation Requirements.

When the USACE and the USEPA published the final 2008 Mitigation Rule it was the culmination of a major stage in the evolution of the mitigation landscape from the mid-1970's until the adoption of the rule. The Rule represented a true sea-change in the way the federal regulatory process handles the mitigation process. The 2008 Mitigation Rule is really the first formal codification of a requirement for a quantitative analysis of the functions and values (chemical, physical, and biological) of the waters of the US taken by a project, and of the ecological lift contained in the mitigation proposed for that project under the federal Clean Water Act (CWA). The Report recognizes that mitigation of impacts occurs by ". . . improving the ecological functions of other land." Report at p. 24.

While the 2008 Rule is clearly critical to any analysis of the amount of mitigation required, it is also important for another reason. Over the more than six years since the adoption of the rule, methods have developed to allow the quantitative assessment of impacts and mitigation. While it may be justified to defer full application of those methods until a project is nearer the permitting process than the Marvin Nichols reservoir is at this time,[1] they could be utilized in a simple form to produce

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[1] The 2008 Mitigation Rule would be applied in detail in the permitting process to develop the mitigation for the various types of impacts that result from the MNR Strategy and as such is the backdrop for making early estimations of the nature of the impacts and attendant need for mitigation. The Mitigation Plan required for the permit would necessitate vastly greater information than is appropriate at an early stage including: an analysis of the objectives of the mitigation (resource type and amount to be provided, method of compensation, and how the compensation will address the needs of the watershed), a description of the site selection process for the mitigation, the mitigation site protection instrument, baseline ecological information on both the mitigation site and the impact site, a determination of credits, a mitigation work plan, a maintenance plan, performance standards to determine if the mitigation is meeting the objectives, monitoring requirements to determine if the project is on track to meet the performance standards and if adaptive management is needed, a long term management plan, an adaptive management plan, financial assurances, and other information requested by the District Engineer as needed to determine the appropriateness, feasibility, and practicality of the mitigation project.

quantitative estimates rather than the assumption-based estimates in the Report. Due diligence periods are often only 60 to 90 days in length and reasonable quantification of impacts can be accomplished, so a preliminary quantification of the impacts of the MNR Strategy was certainly doable, even within the almost three month period directed by the TWDB. When one considers that this issue of the impact of the mitigation on Region D is not a new issue in this interregional conflict, the failure to employ current accepted and available analytical tools becomes even less justifiable.

An example may be helpful. The 2008 Mitigation Rule places a strong focus on mitigation for streams and riparian habitat, an issue that is ignored by the Report. An estimate of the nature and extent of this type of impact is critical to a determination of the impacts of the MNR Strategy and of the mitigation that will be necessary. Preliminary estimates of the number of linear feet of jurisdictional tributaries can be made using aerial photographs and USGS Quadrangle Maps. If even a relatively few typical stream segments were assessed using TXRAM, a field method used in the Fort Worth District of the USACE, an actual quantitative assessment of stream mitigation required could have been made.

This type of information concerning mitigation for project impacts is also required at an earlier stage than before the 2008 Rule. Now a mitigation statement is required with the initial permit application to the USACE.

The 2008 Mitigation Rule also affects the analysis of the extent of mitigation required in numerous other ways as is discussed below.

After more than six years, the 2008 Rule is phased in and fully applicable to future projects such as the MNR Strategy. None of the historical examples given in the Report are, therefore, relevant to a determination of future mitigation requirements.

III. The Report underestimates the number of acres that will have status as waters of the US.

The Report estimates there are 23,530 acres of waters of the US, other than non-stream open waters, which will be taken by the MNR Strategy. No basis is provided for this number, nor is a basis readily discernible by an examination of the Report. *See* Report at 25.

Initially, the Report estimates impacts only for the inundation area of the Reservoir itself – that is, the footprint of reservoir. The Report fails to estimate jurisdictional areas for the 2,751 acres of "ancillary facilities" recognized in the Region C Plan. The ancillary facilities must be part of the USACE permit, which must assess the complete project. In addition, the Report fails to include any estimates for lands used during the construction process. The estimate also fails to include any estimate of critical secondary impacts to waters of the US, which will also require mitigation if losses of waters of the US result. One example of a secondary impact that would likely have a material impact is wetlands adjacent to the Sulphur River downstream of the proposed dam that will no longer be inundated by frequent flood events.

The 23,530 acre estimate of jurisdictional areas is not consistent even with the data on land coverage types provided in Table 2[2] of the Report. Based on my review of the EEIR-SRBCA, I would include the estimated acreages for bottomland hardwoods, forested wetlands, herbaceous wetlands, open water[3], and shrub wetland. In addition other habitat types identified in Appendix G as subtypes under Grassland/Old Field, Shrubland, and Upland Forests that are not broken out but likely qualify as waters of the U.S., include Pineywoods: Bottomland Wet Prairie, Pineywoods: Small Stream and Riparian Wet Prairie, Pineywoods: Small Stream and Riparian Evergreen Successional Shrubland, and Pineywoods: Small Stream and Riparian Temporarily Flooded Mixed Forest.

The total of only the habitat types listed in Table 2 of the Report is 35, 411 acres, which I believe to be a more realistic minimum estimate of the number of acres that require mitigation, if one is limited to the numerical data provided in the Report. This number, however, still excludes the additional habitat types given above, which will also contain jurisdictional areas. It further excludes the small, but identifiable wetlands, streams, and other waters that are certainly present in other habitat categories. Although no data on these omitted waters is included, it would certainly increase the realistic minimum number of jurisdictional waters of the US. For planning purposes, an estimate of at least 40,000 jurisdictional acres is reasonable. To deal with uncertainty in early estimates I often use a range of potential jurisdictional acres to aid in understanding possible impacts and costs.

IV. The Report underestimates the number of acres that will be required for mitigation.

The failure to accurately estimate the amount of acreage for which mitigation is required leads inevitably to a more severe underestimate of lands needed for mitigation. This is true because in virtually every case, more than one acre of land is required to compensate for the functions and values associated with the destruction of one acre of jurisdictional waters.

A. The Report fails to quantify impacts to streams.

The Report simply asserts, without further basis, that required mitigation is estimated as twice the acreage of waters of the US, other than non-stream open waters, which totals 43,060 acres.

While apparently recognizing that the impacts to streams will require mitigation, the Report fails to quantify stream impacts. Streams are a major focus of the 2008 Rule. The functions and values for streams are calculated on a linear basis. A desk top analysis could have been conducted to estimate the linear feet of tributaries that will be impacted by the project. As mentioned earlier, even limited quantitative evaluation of those streams would provide the needed quantitative picture of mitigation required.

The acreage approach to stream mitigation seriously underestimates the total area required for stream mitigation. Creation of new tributaries is often very difficult or even impossible as a result of limited

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[2] Note that this Table is based on secondary rather than primary sources.

[3] This number presumably includes some streams, the river, and herbaceous flatwoods ponds that likely would require mitigation.

watershed to maintain newly created streams. Thus restoration or enhancement, often combined with preservation, is more usually employed for mitigation. The number of acres of land required to mitigate for a given length of stream is much greater than the actual acreage that is included within the bed and banks for the stream. Thus, a hypothetical stream segment 1000 feet in length and 30 feet wide physically occupies a little over ¾ acre. It will take many times that much land to permanently protect the stream functions and values of that 1000 feet of stream, since a functional stream must meander, and much of its value is in its connection to the riparian area surrounding it. Moreover, if because of the difficulties involved in stream mitigation a mitigation plan proposes to use "out of kind" mitigation to compensate for functions and values, the ratios required are greater.

B. Preserving land as viable mitigation requires that economically-useful lands be taken out of production.

Compensation for impacts by preservation, a common historical approach to mitigation of forested wetlands, and one permit applicants often favor for stream mitigation, is difficult under the 2008 Rule and will certainly require more than 2:1. Indeed, when bottomland hardwoods or other forested wetlands are involved, a more typical preservation ratio would be **10:1**. Preservation is allowed under the 2008 Mitigation Rule only when five criteria are met. See 33 CFR 332.3 (h)(1). One of those criteria is that the preserved lands be under threat of destruction or adverse modification.

Simple preservation of existing habitat, even at 2:1, does not result in no net loss of functions and values, the ecological lift is what counts. Land that is not at risk of use (e.g., sand and gravel, timbering, agriculture) or development, which is simply preserved, produces very little ecological lift. If a project destroys 100 acres of bottomland hardwood wetlands, and proposes to mitigate by preserving 200 acres of nearby bottomland hardwoods, there is still a decrease in total bottomland hardwoods in the region of 100 acres. So the land that is of value for preservation is also that land with other economic uses, whether for agriculture or development.

Thus, the 2008 Rule provides that when preservation is used for compensatory mitigation, it shall be done in conjunction with restoration, establishment, and/or enhancement activities. While this requirement can be waived by the District Engineer in certain circumstances, the rule requires that "compensation ratios shall be higher." 33 CFR 332.3 (h)(2).

C. Historic experiences cannot predict future mitigation requirements.

None of the historic examples presented in the Report are a fair surrogate for the MNR Strategy, although even that data recognizes that mitigation requirements were trending upward. An important limitation of the data presented in the Report is that it contains absolutely no information about the acreage of jurisdictional waters that may have been present within the inundation pool of each reservoir project. It merely compares mitigation to the total surface area of the reservoir. So, to the extent that the information is supposed to support the conclusion that a 2:1 ratio of jurisdictional waters to mitigation acreage will be required for the MNR Strategy, it relies on a misplaced apples to oranges comparison. This is not reasonable even without consideration of the 2008 Rule.

Region C Assertion of Ratio of Reservoir
Surface Area (Not Jurisdictional Waters) to Mitigation Acreage

	Pre -1990	
1986-1989	3 Projects	No Mitigation
1987	1 Project	0.31 to 1
1989	1 Project	1.0 to 1.0
	1990-1997	
1990	1 Project	0.31 to 1.0
1991	1 Project	1.85 to 1.0
1993	1 Project	No Mitigation
1993	1 Project	1.04 to 1.0
1997	1 Project	1.54 to 1.0

Moreover, the pattern of mitigation history from the 1970's to the present day has been one of increasing complexity of ultimate calculation and ever increasing ratios, when the ratio method of conceptualizing mitigation is used.[4] As a result in over 30 years of advising clients in the development of projects about the need for mitigation I have learned that at an early stage of a project in particular, it is not wise to ignore realistic indicators and be blindly optimistic about the amount of mitigation that will be required or what it will cost.

D. An Analysis of Other Reservoir Projects and Mitigation.

There is one historic example of reservoir development within the Sulphur River basin that is an instructive point of reference concerning what mitigation may be required for the MNR Strategy, although it pre-dates the 2008 Mitigation Rule. That example is Lake Jim Chapman, previously known as Cooper Lake. Cooper Lake was authorized by Congress in 1955, in a project that included the lake and an associated system of channels and levees. Much of the levee and channel work was done between 1955 and 1967. In 1971 the USACE received funding to begin work on the dam. The project was stopped to address requirements under the National Environmental Policy Act (NEPA). Construction finally began in 1986. The need for mitigation was a prime factor in the lengthy NEPA and related-litigation process. The Final Environmental Impact Statement (FEIS) for the project was released in 1977, but a court halted the project in December 1977. The court found the FEIS legally flawed for its lack of a mitigation plan for loses of fish and wildlife habitat, among other issues. The USACE prepared a Supplemental EIS, which was released in 1981 and included a mitigation plan.

The plan included the preservation and management of approximately 10,000 acres of reservoir perimeter lands, and the preservation and management of the approximately 25,500 acres White Oak Wildlife Management Area. In July 1981 the USACE asked the Court to dissolve the injunction against the project. The district court responded with a memorandum opinion over 100 pages in length, describing detailed inadequacies in the EIS. In March 1983 the district issued a second injunction against

[4] Under the 2008 Rule, quantitative methods are used for measuring impacts and mitigation lift. The measured chemical, physical, and biological values are generally expressed as Functional Capacity Units or FCUs.

the project. In July 2004, after the mitigation plan had been submitted to Congress for authorization, the Fifth Circuit Court of Appeals applied the now well established "hard look" test for judicial review of the USACE 1981 SEIS and dissolved the injunction. *Texas Committee on Natural Resources v. Marsh*, 736 F.2d 262 (1984). Nevertheless, even by the earliest approximations of calculating mitigation, the mitigation implemented for Jim Chapman was nearly 2:1 using the inundation pool area. When a 2:1 ratio is applied to the 66,103 acres of surface area for the MNR Strategy given in Table 2 of the Report, the estimate of mitigation required for MNR is 132,206 acres.

While it is true that the laws that led to the mitigation plan for Lake Jim Chapman are different than those laws that will drive the mitigation plan for the MNR Strategy, the 2008 Mitigation Rule, the 404(b)(1) guidelines, and the other policies and guidance will certainly cause the aquatic values to be used in the development of the MNR Strategy to be valued at least that greatly. Even by the standards of the early 1980's, when a hard look was taken at the natural resources impacted at Lake Jim Chapman, significant mitigation was required and it was placed in Region D.

As the Report notes there are other reservoirs that are further along the USACE permitting process that leads to construction that may be relevant to an analysis of MNR Strategy mitigation. Two of these reservoirs are planned for Fannin County, Texas in the Sulphur River Basin, the Lower Bois d'Arc Reservoir and Lake Ralph Hall. Lower Bois d'Arc is undergoing analysis by the Tulsa District of the Corps. Scoping began in 2009. Preparation of an EIS has been proceeding since that time. The reservoir will impact about 6,000 acres of wetlands, largely forested, and approximately 125 miles of streams. The EIS is still in the pre-draft stage, although a draft EIS is expected to be available in 3 to 4 months, and it will contain a formal mitigation plan consistent with the 2008 Rule. (Personal communication Jamie Highslope, USACE Project Manager). Information about the mitigation plan is not publically available from the USACE until the release of the DEIS. That mitigation plan is being prepared by Freese and Nichols. *Id.* The mitigation plan is likely considerably advanced, and yet it was not used to support the suggested 2:1 ratio in the Report, a report also drafted by Freese and Nichols.

Lake Ralph Hall has also had a mitigation plan prepared as part of the permit process but that mitigation plan has apparently been rejected by the Fort Worth District of the USACE, at least partially because it did not adequately compensate for impacts to streams. Water Rights Hearing, SOAH Docket No. 582-12-5332, Transcript Vol. 2, 518-1;519-12 and Vol. 5, 1036:1319. This serves as a clear example that the federal government will push back against inadequate mitigation plans. Lake Ralph Hall is currently undergoing the preparation of a draft EIS, which is scheduled for release sometime in the second half of 2015. (personal communication Chandler Peter, Fort Worth District USACE Technical specialist).

The Lake Columbia Regional Water Supply Reservoir is proposed to be constructed in the Neches River Basin in Cherokee and Smith Counties. It is undergoing analysis by the Fort Worth District of the USACE. The Lake is proposed to have a surface area of 10,133 acres; a total of 5,746.5 acres of waters of the U.S. were delineated (56.71% of the total surface area), including 589,248 linear feet of streams and channels. The mitigation includes 3,500 acres on-site (timber purchased and left standing); 3,750 acres near-site and 6,000 acres off-site, for a total of 13,250 acres. This exceeds the 2:1 ratio used in the Report. Indeed the mitigation plan notes that this plan depends on the 3,500 acres of off-site preserved land proposed for preservation being given greater credit than is usual because the preserved land is proposed to be adjacent to the Big Thicket preserve. The plan seeks a variance from the usual 10:1 ratio and proposes that a 5:1 ratio should be used. If a 10:1 ratio is employed the mitigation lands required by the plan would increase to 16,750 acres or approximately 3:1. There is no indication that the USACE has approved this mitigation proposal. The project is currently on hold at the Fort Worth USACE District office. (personal communication Chandler Peter).

The shift away from simple ratios to modelling and Functional Capacity Units (FCUs) makes a comparison of the 2:1 ratio suggested in the Report with recent mitigation projects rather difficult. What is clear, however, is that the 2:1 ratio of jurisdictional acreage cannot be directly compared to the surface acreage to mitigation data shown in the Report and is not derived from any framework associated with the 2008 Mitigation Rule. Further, the reasonable implications of the recent projects are that a 2:1 ratio is far too optimistic, particularly when impacts to streams and bottomland hard woods must be figured in. Mitigation for bottomland hardwoods had reached high multiples for preservation before the 2008 Rule, which further disfavors preservation.

V. The Mitigation Will Be Located in Region D

Importantly, even historically, all required mitigation occurred in the watershed of the reservoir. According to Table 10 of the Report in each occasion mitigation was located either "downstream" or "next to" the reservoir. Further, given that the watershed approach is a central focus of the 2008 rule, all mitigation required for the MNR Strategy must certainly occur within Region D. The Report, however, is silent on the location of the required mitigation. Clearly it is not possible to assess the impact of the MNR Strategy on Region D without explicit recognition that both the reservoir and the mitigation will be located in Region D.

The impacts of the MNR Strategy on the natural and agricultural resources can only be understood when the mitigation is understood. The reservoir permit application must satisfy the legally binding 404(b)(1) guidelines. These guidelines require a process of avoidance of impacts, minimization of impacts, and compensation for impacts, or mitigation. Since the adoption of the 2008 Rule, mitigation has increasingly been thought of less as acres and more as FCUs. This is true not only for mitigation banks but also for permitee responsible mitigation. The focus on FCUs means that the USACE is able to look at what reduction in values – physical, chemical, and biological – will result from the construction of a project and then also measure the anticipated ecological lift in the proposed mitigation using the same units. This allows a fair comparison of impacts and compensation during the regulatory process.

The Clean Water Act, under section 404(c), gives EPA the ability to veto a section 404 permit when it determines that there is an unacceptable adverse effect on municipal water supplies, shellfish beds, fishery areas, wildlife or recreational areas. This veto process has been used sparingly over the decades.

Only 13 final vetoes have been issued; four of those have involved water supply reservoirs and inadequate mitigation has been a key reason for each veto.[5]

VI. The Quantitative Data contained in the Report is Not Sufficient in Light of Available Resources.

Preliminary assessments of the nature and likely magnitude of environmental issues are a recognized part of the due diligence process in private real estate transactions. Particularly for large real estate transactions it has been common for the past several years to perform an accelerated 'desk-top reconnaissance' to estimate the nature and extent of waters of the US. While such an abbreviated analysis and quantification cannot form the basis of a jurisdictional determination for permitting purposes, it can provide a good indication of the potential jurisdictional waters on the property analyzed. This analysis is done because the cost of permitting and mitigation can have a material impact on the feasibility of the real estate transaction. This type of analysis was not done for the Report and could have provided a more realistic picture of the impacts on Region D.

Instead, Region C provided a restatement of a previous report made for a different purpose without appropriate acknowledgment of its limitations, or refinement or supplementation of its data. All of the "quantitative" information on natural resources to be found in the Report is taken from the *Environmental Evaluation Interim Report – Sulphur River Basin – Comparative Assessment* ("EEIR-SRBCA").[6] The purpose of the EEIR-SRBCA was to develop preliminary evaluations to compare various potential projects within the Sulphur River Basin. EEIR-SRBCA at p.1-1. The result of the study was a structured comparison of the various projects assessed in that report. *See* EEIR-SRBCA p. 1-1, 2-8, 3-8 to 3-9, 4-4, 5-1, and 6-1. So long as the same methodology was used for every project to assess the relative magnitude of the impacts, a comparative assessment can be done. The importance of the accuracy or precision of the underlying estimates is reduced in that situation. The USACE does not say that the information in the EEIR-SRBCA can be used as a basis for either a jurisdictional determination or to determine mitigation. *See* p. 2-7 ("areas should not be considered jurisdictional until a formal jurisdictional determination and delineation has been completed"). Indeed, the fact that the EEIR-SRBCA does not discuss the 2008 Mitigation Rule clearly establishes that such was not the intent of the USACE.

Moreover, the language used in the Report tends to inflate the use made of the data in the EEIR-SRBCA.[7] For example, the USACE concluded that since "all of the reservoir sites evaluated fell within the area surveyed in the Ecological Classification System project. . . . (the data from that project) was considered

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[5] In the Lake Alma veto the loss of 1,350 acres of bottomland hardwoods was sufficiently adverse to warrant an EPA veto. Approximately 10,156 acres of bottomland hardwoods are present in the inundation footprint of the MNR.

[6] Freese and Nichols, Inc., U.S. Army Corps of Engineers, *Environmental Evaluation Interim Report – Sulphur River Basin – Comparative Assessment* (2013).

[7] The Report does not contain any independent analysis of the data taken from the EEIR-SRBCA. This can clearly be seen by a comparison of the description of the work on page 10 of the Report with the excerpt from the EEIR-SRBCA included as Appendix G to the report. The Report relies only on the EEIR-SRBCA, a secondary source, and not the underlying data.

to be the most recent, readily available data collected for all alternative reservoir sites that would allow for a balanced comparison." Report at G-2. The Report concludes that the EEIR-SRBCA data– the secondary source – is "the most recent, readily available data on land cover types in the Sulphur River Basin." Report at 10. Moreover, the Report recognizes that the reservoir project in the EEIR-SRBCA is at least somewhat different from the project proposed by Region C. Report at 11. Further, in the USACE discussion of its methodology, the agency notes that it performed an "additional re-classification" utilizing USFWS NWI data. Report at G-2. In the Report the NWI data were used "to further refine the classifications." Report at 10.

It is true that the MNR Strategy remains in the planning stage, and that more detailed assessments of at least "the quality of wildlife habitat" will be part of the permitting of the Marvin Nichols Reservoir. Report at 11. But the mere potential that additional work will be done in the permitting process does not eliminate the reality that is reasonable and feasible to conduct a meaningful quantitative analysis as a basis for the resolution of an interregional conflict right now. Region C was directed to conduct both an analysis and quantification but did not utilize readily available resources and tools to comply with the Board's Order.

VII. Conclusion

Based on the available data and my experience with mitigation plans, the mitigation required for the MNR Strategy will require at least 3 times as much land as the acres of jurisdictional waters, and potentially much more. Any of the reasonable estimates suggest the mitigation land required for the MNR Strategy will exceed 100,000 acres. Thus, the quantification of impacts in the Report is not reasonable.

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Education and Professional Background

- Sharon M. Mattox, PLLC, 2014 – present
- Vinson & Elkins, L.L.P. 1981 – 2013
- University of Texas School of Law, J.D., 1981 (Order of the Coif; Order of the Barristers)
- University of Texas, Ph.D. Botany, 1978
- Emporia State University, B.A. Biology and Chemistry, 1974
- Admitted to practice: Texas, 1981; U.S. Court of Appeals for the Fifth Circuit; U.S. Court of Appeals for the District of Columbia; numerous federal district courts

Representative Experience Involving Mitigation

- Environmental Permit Counsel for various coastal residential, resort, and marina development
- Successfully obtained all environmental permits required for the construction of a $1.5 billion marine terminal for container and cruise ships; this high-profile, controversial project opened its first phase in late 2006; the mitigation package was approved by all state and federal environmental agencies
- Resolved numerous Clean Water Act enforcement actions
- Advised on NEPA and land use issues for a commercial space launch facility.
- Providing strategic permitting counsel for a several thousand acre new community
- Represents the developer of a 15,000-acre development on issues involving endangered species, wetlands, floodplains, archaeology, oil field wastes, and other environmental issues
- Represented the developer of a central Texas surface coal mine
- Represented the City of Houston in litigation brought by the Sierra Club to block the Wallisville Dam Project; the project was ultimately approved by the U.S. Court of Appeals for the Fifth Circuit (*Sierra Club v. Siegler*)
- Counseled clients on NEPA compliance in a wide variety of large projects including highways, airports, levee improvement districts, and marine terminals
- Represented a client in a NEPA case that involved a proposal to dredge a deep water port and build an oil terminal on Pelican Island in Galveston Bay (*Sierra Club v. Marsh*)

- Environmental counsel for numerous pipelines and other energy facilities
- Environmental counsel on various navigation channel construction and improvement projects
- Advice on the re-licensing of the Trans-Alaska Pipeline
- Advice on the expansion of a major airport
- Numerous clients with levee and floodplain issues

Professional Recognition

- *The International Who's Who of Business Lawyers* in environment, 2008 - 2009 and 2011
- *Who's Who Legal*: Texas in environmental law, 2007 and 2008
- *The Legal 500 US: Volume III (Litigation)* in environment, 2007
- *Chambers USA: America's Leading Business Lawyers* in environmental law and litigation, 2005 - 2006, 2008 - 2014
- *The Best Lawyers in America®* in environmental law, 2005 - 2015; in water law, 2011 - 2015
- Recognized in *Texas Super Lawyers*, 2003 - 2005, 2007 - 2011
- "Texas' Top 50 Women Lawyers," *Texas Monthly*, 2003 - 2005

Highlights of Publications and Presentations

- Chair for 25 years of CLE International's Texas Wetlands Conference
- "New Worries for Section 404 Permit Recipients: D.C. Circuit Rules that EPA May Retroactively 'Veto' Permits Already Granted by the Army Corps," V&E Environmental Law Update E-communication, April 25, 2013 (co-author)
- "High Court Leaves Road Wide Open For CWA Citizen Suits," *Law360*, April 12, 2013 (co-author)
- "D.C. District Court Overturns EPA Final Clean Water Act Guidance on Appalachian Surface Coal Mining Operations," V&E Environmental Law Update E-communication, August 6, 2012 (co-author)
- "U.S. Supreme Court to Review Two Controversial Decisions on Clean Water Act Jurisdiction," V&E Environmental Law Update E-communication, July 2, 2012 (co-author)
- Author on numerous environmental articles
- Speaker on land-use regulations and their impact on the use and value of property, toxic torts, expert witnesses, and *Daubert*