

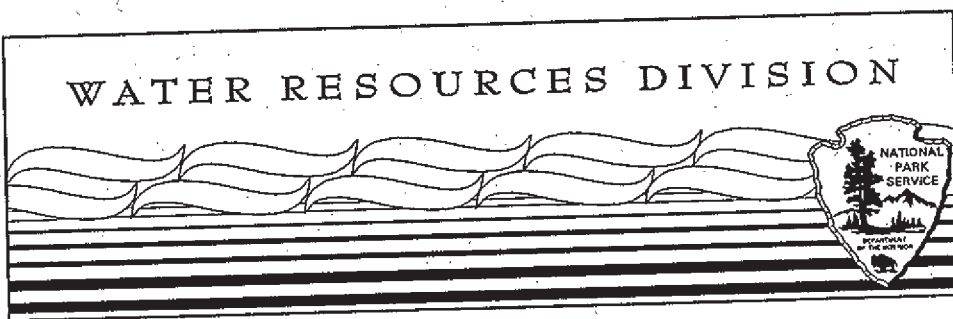
WASHITA BATTLEFIELD NATIONAL HISTORIC SITE,

OKLAHOMA

WATER RESOURCES SCOPING REPORT

John Reber, Mark Flora and Jim Harte

Technical Report NPS/NRWRS/NRTR-99/235



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May 1999

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United States Department of the Interior
National Park Service

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EXECUTIVE SUMMARY

Washita Battlefield National Historic Site is a historic site set aside primarily to interpret an important battle in the struggle between Native Americans and the US Cavalry in the opening of the west. The water-related resources of the site serve not only as important natural components, but are an integral component of the historical context of the site and its cultural landscape. In selecting a winter campsite, Chief Black Kettle of the Southern Cheyenne Tribe and his followers chose a location close to a water supply sufficient for the assembled tribes and their numerous ponies, a site whose riparian zone provided adequate wood for winter fires, and an encampment whose low-lying position and bordering alluvial terraces offered a modicum of protection from the winter winds prevalent on the Great Plains.

This Water Resources Scoping Report is being provided at the request of the National Historic Site to assemble information pertaining to the unit's water resources for use in the development of the National Historic Site's first General Management Plan (GMP). In addition, information pertaining to existing water-resource issues and management concerns is being provided to assist the National Historic Site in the development of their Natural Resources Management Plan which will be completed subsequent to the completion of the GMP.

This current assessment identifies and discusses seven water-related management issues and further provides management with recommended actions to begin to address each of the these concerns. These include:

- lack of adequate water quality monitoring,
- lack of baseline information on aquatic biological resources,
- need to acquire knowledge of ownership and validity of water rights claims,
- need for conducting a riparian zone condition assessment,
- need to survey/initiate exotic plant control,
- follow-up on compliance monitoring of an upstream drilling mud disposal pit facility, and,
- acquiring a more complete knowledge on local mineral rights and development activity.

INTRODUCTION

Washita Battlefield National Historic Site, located in west-central Oklahoma is the site of an 1868 conflict between the U.S. Cavalry and the southern Cheyenne Indians. It was established as a National Historic Site in 1996 to recognize the importance of the Battle of Washita as a nationally significant element of frontier military history and as a symbol of the struggles of the Southern Great Plains tribes to maintain control of their traditional use areas (Public Law 104-333). The site consists of approximately 315 acres centered upon the Washita River, along whose banks was the winter encampment of a band of southern Cheyenne under the leadership of Chief Black Kettle. Early on the morning of November 27, 1868, mounted troopers of the 7th U.S. Cavalry, under the leadership of Lt. Col. G.A. Custer, attacked the encampment from the north, east, and west reportedly killing or capturing 103 men, women, and children (Hoig, 1976).

The major water resource feature of the National Historic Site is the Washita River, though the confluence with Sergeant Major Creek, which was also of historic significance during the battle, is located just downstream of the National Historic Site (Figure 1).

OBJECTIVES

The purpose of a Water Resources Scoping Report is to identify major water resource issues and to provide recommendations for addressing National Park Service management concerns. It is often completed in support of other, ongoing NPS planning efforts such as the development of a unit's General Management Plan (GMP). Initiation of GMP planning activities for Washita Battlefield NHS is scheduled for 1999.

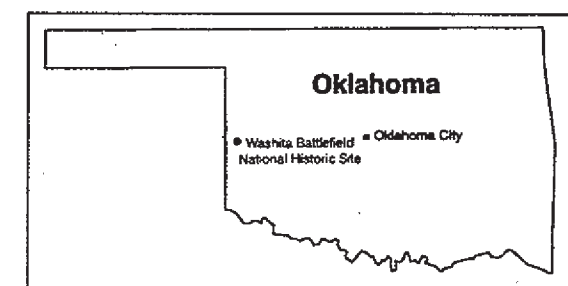
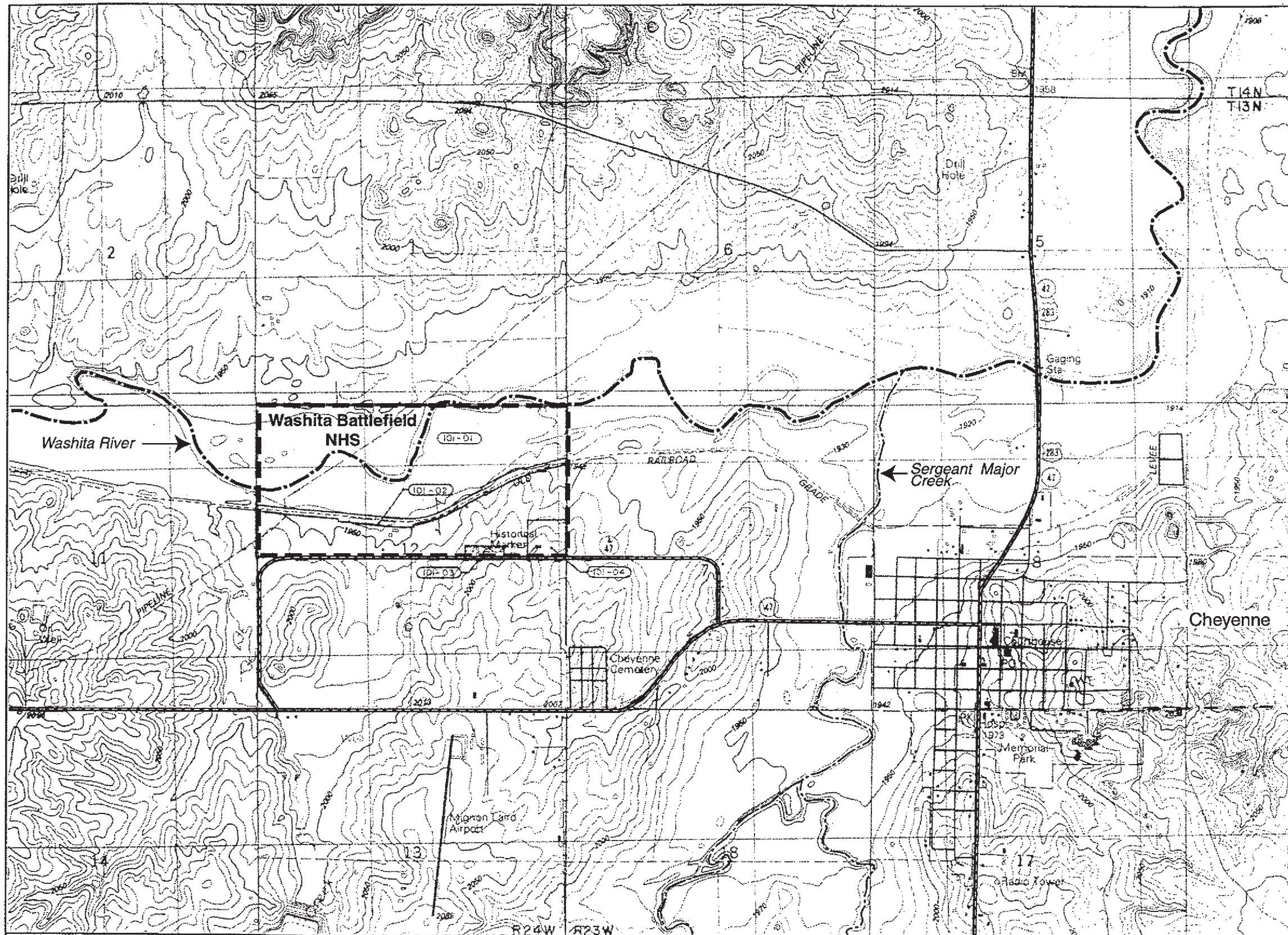
Information contained within this scoping report is derived from many sources, usually including interviews with park management, reviews of existing hydrologic information pertaining to past and present water resource conditions, and meetings with local water resource professionals, state and federal regulators, and public land managers. The authors would like to acknowledge the assistance provided by Washita Battlefield National Historic Site, USDA - Natural Resources Conservation Service (Upper Washita Conservation District), U.S. Geological Survey (Oklahoma District Office), USDA - Forest Service (Black Kettle National Grassland), Oklahoma Water Resources Board, Oklahoma Department of Environmental Quality, Oklahoma Historical Society, the Town of Cheyenne, OK, and the Little Bighorn Battlefield NM in the completion of this water resources scoping report.

HYDROLOGIC ENVIRONMENT

The Washita River, a tributary to the Red River, rises in the high plains of the eastern panhandle of Texas northwest of the intersection of the Roberts, Gray, Hemphill and Wheeler county lines (USGS, 1982). From its source, the river flows in a generally easterly direction approximately 50 miles through sparsely populated areas of the Texas panhandle and west-central Oklahoma before flowing through Washita Battlefield NHS above the confluence of Sergeant Major Creek near the Town of Cheyenne, OK (Figure 2).

Washita Battlefield National Historic Site is located within the Sergeant Major Creek sub-drainage of the Washita Headwaters watershed (USGS Hydrologic Unit 11130301). The Washita Headwaters watershed above the National Historic Site encompasses approximately 750 sq mi, is rural in character, and consists primarily of rangeland (cattle ranching) with a limited amount of irrigated agriculture (wheat, sorghum and conservation grassland) occurring in suitable areas (Figure 2). The climate is semi-arid, and the annual 27 inches of rainfall is poorly distributed (Oklahoma Water Resources Board, 1984). The region is subject to long- and short-term droughts. Historically, flooding and eroded sediment flow along the Washita River was a very serious problem especially during the dust bowl years of the 1930s (USDA, 1963).

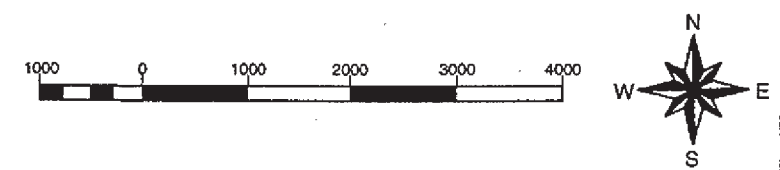
The predominant topography of the region consists of rolling hills, moderate valley slopes, and upland slopes of 2 to 20 percent. Washita Battlefield National Historic Site contains three alluvial terraces, consisting of stream-laid deposits of sand, silt and clay which rise above the active floodplain and upland areas composed of red-bed sandstones, siltstones, mudstones and gypsum of Permian age (Haynes, 1995). In addition, most of the watershed overlies the Anardarko Basin, a region of natural gas exploration and production (Carr and Bergman, 1976).



- LEGEND**
- TRACT BOUNDARY
 - SITE BOUNDARY
 - TRACT NUMBER

Figure 1: Map of Washita Battlefield National Historic Site and Environs

**WASHITA BATTLEFIELD
NATIONAL HISTORIC SITE**
ROGER MILLS COUNTY
OKLAHOMA



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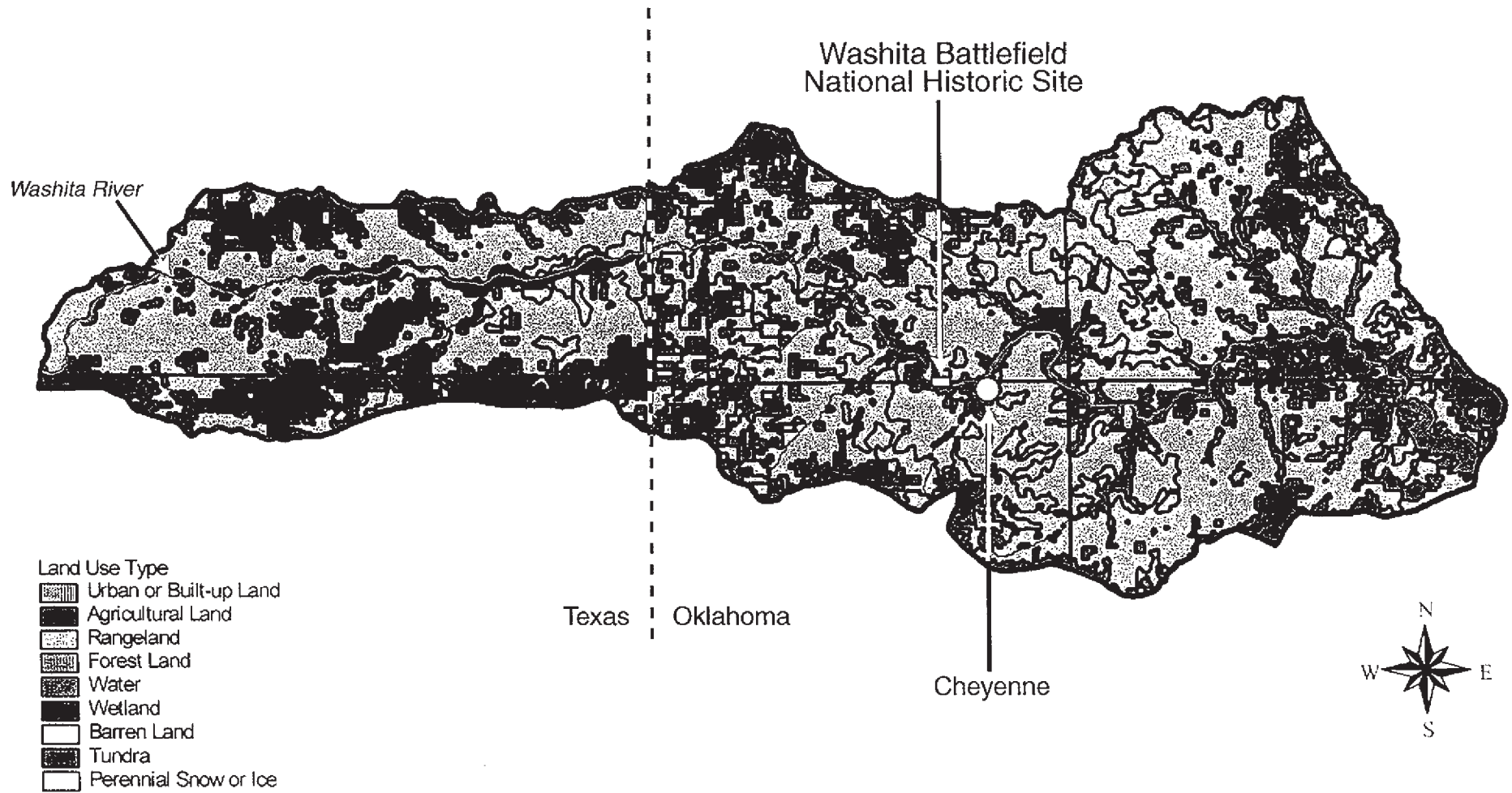


Figure 2: Watershed landuse map of the Washita Headwaters water shed (Hydrologic Unit 11130301). Courtesy of U.S. Geological Survey.

The watershed is unusual in that it contains some of the oldest upstream flood control dams in the nation. There are more than 70 upstream flood control dams, most between 35 and 50 years old, located along the river and its tributaries above Washita Battlefield National Historic Site (Oklahoma Water Resources Board, 1984). Long-term flow records (1937 – present), available from USGS Station 07316500 (Washita River near Cheyenne, OK) located just downstream of the Washita Battlefield indicate that these structures have greatly reduced flooding and significantly modified natural flow patterns on this reach of the Washita River from at least the early 1960s (Figure 3) (Tortorelli and Bergman, 1985).

SIGNIFICANT WATER-RESOURCES ISSUES

Surface Water Quantity

- Altered Flow Conditions

The construction of upstream flood control dams has greatly altered streamflow patterns in the upper Washita River over the past 40 years. Prior to the early 1960s, seasonal flooding was a frequent occurrence along the riverbottom areas, which support much of the existing cropland within the region. The introduction of flood control dams not only reduced flooding, but also created numerous impoundments, which have enhanced domestic and agricultural water supply. In addition, flow from these impoundments, which tend to store water during the wetter seasons, have moderated the intermittent nature of flow in many of the tributary streams.

The local impacts of altered flow conditions upon stream channel morphology, water quality, aquatic habitat, and adjacent riparian zones are largely unknown. Friedman et al. (1998) report a post-impoundment stream channel narrowing of 35% or more for a segment of the Washita River below Foss Reservoir (about 40 miles downstream of the National Historic Site) and also Sandstone Creek, an important tributary to the Washita (whose confluence is less than 10 miles downstream from the National Historic Site). Channel narrowing, as well as elimination of annual bank overflow and drawdown of alluvial groundwater to support expanded riverbottom agricultural activities in flow-regulated areas can significantly alter adjacent riparian vegetation (Johnson, 1998). Over the long-term, these changes can sometimes reduce riparian forest viability and may have reduced the thickets of cottonwood, elm, hackberry and willow that were reported to dominate the floodplains in pre-settlement times (Lees et al., 1997). It is also possible that the retention ponds created by flood control dams may have increased salinity (by increasing evapotranspiration), decreased sediment loading (by serving as sediment traps), and altered aquatic biological communities by serving as refugia during drier periods of the year. Currently, however, site specific data are lacking to assess the indirect impacts of altered flow conditions on the aquatic habitat of the Washita River within the Washita Battlefield National Historic Site.

The Natural Resource Conservation Service (NRCS) in Cheyenne, OK has a planning effort underway regarding future benefits of the Washita River tributary impoundments (including the nearby Sergeant Major watershed), through public meetings, technical analysis, and possible improvements (Greg Allen, NRCS--Cheyenne, OK, personal communication, 1998). While there is an opportunity to change some of the ways that the tributary impoundments function for irrigation, flood control, wildlife conservation, and recreation uses, no discussions to date have indicated any proposals that would substantially change flow regimes in the Washita River near the National Historic Site.

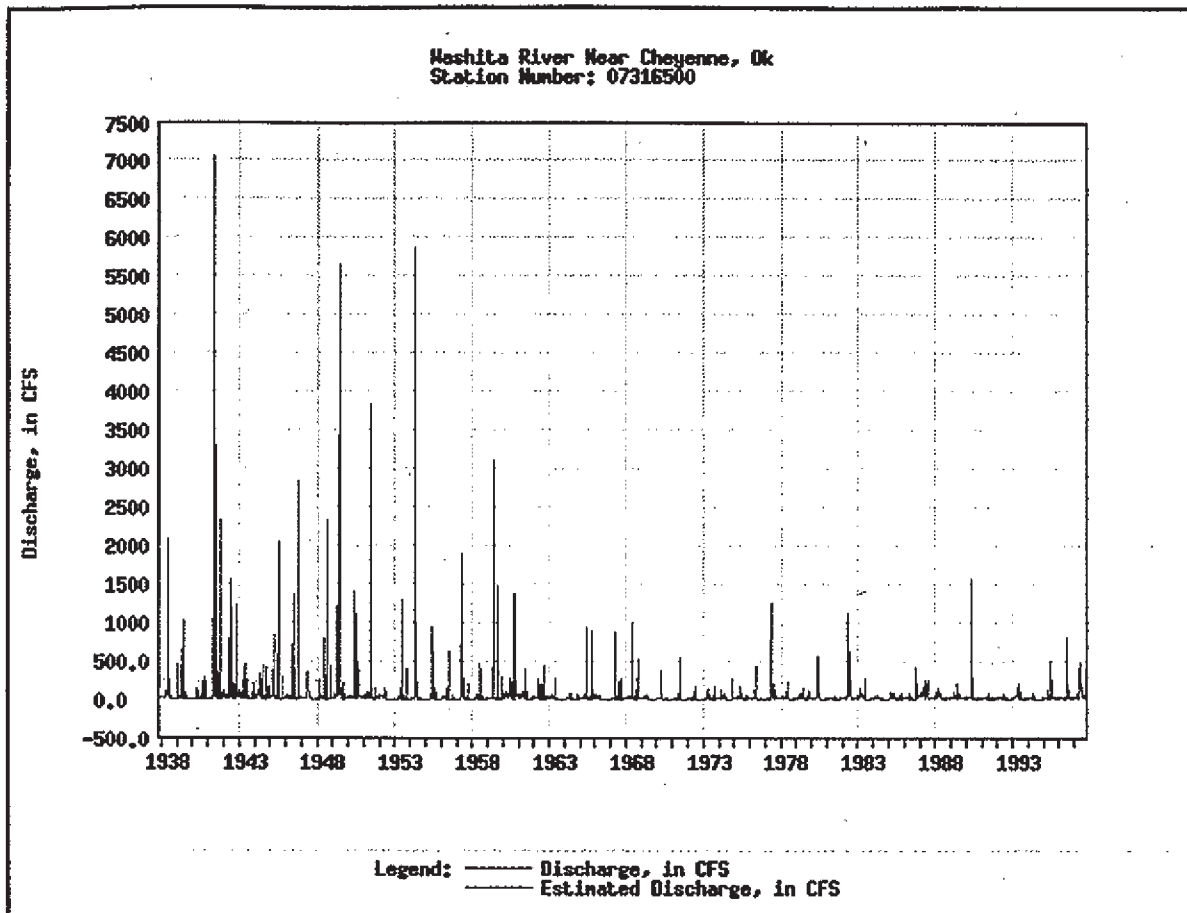


Figure 3. Historical Streamflow for Washita River near Cheyenne, OK (USGS Station 07316500)
Source: USGS NWIS

- Channel Geomorphology

In the winter of 1868, Chief Black Kettle took his followers into camp amongst a grove of cottonwood trees along the Washita River. Contemporary reports during the November, 1868 battle indicate that the Washita River was perhaps only slightly wider than today, as accounts of the battle indicate that the river was not over 20 feet wide. These same narratives also talk of higher and steeper banks than exist today (under which some of the Cheyenne took cover to return fire), thick riparian zone vegetation which obscured the views between combatants, and waist deep water (Bob Rea, Fort Supply Historic Site, personal communication, 1999). Indeed, Figure 4, an 1890 photograph attributed to Lieutenant H. L. Scott of the 7th Cavalry and captioned "Site at Washita River where the Cheyenne hid under the banks to fire their rifles from a protected area" is probably indicative of the channel and riparian conditions that existed at the time of the battle.

A review of existing maps and aerial photography for the site indicates that the river channel may have changed its course, possibly several times since 1868. The earliest available map, the 1873 General Lands Office Survey conducted by H. C. F. Hackbusch shows the Washita River entering and leaving Township 13N, Range 24W, Section 12 in approximately the same location as it does today. However, Lees et al., (1997) surmise that the river channel appears to have undergone changes between these points. They further report that long-time residents recall that the course of the river has also been altered by land owners for agricultural reasons. The first reported attempt was sometime before 1930 when Howard Van Zandt, then a graduate student from the University of Oklahoma, visited the site in 1933 and remarked that the river had been diverted long after the battle to run north of the old stream bed. Later, landowner John Wesner and his neighbor attempted to divert the river in the northwest quarter to run along the north line of the section (Lees et al., 1997). While it is probable that the location of the river channel has changed since the time of the battle, the upstream tributary impoundments constructed in the 1950s and 1960s have greatly reduced flooding and appear to have stabilized peak flows and channel movements in the vicinity of the National Historic Site. Thus, the current river channel and physical scene of the floodplain are likely to be more stable now and in the future than in the years prior to the construction of the upstream flood control impoundments.

Dr. C. Vance Haynes (University of Arizona) reports that at the present time, there appear to be three alluvial terraces rising above the active floodplain (T-0) of the Washita River (Haynes, 1995; Lees et al., 1997). The highest, and therefore oldest, terrace (T-3) rises 6 to 7 meters (20-23 feet) above the riverbed. Battle-related artifacts have been found in the upper 10 centimeters (4 inches) of this terrace, indicating that it existed at the time of the battle. The next lower terrace (T-2) is best developed on the north side of the Washita where it is 3.5 meters (11 feet) above the riverbed. While no battle-related artifacts have been recovered in this terrace, soil characteristics suggest that it is more than 150 years old and therefore existed at the time of the battle. The T-1 terrace, standing 2.5 - 3 meters (8 - 10 feet) above the streambed was apparently an active floodplain before the 20th century construction of the upstream flood control dams, and would therefore be the most likely surface of the 1868 Cheyenne winter encampment.

Further study is currently underway by Dr. C. Vance Haynes to better understand the geomorphological context of the Washita River and adjacent landscape in the vicinity of the battlefield site. While Dr. Haynes believes that the floodplain of the Washita River may have undergone modification by fluvial processes since 1868, he believes that the overall site



Figure 4. WASHITA RIVER ON WASHITA BATTLEFIELD, 1890 By H.L. Scott
Site at Washita River where the Cheyenne hid under the banks to fire
their rifles from a protected area. (Courtesy of Little Bighorn Battlefield
NM)

topography has changed very little and that the terrain today still reflects the terrain that existed in 1868, albeit that the position of the river with respect to the floodplain may not be the same (Lees et al., 1997).

- Water Use

The Upper Washita River Basin, from its headwaters to approximately 10 miles east of the Texas/Oklahoma border, is underlain by the Ogallala Formation, the major aquifer through most of the High Plains. East (downstream) of that point, including the reach of the Washita River flowing through Washita Battlefield National Historic Site, most ground water withdrawals are from "alluvium and terrace deposits" adjacent to the Washita River and its tributaries (Lurry and Tortorelli, 1996). These local deposits along the Washita River are good sources of irrigation water, albeit shallower and of lower yield than the Ogallala formation.

Within Roger Mills County, the major uses of fresh water (approximately 6.71 million gallons per day (mgd) in 1990) included irrigation (60%), livestock (30%), and water supply, commercial, and domestic use (10%). Of the 6.71 mgd, 79% of the water used for irrigation, 25% of the water used for livestock, and 68% of the water used for water supply, commercial, and domestic use was ground water (Lurry and Tortorelli, 1995).

Historically, livestock watering and irrigated agriculture have occurred on the National Historic Site property. Livestock watering on the Washita River is currently occurring at an access point within the National Historic Site on the north bank of the Washita River (Mrs. Betty Wesner, Cheyenne, OK, personal communication, 1999).

In 1953, the Oklahoma Water Resources Board (OWRB) recognized groundwater prior right number 19530802 for irrigation of 40 acres in the NW1/4 NW1/4 of Section 12 and in 1981, the OWRB issued groundwater permit number 19810750 was issued for irrigation of 40 acres in the NE1/4 of Section 12, both in T. 13 N., R. 24 W. The source of water for both permits is ground water appropriated from a well located in river alluvium in the SW1/4 NW1/4 NW1/4 of Section 12, T. 13 N., R. 24 W., IM (Cathy Poage, Oklahoma Water Resources Board, personal communication, 1999).

- Water Rights

Reasonable use of water is the limit associated with any water right in Oklahoma. Prior to statehood, Oklahoma adopted both the Riparian and Prior Appropriation Doctrines to regulate the use of stream water. The Oklahoma Water Resources Board (OWRB) regulates the use of water following statutory law. Persons who believe their water rights are being impaired by the acts of others may seek a resolution in State District Court.

Most water systems in the eastern part of the U.S. are based on the Riparian Doctrine, which is derived from English common law. The original Riparian Doctrine was judicially based and originally stated that owners of land bordering a watercourse (riparians) had entitlement to the use of water from that watercourse without diminution or impairment. As generally applied now, riparians have equal rights to the use of water from natural water bodies, as long as it does not interfere with the reasonable uses of other riparian users. A riparian water right is a property right and generally water can only be used on the riparian land within the drainage basin of the watercourse. A riparian right is not lost because of nonuse and can be correlated with all other

users with no fixed allocation. A riparian is entitled to use the amount of water reasonably necessary for the beneficial use. Water shortages are shared equally among riparians (Wikle et al., 1998).

Water rights in most of the western part of the U.S. are based on the Doctrine of Prior Appropriation. This principle originated in the gold camps of the arid western states and later became the law for distributing water for irrigation. Scarce water supplies required the apportioning of water among competing users based on a first-come, first-served (priority) system. According to this doctrine, a party who applies water to a state-recognized beneficial use (i.e. appropriates the water) has a right that is superior to those who commence their use later. The right is statutory and can be bought or sold. The water's point of diversion, place of use, and purpose of use can also be changed without losing priority. The right is a fixed allocation and if the water is not used for a period of consecutive years it may be lost through action by the state (forfeiture) or intent by the right holder (abandonment). During shortages, right-holders with junior priority dates do not receive water until the allocations of senior right-holders have been satisfied (Wikle et al., 1998).

Oklahoma is one of the few states that have adopted a "hybrid" system of water rights based upon elements of both Riparian Doctrine and the Doctrine of Prior Appropriation. Stream water in Oklahoma is not privately owned and is considered public water available for use. In 1963, the legislature enacted laws that restricted the future exercise of riparian rights to the taking of water for domestic purposes and provided a process for validating and establishing priorities for all pre-existing riparian and appropriative non-domestic beneficial uses. The legislature enacted laws which declared that the acquisition of water for all future non-domestic uses must be accomplished by filing an application with the OWRB, receiving a permit, and putting the stream water to beneficial use. Domestic use refers to the use of water for household purposes, for farm and domestic animals up to the normal grazing capacity of the land, and for the irrigation of land not exceeding a total of three acres for the growing of gardens, orchards, and lawns.

The OWRB may hold proceedings to establish rights to the use of water from a stream after determining that such action is in the best interest of all claimants to the system's water. Oklahoma water policy stipulates that only excess and surplus water should be utilized outside of the area of origin, and that the needs of the citizens within areas of origin should be met before issuing water rights to citizens outside the area of origin.

In Oklahoma, landholders own the ground water beneath their lands but their use of it is subject to regulation. The Oklahoma Groundwater Law provides for the allocation of water located below ground. The law stipulates that the OWRB must determine the allocation based on hydrologic surveys. A hydrologic survey describes the following basin characteristics: 1) total land area, 2) quantity of ground water, 3) recharge rate to, and discharge rate from, aquifers, 4) transmissivity of aquifers, and 5) possible pollution from natural sources. The OWRB then determines the amount of groundwater that may be withdrawn from each acre that overlies the basin on a minimum basin life of 20 years. Landowners and/or their lessees may be granted permits to withdraw a proportionate share of the yield equal to the percentage of land overlying the basin which is owned or leased. Permanent permits are issued only after a hydrologic survey has been completed (Wikle et al., 1998). Temporary permits that allow for use of up to 2 acre-feet per acre per year are issued in basins where hydrologic surveys have not been completed. Temporary permits must be revalidated annually and can be converted to permanent permits following completion of a hydrologic survey (Oklahoma Water Resources Board, 1998). A hydrologic survey for the Upper Washita River, in Roger Mills County, (including Washita

Battlefield NHS), was completed in 1984 and the annual allocation has been set by the OWRB at 2 acre-feet per acre per year (Kent et al., 1984).

The OWRB uses a procedure for establishing rights to use ground water from wells that existed prior to July 1, 1973, the date the current groundwater law became effective. Such rights are referred to as "prior rights to ground water". A ground water well located in the SW1/4NW1/4NW1/4 Section 12 of the National Historic Site property was constructed prior to 1973. The OWRB recognized the use of 40 acre-feet of groundwater from this well for irrigation purposes under prior right number 19530802. (Oklahoma Water Resources Board, 1998).

Conflicts or disputes over the use of water can be resolved by the OWRB through an administrative hearing process. Any interested party has the right to protest an application to take surface or ground water. Protesting parties must then present evidence in support of their position at a hearing regarding the application. In the matter of a surface water application the OWRB determines whether; 1) unappropriated water is available, 2) the applicant has a need for the water, and 3) whether the proposed use interferes with domestic or existing appropriative uses. When reviewing a ground water application, the OWRB determines whether; 1) the applicant owns or leases lands overlying the ground water basin, 2) the use to which the applicant intends to put the water is beneficial, and 3) waste by depletion or pollution will not occur.

Within Washita Battlefield National Historic Site, the United States has riparian water rights for domestic use, not to exceed five acre-feet per year, because it owns land adjacent to the Washita River. There are no known appropriative surface water rights for the National Historic Site.

Two water rights, for appropriation of ground water within the national Historic Site in the N1/2 of Section 12, T. 13 N., R. 24 W., were found in the OWRB database. Permit Number 19810750, in the name of Betty J. Wesner, is for 40 acre-feet per year to be used to irrigate 40 acres in the NE1/4 of Section 12. Permit Number 19530802, in the name of Dale W. Wesner, is for 40 acre-feet per year to be used to irrigate 40 acres in the NW1/4NW1/4 of Section 12 (Cathy Poage, Oklahoma Water Resources Board, personal communication, 1999). The General Warranty Deed executed between Betty Jean Wesner and the United States of America, for sale of a parcel of land in the N1/2 of Section 12, T. 13 N., R. 24 W. includes the statement; "Together with all the Grantor's right, title and interest in and to any and all water rights and interests in water running with, attaching to, or otherwise appurtenant to the foregoing described land" (Roger Mills County, 1997).

A search of the OWRB database for water rights held by adjacent upstream and downstream landowners found seven water rights permits. All permits are for appropriation of ground water. Table 1 lists the location of well, location of use, permit owner, permit number, allocation, and purpose of use for water rights permits held by landowners adjacent to the Washita River and National Historic Site.

Table 1. Location of well, location of use, permit owner, permit number, allocation, and purpose of use for water rights permits held by landowners adjacent to the Washita River and WABA (Personal communication with Cathy Poage, Oklahoma Water Resources Board, 1999).

Location of Well	Location of Use	Permit Owner	Permit Number	Allocation (acre-feet)	Purpose of Use
Section 1 T. 13 N., R. 24 W.	Section 1 T. 13 N., R. 24 W.	None	None	None	None
CW1/2* Section 2 T. 13 N., R. 24 W.	W1/2 Section 2 and NW1/4 Section 11 T. 13 N., R. 24 W.	C.W. Lester	19580144	960	irrigation
SE1/4SW1/4NE1/4 and SE1/4SE1/4NE1/4 Section 11 T. 13 N., R. 24 W.	NE1/4 Section 11 T. 13 N., R. 24 W.	Larry Bradshaw	19530792	100	irrigation
CW1/2SW1/4* Section 6 T. 13 N., R. 23 W.	SE1/4 Section 6 T. 13 N., R. 23 W.	Billie Burns	19551349	250	irrigation
NW1/4SE1/4SW1/4 Section 6 And NW1/4NE1/4NW1/4 Section 7 T. 13 N., R. 23 W.	S1/2NW1/4 and SW1/4 Section 6 and NW1/4 Section 7 T. 13 N., R. 23 W.	Glenda S. Kirk	19820850	800	irrigation / mining
CSE1/4NE1/4* Section 7 T. 13 N., R. 23 W.	E1/2NE1/4 Section 7 T. 13 N., R. 23 W.	D.L. Calvert	19640185	143	irrigation
NW1/4SE1/4SE1/4 Section 7 T. 13 N., R. 23 W.	S1/2SE1/4 and W1/2NW1/4SE1/4 Section 7 T. 13 N., R. 23 W.	D.L. Calvert	19670536	120	irrigation
SE1/4SE1/4NW1/4 and NE1/4NE1/4NE1/4 Section 7 T. 13 N., R. 23 W.	NE1/4NE1/4 Section 7 T. 13 N., R. 23 W.	D.L. Calvert	19810748	640	irrigation

* "C" indicates "the center of".

Surface Water Quality

- Washita River

The most comprehensive water quality information for the Washita River in the vicinity of Washita Battlefield National Historic Site comes from long-term water quality monitoring conducted by the US Geological Survey (USGS) at the USGS Station 07316500 (Washita River near Cheyenne, OK) located approximately one mile downstream from the National Historic Site. This data set provides information regarding 12 basic physical and chemical water quality constituents including specific conductance, pH, dissolved oxygen, suspended sediments, total hardness, nitrate, phosphorus, sulfate, chloride, sodium, calcium, and magnesium for the period from 1938 through 1990. Unfortunately, water quality monitoring at the site was discontinued in 1991 when budget constraints caused the USGS to significantly realign their national long term water quality monitoring program.

A summary of the information available for these basic physical and chemical water quality constituents (Table 1) indicates that the water at this site is very hard; with the average hardness concentration (578 mg/L as CaCO_3) far exceeding the "very hard water" criterion of 180 mg/L. In addition, the average sulfate concentration (476 mg/L as SO_4) is also extremely high, exceeding the recommended maximum sulfate standard for public drinking water supply (250 mg/L as SO_4) more than 85% of the time. Because of the frequency and magnitude by which the recommended sulfate concentration was exceeded, this water would not be suitable for use as a public water supply (Stoner, 1982)

Stoner (1982) reports that the waters of the Washita River near the National Historic Site are suitable for irrigation purposes, though the salinity hazard (Wilcox, 1955) ranged from "medium" to "high" with more than 90% of the samples rating a "high" salinity hazard. This salinity hazard rating would restrict the use of these waters for irrigation to those soils with adequate drainage and might require special management measures for salinity control and the utilization of crops with a high salinity tolerance. Another important irrigation water criterion, the sodium adsorption ration (SAR) was found to be "low" (Stoner, 1982), indicating that these waters could be used on most soil types with little danger of the development of harmful levels of exchangeable sodium (Hem, 1970). The National Historic Site would need to consider the salinity issue, if irrigation from the river were ever used for future revegetation efforts.

No data concerning agricultural pesticides, heavy metals, or boron (a phytotoxic trace element sometimes important in determining the suitability of water for irrigation) are available for the Washita River in the immediate vicinity of Washita Battlefield National Historic Site. However, in a similar southwestern Oklahoma watershed (the Little Washita River watershed), located approximately 100 miles southeast of the National Historic Site, Smith et al. (1986) investigated water quality issues associated with agricultural chemicals and heavy metals. Smith et al. (1986) found that floodplain alluvial deposits in the Little Washita River watershed were not significantly impacted by nutrients, heavy metals, or measured pesticides and attributed this to changes in agricultural practices, including improved soil conservation practices which are being employed in the Little Washita River watershed.

As mentioned previously, much of the Washita Headwaters watershed (USGS Hydrologic Unit 11130301) overlies the Anardarko Basin, a region of considerable natural gas exploration and production activity. The local effects impacts of these activities upon the water quality has not

been well documented. A particular concern of the National Historic Site are the potential impacts from a commercial waste pit facility being developed by Briggett, Inc. west of the National Historic Site, less than two miles upstream of the National Historic Site's boundary. Until recently, this facility consisted of a commercial saltwater disposal well used primarily for the injection of saline waters produced in the oil & gas drilling process into a deep aquifer. However, in 1998 Briggett, Inc. received permission from the Oklahoma Corporation Commission to develop this operation into a commercial pit facility (PD No. 970000392) consisting of three 350' x 1150' earthen pits (evaporative ponds) for the disposal of oil field wastes including water-based drilling fluids and/or cuttings and salt-contaminated soils.

The Washita River lies approximately 0.25 miles downgradient from the disposal pits. While the rules and regulations of the Oklahoma Corporation Commission will require some modest groundwater monitoring (Oklahoma Corporation Commission, 1998) the National Park Service has expressed concerns that : 1) the permittee will not be required to employ testing (other than for chlorides) to assure that non-permitted (i.e. other industrial, hazardous, or toxic) wastes would not be disposed at the site; 2) monitoring may not be adequate to detect leakage from the disposal pits nor does a mitigation plan exist should such leakage occur; 3) there is no provision in the permit for contaminants testing or control in the (somewhat unlikely) event that contaminant dispersal via fugitive dust becomes a concern; 4) there is no provision to assure that proper dike preventive maintenance will be undertaken to prevent a breach of the dikes and possible release of materials to the river; and 5) there is no provision in the permit for the prevention of waterfowl contamination due to contact with hydrocarbon-contaminated materials (National Park Service, 1998a).

The Washita River and Sergeant Major Creek are currently listed as "attaining" existing state water quality standards in the vicinity of the National Historic Site (State of Oklahoma, 1998). The State of Oklahoma draft 303d list of "non-attainment" waters includes only three small segments (one tributary stream and two lakes) upstream of the National Historic Site which do not fully attain state water quality standards (Table 3). The tributary stream segment, Spring Creek (OK310840020240), is a tributary of the Washita River, which enters the Washita River approximately 12 miles upstream of the National Historic Site. The cause for non-attainment in this segment is listed as "unknown toxicity" and the source is listed as "source unknown". Baker Lake (OK31084002080) lists "nutrients", "siltation", "suspended solids", and "total toxics" as the causes and "rangeland", "petroleum activities", "flow regulation/ modification" and "highway maintenance/runoff" as the sources though it does note that oilfield pollution is no longer a known problem. Skipout Lake lists "nutrients" as the cause and "source unknown" as the source. However, Reggie Blackwell (USDA-FS Cheyenne, OK, personal communication, 1998) reports that Skipout Lake had one or more fish kills in 1988-1989, but he is unsure if this is the reason for the 303d listing.

- Sergeant Major Creek

The town of Cheyenne, OK draws its public water supply from a surface water reservoir (City Lake) located in the headwaters of Sergeant Major Creek. Water quality sampling by the town, undertaken at one site above and one site below the lake (February 1998), indicates a higher quality water than found in the Washita River. The water can still be classified as "very hard" (hardness = 227 and 249 mg/L as CaCO₃, respectively), but the sulfate concentrations were

Table 2 . Statistical Summary of Selected Water Quality Data Collected at USGS Station 07316500 (Washita River Near Cheyenne, OK) 1938-1990 (Source: USGS NWIS Database)

Constituent	USGS Code	Units	Sample Size	Mean	Maximum Value	Minimum Value
Specific Conductance	00095	microS/cm	74	1463	2300	435
PH, Field	00400	pH units	70	8.1	8.7	6.9
Dissolved Oxygen	00300	mg/L	20	10.1	14.8	5.1
Suspended Sediment	80154	mg/L	65	3863	31000	100
Total Hardness	00900	mg/L as CaCO ₃	32	578	1100	200
Nitrate Nitrogen	00618	mg/L as N	9	.08	.18	0
Total Phosphorus	00665	mg/L as P	13	.40	1.2	0.1
Dissolved Sulfate	00945	mg/L as SO ₄	34	476	990	130
Dissolved Chloride	00940	mg/L	34	65	200	5
Dissolved Sodium	00930	mg/L	31	122	190	44
Dissolved Calcium	00915	mg/L	14	134	260	74
Dissolved Magnesium	00925	mg/L	14	49	107	17

within recommended drinking water standards (15 and 21 mg/L, respectively). Total soluble salts were still high (438 and 554 mg/L), making this a marginal source for drinking water, but with proper treatment the water can be made acceptable.

Groundwater

In Oklahoma, groundwater is the major source of water for irrigation, the largest single use of water in the state (Horak and Stoner, 1986). An alluvial aquifer along the Washita River in the vicinity of Washita Battlefield National Historic Site is used primarily for irrigation and domestic supply. This is a water table (unconfined) aquifer composed of mostly fine- to medium- grained sand with some gravel and inter-bedded clays. The alluvium averages about one mile wide in Roger Mills and Custer counties and had a saturated thickness (in 1973) of approximately 150 feet in the vicinity of Cheyenne, OK (Schipper, 1983). Wells in the alluvium of the Washita River upstream from Clinton, OK are capable of providing large amounts of irrigation water, with most wells in the area yielding between 400 and 700 gallons per minute (Lurry and Tortorelli, 1995).

All groundwater contains minerals dissolved from rocks and soil. High concentrations of dissolved minerals may restrict water usage for many purposes. Groundwater in the vicinity of Washita Battlefield National Historic Site is generally very hard (greater than 180 mg/L as CaCO_3) and may locally contain excessive dissolved solids (greater than 2500 mg/L). Sulfate concentrations are often above the recommended drinking water limit (250 mg/L) and in some cases chloride concentrations may be high. The chemical quality of groundwater from the alluvium, however, can differ greatly within short lateral distances. Such differences may be due partly to variations in quality of recharge from bedrock bordering or underlying the alluvium or to pumpage that increases inflow of water into the alluvium from nearby streams (Carr and Bergman, 1976). The greatest potential for human-induced groundwater contamination in the Washita Headwaters watershed is likely to be from oil and gas exploration and production activity.

Aquatic Ecology

Few studies have considered the biological communities associated with the Washita River, and none has been completed immediately adjacent to or within the area of the National Historic Site. Several studies undertaken in the late 1970s and early 1980s, centered around the issue of salinity effects upon macrobenthic insect organisms, sampled reaches of the Washita River at and below the Foss Reservoir, 20 to 30 miles below the National Historic Site. Except for the manmade reservoir itself, the Washita River has a very similar low gradient, meandering habit, sand and silt bottom, and flood controlled flow between the National Historic Site and the reservoir. So, absent the physical and chemical effects caused by the reservoir itself, the macrobenthic invertebrate species discussed in those studies may be similar to those residing in the vicinity of the National Historic Site.

The Oklahoma Water Resources Board studied 10 sites on the Washita River immediately below the Foss Reservoir (approximately 30 miles downstream from the park) and along 20 river miles to Clinton, OK for possible effects due to water quality changes brought about by the Foss Demineralization Plant (Magdych, 1979). Large and diverse macrobenthic insect communities were found, with greatest species numbers in the mayfly and chironomid grazer groupings. Large increases (doubling) in salinity levels measured in the Washita subsequent to the initial phase

Table 3. List of Waters in the Washita Headwaters watershed failing to meet State of Oklahoma Water Quality Standards (State of Oklahoma, 1998a)

WATER	OK ID #	CAUSE OF LISTING	SOURCE OF POLLUTION
Spring Creek	OK310840020240	Unknown toxicity	Unknown source
Baker Lake	OK310840020280	Nutrients Siltation Suspended solids Total toxics	Range land Petroleum activities* Flow regulation/modification Highway maintenance/runoff
Skipout Lake	OK310840020030	Nutrients	Unknown source

*Oilfield pollution no longer a known problem

of this study led to substantial decreases in the grazing genera, particularly the mayflies, and may indicate long-term effects of salinity increases in the river. This particular salinity increase was associated with demineralization plant brine outflow and some reservoir influence, but provides a note of caution to those considering changes to the existing hydrologic system.

Only limited information is available on fish in the Washita River and Roger Mills County (Miller and Robison, 1973). Common warm water fishes suitable to the Washita River are common carp, black and yellow bullheads, channel catfish, largemouth bass, and several shiners, minnows and sunfish (Table 4). Information provided by the regional office of U.S. Fish and Wildlife Service (USFWS) listed no threatened or endangered fish species present in the Washita River drainage in Roger Mills county (US Fish and Wildlife Service, 1997). Alteration of the flood and low flow regimes of the river have likely affected fish communities by changes in seasonal water and food availability as well as breeding site changes and potential presence of exotic species.

Table 4. Fish Species Likely to Occur in the Washita River Drainage, Roger Mills County, Oklahoma

Family	Fish Species	Scientific Name
Clupeidae	gizzard shad	<i>Dorosoma cepedianum</i>
Cyprinidae	common carp speckled chub suckermouth minnow emerald shiner red shiner plains minnow bullhead minnow	<i>Cyprinus carpio</i> <i>Hybopsis aestivalis</i> <i>Phenacobius mirabilis</i> <i>Notropis atherinoides</i> <i>Cyprinella lutrensis</i> <i>Hybognathus placitus</i> <i>Pimaphales vigilax</i>
Catostomidae	river carpsucker	<i>Carpoides carpio</i>
Ictaluridae	black bullhead yellow bullhead channel catfish	<i>Ictalurus melas</i> <i>Ictalurus natalis</i> <i>Ictalurus punctalis</i>
Poeciliidae	Mosquitofish	<i>Gambusia affinis</i>
Fundulidae	plains killifish	<i>Fundulus kansae</i>
Centrarchidae	largemouth bass green sunfish bluegill orangespotted sunfish longear sunfish redeer sunfish	<i>Micropterus salmoides</i> <i>Lepomis cyanellus</i> <i>Lepomis macrochirus</i> <i>Lepomis humilis</i> <i>Lepomis megalotis</i> <i>Lepomis microlophus</i>

Source: Miller and Robison, 1973

Wetlands

National Wetland Inventory mapping consulted for the site revealed only the Washita River and its immediate banks as wetland areas. Successive aerial photos from wet and dry seasons interpreted by Natural Resources Conservation Service (NRCS) staff have confirmed the same.

A vegetation analysis performed on the park in June/July 1998 (Stotts and DuBey, 1998) identified plant habitats by vegetation cover, topographic aspect, groundwater table, and soil characteristic. Two-thirds of the site consists mostly of a flat floodplain along the Washita River with alluvial soils and vegetation. The remaining one third of the site, south of the approximate location of the abandoned railroad embankment is upland range. A small intermittent drainage from the property immediately south of the site flows north to the river approximately 1200 feet downstream of the site's western boundary.

Riparian wetlands were identified in the 1998 vegetation survey along the Washita River, including 1) the riverbanks lined with trees and shrubs and 2) floodplain fringe and internal drainage slough areas lined with trees and shrubs. These seasonally wet areas would likely meet wetland criteria under the Cowardin classification methodology in the riverine and palustrine systems (Cowardin et al, 1979) and require consideration by the newly adopted NPS Director's Order #77-1: Wetland Protection (National Park Service, 1998b). Additionally, some of these areas would qualify as jurisdictional wetlands regulated by the U.S. Army Corps of Engineers.

The stability of the riparian zone south of the river is dependent upon the good management of the upland range to the south, both within and outside of the park. Heavy grazing on the neighboring section south of the park has been contributing to erosion and gully formation just 200 feet from the park's boundary (Stotts and DuBey, 1998).

A proposal to produce landcover maps of the National Historic Site was provided in 1998. The maps would depict landcover and landuse at approximately 40-year intervals back to the time of the battle (1868) and include vegetation and wetland information (Ramsey and Strong, 1998). This project is currently unfunded.

Floodplains

The floodplain bordering the Washita River is well defined by riparian habitat of tree and shrub communities in combination with seasonally wet sloughs and elevation changes to upland range. Historically, much of the flat sandy loam soils along the river have been in agricultural use for grain crops and hay, but perhaps most successfully after major flooding was controlled by the Washita River tributary watershed flood control impoundments.

An analysis of the floodplain for 100 to 500 year flood frequency elevations along the Washita River is nearing completion along the Washita River as part of the Roger Mills County-wide survey by the Federal Emergency Management Administration. The study has been in progress for three years and a draft report is expected during 1999. Much of the historic battlefield site is likely to be within the 100-year floodplain.

Flooding is not a serious issue for any current park structures, but in the past it was an important element in both altering and maintaining the natural and historic scene along the river. Both before and after the 1868 battle, periodic seasonal flooding across the entire floodplain, and some

associated channel movement have been natural processes of the Washita River. This ended in the 1950s when the flood impoundments were placed on the Washita River tributary watersheds.

The current vegetative and wildlife communities on the site reflect many site-specific conditions and factors that were a part of the site prior to becoming a NPS unit. Agricultural activities probably fostered a very similar appearance of the often scoured floodplain prior to the 1950s. But, the vegetative "look" of the historic scene on the floodplain is unlikely to remain the same unless some form or combination of forms of agricultural practices such as cutting, burning, or selective revegetation with native plants is undertaken. Some of the non-native exotic plants currently on the floodplain and riparian areas that might have been prevented or controlled, by periodic flooding, have changed the "look" and the makeup of the vegetative community. These exotic plants will have to be managed by the National Historic Site via appropriate physical, biological, and/or chemical control options currently available.

CONSIDERATIONS FOR FUTURE ACTION

The water-related resources of Washita Battlefield NHS are not only important natural components, but are integrally related to the historical context of the site and its cultural landscape. In selecting a winter campsite, Chief Black Kettle and his followers chose a location not only affording a sufficient water supply for the assembled tribes and their considerable number of ponies, but also a site whose riparian zone provided an adequate wood supply for winter fires and whose low lying position and bordering alluvial terraces offered at least a modicum of protection from the winter winds prevalent on the Great Plains. The very same location probably also provided strategic advantage to General Custer and the 7th Cavalry as they were able to attack the low-lying encampment both from higher ground and by surprise.

Thus, the protection and preservation of these water-related resources in as natural a condition as possible is an important objective in the management of this unit of the National Park system. Achieving this objective will require increased cooperation with upstream landowners and water users, the States of Texas and Oklahoma, and a number of other federal agencies, regional and local entities, and concerned citizens groups with a vested interest in these resources.

Specific issues and recommended actions to be considered for future action include:

- ◆ **ADDRESSING THE LACK OF MONITORING NECESSARY TO ESTABLISH WATER QUALITY BASELINE AND MONITOR LONG-TERM WATER QUALITY TRENDS** -- The elimination of water quality monitoring at USGS Station 07316500 in the early 1990s ended efforts to establish water quality baseline in the Washita Headwaters for even basic physical and chemical constituents. No current program has been identified which is providing water quality information in this portion of the watershed. Avenues should be explored to re-institute water quality monitoring at this location. In 1999, the USGS and NPS initiated a water quality partnership designed to enhance water quality monitoring and management in many units of the National Park System. One component of this program is designed to expand fixed station baseline water quality monitoring.

RECOMMENDED ACTION: While the project selection process for the USGS/NPS water quality partnership is highly competitive, the National Historic Site is encouraged to work with the USGS Oklahoma District Office and the NPS Water

Resources Division in order to develop a project proposal which could be considered as part of this program.

- ◆ **ADDRESSING THE LACK OF INFORMATION ON AQUATIC BIOLOGICAL RESOURCES** -- While limited surveys have been conducted well downstream, there is currently an almost total lack of information pertaining to the aquatic biological resources of the Washita River in the vicinity of the National Historic Site. A number of comprehensive, multimetric indices, assessing components such as water quality, habitat characteristics, and biological communities have been developed over the last two decades to assess the biological integrity of fish and aquatic invertebrate communities. The Oklahoma Department of Environmental Quality (DEQ) uses a multimetric approach based upon the technical guidance of the U.S. EPA's Rapid Bioassessment Protocols (Plafkin et al., 1989) and the Index of Biological Integrity for measuring the biological condition of macroinvertebrate and fish assemblages to assess nonpoint source implementation effectiveness and to identify impaired waters (Davis et al., 1996).

RECOMMENDED ACTION: The National Historic Site is encouraged to partner with the State of Oklahoma, the USGS-BRD, or a local university, to undertake on a periodic basis (i.e. every 2 - 3 years), Rapid Bioassessment or Index of Biological Integrity surveys following the protocols employed by the Oklahoma Department of Environmental Quality. These data would provide an adequate baseline for aquatic biological resources and further allow for the comparison of the health of the sites' aquatic biological communities with other appropriate basins throughout the southern Great Plains.

- ◆ **ACQUIRE COMPLETE KNOWLEDGE OF PROPERTY AND WATER RIGHTS OWNERSHIP AND OBTAIN A SOLICITOR'S OPINION AS TO THE OWNERSHIP AND VALIDITY OF ALL WATER RIGHTS ASSOCIATED WITH THE NATIONAL HISTORIC SITE** -- Two water rights permits associated with the national Historic Site property were found in the OWRB water rights database. Both water rights were apparently conveyed to the United States of America with the acquisition of the National Historic Site property. Questions regarding historical property/water rights ownership and conveyance, and validity of water rights with regard to continuous use requirements, are routinely addressed with the acquisition of any NPS property.

RECOMMENDED ACTION: Historical property and water rights ownership should be researched and a solicitor's opinion should be obtained in order to determine the ownership and validity of all water rights associated with the National Historic Site property. The Water Resources Division, Water Rights Branch, could provide technical assistance to the National Historic Site in obtaining that information.

- ◆ **COMPLETING A RIPARIAN ZONE CONDITION ASSESSMENT** -- Healthy riparian systems can be described as being morphologically stable, with streamflow and sediment discharges in dynamic equilibrium with their upland watersheds, and having wetland and riparian vegetation that has appropriate structural, age, and species diversity. When these attributes are maintained, riparian systems provide forage and cover for wildlife and improve water quality by filtering sediment and recycling nutrients. If, however, any of these essential attributes are missing or degraded, or if the system becomes morphologically unstable, widespread erosion may occur that will degrade water quality and may damage or

cause the loss of wetland and riparian habitat. A riparian-wetland assessment tool, The Process for Assessing Proper Functioning Condition, which has been developed by the Bureau of Land Management (Bureau of Land Management, 1993) and is now widely used by the US Forest Service and the Natural Resources Conservation Service can be used to evaluate riparian systems.

RECOMMENDED ACTION: The National Historic Site is encouraged to request technical assistance from the NPS Water Resources Division, to investigate the feasibility of developing a joint proposal with the US Forest Service and the Natural Resource Conservation Service to conduct a study which would assess the condition of the riparian zone within Washita Battlefield NHS and possibly other high priority riparian areas within the federally administered lands of the Black Kettle National Grassland .

- ◆ **SURVEY FOR AND INITIATE CONTROL OF EXOTIC PLANTS** --- Several exotic (non-native) plants were identified in a 1998 vegetation analysis on site (Stotts and DuBey, 1998). A complete survey should be undertaken for the exotic plants on site and in the immediately surrounding area. Because the park will be performing revegetation efforts on several large acreages to stabilize the historic scene, prevent weedy exotic growth, and prevent erosion, this is an excellent time to evaluate the exotics. Numerous handbooks exist for surveying and managing exotic plants (Hiebert and Stubbendieck, 1993; National Park Service, 1996).

RECOMMENDED ACTION : The National Historic Site should contact Gerald McCrea of the Santa Fe Intermountain Support Office or Pam Benjamin of the Denver Intermountain Support Office requesting their further recommendations for implementation of this project.

- ◆ **FOLLOWING-UP ON THE BRIGGETT, INC. COMPLIANCE MONITORING** --In their operating permit, the Corporation Commission of the State of Oklahoma is requiring that Briggett, Inc. implement a modest groundwater monitoring program to assure that the liners of their waste disposal pits do not leak and potentially contaminate local surface and/or groundwater. Many times, staff is not available to closely monitor the results of compliance monitoring.

RECOMMENDED ACTION: The National Historic Site is encouraged to request that the State of Oklahoma forward compliance monitoring data (at least on an annual basis) so that the National Historic Site staff can review the data, and if necessary, request technical assistance from the NPS Water Resources Division in order for a contaminants and/or groundwater specialist review the monitoring results.

- ◆ **ACQUIRE A MORE COMPLETE KNOWLEDGE OF MINERAL RIGHTS AND POTENTIAL DEVELOPMENT WITHIN THE LOCAL WATERSHED/VIEWSHED** -
- As a new unit of the National Park System, time has not yet been available to attain a working knowledge of mineral rights within or adjacent to the National Historic Site or for the potential for increased oil and gas development within the local watershed and viewshed.

RECOMMENDED ACTION: The National Historic Site is encouraged to request technical assistance from the NPS Geologic Resources Division in summarizing future oil and gas activities and development potential in order to better address these issues in their long term planning. If oil and gas development may occur within the National Historic Site or closely nearby, the National Historic Site should work closely with the Geologic Resources Division, Water Resources Division, the NPS Intermountain Support Office and the lessor of development rights to discuss operational, contaminant, and viewshed concerns.

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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.