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The Timing and Magnitude of Channel Adjustments in the Upper Green River Below Flaming Gorge Dam in Browns Park and Lodore Canyon, Colorado: An Analysis of the Pre- and Post-Dam River Using High-Resolution Dendrogeomorphology and Repeat Topographic Surveys

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THE TIMING AND MAGNITUDE OF CHANNEL ADJUSTMENTS IN THE UPPER GREEN RIVER BELOW FLAMING GORGE DAM IN BROWNS PARK AND LODORE CANYON, COLORADO: AN ANALYSIS OF THE PRE- AND POST-DAM RIVER USING HIGH-RESOLUTION DENDROGEOMORPHOLOGY AND REPEAT TOPOGRAPHIC SURVEYS

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ABSTRACT

The Timing and Magnitude of Channel Adjustments in the Upper Green River below Flaming Gorge Dam in Browns Park and Lodore Canyon, Colorado: An Analysis of the Pre- and Post-Dam River Using High-Resolution Dendrogeomorphology and Repeat Topographic Surveys

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Channel narrowing on the Green River in Utah and Colorado has been well documented by several authors and has been attributed to reductions in flow after 1930, the construction of Flaming Gorge Dam (FGD), and the invasion of the woody riparian plant Tamarisk (*tamarix ramosissima).* Narrowing has occurred through the deposition of inset floodplains, which have vertically accreted within a previously larger active channel. Prior to closure of FGD, lower magnitude floods aggraded surfaces in the areas of the channel that had the highest divergence in the velocity flow field (i.e. bars and banks). These surfaces later became the platforms for deposition of large volumes of sediment by lower frequency, big floods. FGD began regulation immediately after a big flood, which had vertically accreted active bars within the channel and near the banks. The large reduction in annual peak flows after closure of FGD abandoned these surfaces,

causing them to shift, nearly instantaneously, from active channel to floodplain. The process of floodplain building after the closure of FGD was similar to that of the pre-dam, but large floods became more infrequent, allowing lower elevation floodplains to aggrade within the pre-dam channel. These surfaces were vegetated and stable when bypass flooding during the 1980's deposited up to 90 cm of sediment, raising the elevation of the floodplains beyond the post-dam active hydrologic environment.

The reduction in active channel width from floodplain building has reduced in-channel aquatic habitat, while providing substrate for the establishment of Tamarisk, which has proliferated in the regulated Green River. Controlled flooding is a potential remediation strategy to reactivate stabilized channel features, and control the spread of Tamarisk, but managed flooding is expensive, political, and its potential success is unknown. Large floods have occurred in the post-dam era as hydrologic emergencies and, although they are not planned, the adjustments to the channel during these floods are a proxy for the potential of controlled floods to rehabilitate the Green River. Channel adjustments have been monitored at permanent cross sections in Browns Park and Lodore Canyon since 1994. We use 12 years of monitoring data, which includes four bypass floods, to calculate metrics of fine sediment storage at 36 locations along the river. We combine metrics at each site using a weighting procedure to estimate the general pattern and trend of channel adjustments in these reaches since 1994. These metrics are compared to similar metrics published for the Colorado River in Grand Canyon, a river with similar geologic controls and similar management challenges, but a different sediment supply condition.

(362 pages)

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Jason S. Alexander

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

As part of the continuum of river deposits from channel bars to deltas, the floodplain plays an important role in channel processes as a sediment source and sink, in biogeochemical cycling as a nutrient source and sink, and is the foundation of riparian ecosystems (Meade et al., 1990; Tockner and Stanford, 2002; Naiman et al., 1993). Early descriptions by Gilbert (1877) characterized the floodplain as a deposit on the inside of meander bends that accompanied and balanced the erosion of the outer bend:

> The first result of the wear of the walls of a stream's channel is the formation of a floodplain. As an effect of momentum the current is always swiftest along the outside of a curve of the channel and it is there that the wearing is performed; while at the inner side of the curve the current is so slow that part of the load is deposited. In this way the width of the channel remains the same while its position is shifted, and every part of the valley which is has cross in its shifting come to be covered by a deposit which does not rise above the highest level of the water. The surface of this deposit is hence appropriately called the *flood-plain* of the stream. (p. 126-127)

This early description of channel and floodplain interaction implies an equilibrium channel form, and an upper limit to the elevation of the floodplain because the valley bottom is regularly "wiped" clean as the channel migrates back and forth across the valley bottom, eroding an older floodplain on the outside of bends and leaving a new surface on the inside of bends. Wolman and Leopold (1957) described a similar process of floodplain formation based on long-term monitoring of channel geometry on the Watts Branch, Maryland. They related the top elevation of the floodplain to the stage of frequent flood events, and showed that lateral accretion was the dominant depositional process in the streams they studied. Wolman and Leopold (1957) proposed a theoretical

model of floodplain building which showed that floodplains would be higher than the water surface elevation of the more frequent events if vertical accretion were the dominant depositional process.

We now know floodplains can be built by a wide spectrum of processes that are dependent on the specific hydrologic and geologic context of the river system (Nanson and Croke, 1992). Vertically accreted floodplains can build to elevations above the most frequent flood events, and limit overbank deposition to rare, large floods (Ritter, 1973; Brakenridge, 1984). In rivers that have low migration rates and high suspended sediment concentrations vertical accretion can eventually "disconnect" the floodplain from the annual range of flows. Disconnection can also occur from climate or human-induced reductions in flood magnitudes (Hereford, 1984; Graf, 1987; Schmidt and Rubin, 1995; Allred and Schmidt, 1999; Grams and Schmidt, 2002). In some cases disconnection is kept in check when a floodplain is 'stripped' (catastrophically eroded to a lower elevation) by rare, very large floods (Schumm and Lichty, 1963; Burkam, 1972; Nanson, 1986; Pizzuto, 1994). When floodplain stripping occurs on local scales, or when hydrologic variability shifts floodplain building to locations within a larger channel, multiple elevations of floodplains can exist corresponding to both frequent and infrequent flood hydrology (Nanson, 1986; Schmidt and Rubin, 1995; Grams and Schmidt, 2002).

Riparian vegetation also plays an important role in channel and floodplain sedimentation processes (Thorne, 1990; Simon and Collinson, 2002). Flood frequency and magnitude influence the establishment and survival of riparian plant species through the creation and destruction of suitable establishment surfaces, transport and emplacement of dispersed seeds, as well as determining the localized stress regimes and

subsequent ability of a species to survive to maturity (Hupp and Osterkamp 1996; Scott et al. 1997; Auble et al. 1994; Bendix and Hupp 2000). Vegetation similarly influences channel form by stabilizing surfaces and influencing local sedimentation patterns, which can in turn influence vegetation composition. These feedback mechanisms introduce complexities in the cause and effect relationships between fluvial process and riparian vegetation (Bendix and Hupp, 2000).

While much has been published on the various geologic contexts and styles of floodplain formation, few studies explicitly address the annual hydrologic context and its associated magnitude of deposition. Observations of floodplain deposition with high temporal and spatial resolution are limited to those locations where scientists or managers have had the foresight to monitor or the locations of stream discharge gages (i.e. Gomez et al., 1998; Allred and Schmidt, 1999; Moody et al., 1999; Grams et al., 2007). The details of floodplain formation are important to scientists and managers alike. The roles and relative importance of frequent versus infrequent processes is of longstanding debate amongst geomorphologists (Wolman and Miller, 1960; Baker, 1977). Physically-based numerical models intended to predict river response and floodplain depositional patterns are generally calibrated using a temporally limited set of floodplain deposition data, or long-term averages (Nicholas and Walling, 1997, 1998; Moody and Troutman, 2000; Nicholas and Mitchell, 2002). Singular observations of flood deposition or long-term averages distort the depositional potential for individual flood events. Thus, observations of the long-term patterns of floodplain deposition are needed to understand the role of annual hydrology, or decadal-scale hydrologic patterns involved in floodplain building. Water resource managers seeking a better understanding of river management techniques,

also have a vested interest in understanding the effects of annual hydrology on floodplain formation and the subsequent influences on riparian ecosystem structure and function.

This study seeks to better understand channel adjustment and floodplain depositional patterns within the context of natural and human induced changes to annual flood hydrology. These subjects are addressed using the upper Green River below Flaming Gorge Dam (FGD) of Colorado and Utah as a study area. The term 'upper Green River' refers to the section of the Green River between its headwaters in the Wind River Mountains of Wyoming and its confluence with the Yampa River in Dinosaur National Monument (DNM). The segment of the upper Green River addressed in this study is that portion downstream of FGD, and within DNM. Within this section, the Green River flows through a wide, alluvial valley known as Browns Park and a narrow bedrock gorge known as Lodore Canyon.

In the upper Green River of DNM, the channel has narrowed between 10 and 20% since the early part of the 20^{th} century. Channel narrowing has occurred through the deposition of inset floodplains that reflect a new balance of sediment supply and hydrologic regime following climatic shifts in the early 20^{th} century and completion of Flaming Gorge Dam (FGD) in October 1962 (Allred and Schmidt 1999; Grams and Schmidt, 2002). Reduced peak flood magnitudes and durations coupled with tributary sediment contributions below FGD, have acted to simplify reaches through the accretion and filling of side channels and backwaters, the bank attachment of channel bars, and the expansion of point bars. Non-native Tamarisk (a federally designated noxious weed) has established, spread, and stabilized these new surfaces, precluding mobilization and

subsequent restoration of simplified reaches (Cooper et al., 2003; Larson, 2004; Birken, 2004). Tamarisk has also out-competed native Cottonwood (*Populus fremontii*) and Box Elder (*Acer negundo*), limiting their establishment on the lower elevation, more narrow modern floodplain of the Green River (Merritt and Cooper 2000). The reason for the spread of Tamarisk on these surfaces is of some debate, but regulation has undoubtedly played in its favor by disturbing the timing of the natural flood regime and increasing base flows (Merritt and Cooper, 2000; Cooper et al., 2003; Larson, 2004).

Previous studies of channel narrowing and adjustments in the Green River below FGD have used combinations of aerial photos, ground-level repeat photography, and sediment budgets to constrain the mechanisms, timing, and magnitude of channel adjustment (Graf, 1978; Andrews, 1986; Lyons et.al., 1992; Allred and Schmidt, 1999; Merritt and Cooper, 2000; Grams and Schmidt, 2002, 2005; Birken and Cooper, 2006). Due to limitations in the temporal and predictive resolution of these methods, the details of narrowing are restricted to the multi-decadal gaps of photos or the uncertainty in the spatial and temporal predictive capabilities of sediment budgets (Grams and Schmidt, 2005). Only Allred and Schmidt (1999) using the extensive hydrologic and channel geometry record at Green River, Utah, in combination with GIS analysis of aerial photos, obtained a spatially and temporally high-resolution description of channel narrowing. Most recently, Birken and Cooper (2006) excavated pits through vertically accreted sediment in the Green River floodplains of Desolation, Gray, Labyrinth, and Stillwater Canyons and used the establishment elevation of Tamarisk to obtain the minimum age of floodplain surfaces. However, due to low stratigraphic and dendrogeomorphic

resolution, Birken and Cooper (2006) were unable to obtain the timing and magnitude of deposition of floodplain sediments above Tamarisk establishment elevations.

Chapter 2 describes floodplain building in the Green River of Browns Park and Lodore Canyon since 1950, and provides a model of floodplain building that can be applied in reaches of the Green River upstream and downstream by identifying the magnitude and timing of floodplain building events. The details of floodplain building are obtained using recently developed high-resolution dendrogeomorphic methods developed by Friedman et al. (2005). These methods allow aging of individual sedimentary units within the floodplain. The dendrogeomorphic data are compared with other lines of evidence to obtain a temporally fine-scaled model of floodplain depositional patterns. These data show that floodplain building in the meandering and debris-fan dominated reaches was occurring prior to closure of Flaming Gorge dam, but these processes underwent a fundamental shift to locations within the channel after closure of the dam. These data present a dilemma for water resources and environmental managers, whereby infrequent controlled flooding may further impair an already damaged river system and riparian corridor by causing increased floodplain disconnection.

Chapter 3 builds on the floodplain history and describes the pattern and trend of channel adjustment in the upper Green River since 1994. Chapter 3 is the culmination of over a decade of channel geometry surveying and monitoring in Dinosaur National Monument, by the Utah State University Geomorphology Lab. These surveys include topographic and bathymetry measurements before, during, and after high-magnitude flood events in 1997, 1999, 2005, and 2006. The metrics computed from these

measurements show that the Green River in the study area has changed little since 1994, with the exception of temporary adjustments centered on the flood of 1999. This equilibrium condition is contrasted against the condition of declining fine sediment storage in the Colorado River in Grand Canyon, a section of river with a similar geomorphic setting and similar management goals. This condition of relative equilibrium presents managers of the Green River ecosystem below FGD with more and better options than those available to managers of the Colorado River below Glen Canyon Dam.

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CHAPTER 2

RECONSTRUCTING FLOODPLAIN DEPOSITON RATES IN THE PRE- AND POST-REGULATED UPPER GREEN RIVER, COLORADO USING HIGH-RESOLUTION DEONDROGEOMORPHIC ANALYSIS OF TRENCHES

Abstract

Alluvial rivers adjust the geometry of their channels to transport their annual loads of water and sediment. Although channel narrowing in the upper Green River of Colorado and Utah, from Flaming Gorge Dam (FGD) to the confluence with the Yampa River has been well documented, the details of the narrowing, specifically the frequency and magnitude of floodplain building events, have not been described because of the poor temporal resolution of the methods applied. These details are important to resource managers seeking rehabilitation and restoration tools, as well as scientists seeking a better understanding of how floodplains are built in vertically accreting, suspended sediment river systems.

To derive a more spatially and temporally explicit understanding of floodplain construction in the upper Green River, we use high-resolution stratigraphic and dendrogeomorphic analysis of four trenches excavated through floodplains in Browns Park and Lodore Canyon. Our results show that lower frequency, high-magnitude flood events have vertically accreted large proportions of the floodplains in both the pre and post-regulated upper Green River. Closure of FGD occurred immediately after a floodplain building event, abandoning the higher elevation surfaces and building lower floodplains inset to the pre-dam surfaces. These lower floodplains acted as platforms for

vertical accretion when FGD spills exceeded the capacity of the powerplant. Thus, our data show that infrequent, short-duration controlled floods may not be an effective rehabilitation tool because they may cause additional disconnection of floodplains from the typical post-dam hydrologic regime.

1. Introduction

Alluvial rivers adjust the geometry of their channels to transport their annual loads of water and sediment. The depositional features associated with adjustments that are stable and vegetated for extended periods of time, and inundated by the contemporary hydrologic regime, are classified by geomorphologists as floodplains. Processes of floodplain development are highly variable amongst fluvial systems and depend largely on flood hydrology, channel confinement, caliber of sediment load, and the valley form inherited from previous climatic or hydrologic regimes [Brown, 1996].

Although many types of floodplains have been described [Nanson and Croke, 1992], the relative roles of large magnitude, infrequent floods and of lower magnitude, common floods in forming floodplains is poorly understood [Moody et al., 1999]. Rivers with low rates of lateral migration and whose floods transport high concentrations of suspended sediment, generally build floodplains through the vertical accretion of sediments during overbank flow. In such systems, one might expect that the rate of deposition decreases as the elevation of the floodplain increases, because the frequency of inundation decreases with time as the floodplain builds vertically [Wolman and Leopold, 1957; Ritter et al., 1973; Brackenridge, 1984]. Some vertically accreting floodplains develop several surfaces of different elevations reflecting both common and rare floods [Nanson, 1986; Grams and Schmidt, 2002].

The magnitude of floods responsible for shaping a channel and building floodplains is of interest to more than the scientific community. Controlled floods have gained popularity as an effective restoration and rehabilitation tool in rivers that have undergone changes deemed undesirable [Webb et al., 1999; Richter and Richter, 2000; Poff and Allan, 1997; Hughes and Rood, 2003]. Land managers seeking a better understanding of the potential success of restorative floods have a vested interest in such research.

This paper describes floodplain accretion in the Green River between Flaming Gorge Dam (FGD) and the Yampa River (hereafter referred to as "upper Green River") over a period of 50 years based on stratigraphic analysis of trenches at four locations (Figure 2.1). We describe the relative roles of common versus rare, large floods in the construction of a vertically accreted floodplain at four locations along a 13-km segment of the river within the boundaries of Dinosaur National Monument (DNM). To constrain the depositional history of the floodplain at each trench location, we use dendrogeomorphic analysis of Tamarisk, local rating curves, aerial photos, and the stream-flow record.

2. Background

Contemporaneous with the widespread construction of dams during the late 19th and throughout the 20th century, the intermountain west and the desert southwestern U.S. experienced decadal-scale climatic shifts. These shifts affected the hydrology of the main-stem and tributaries to the Colorado River system [Stockton and Jacoby, 1976; Hereford and Webb, 1992; Webb et al., 2004; Woodhouse et al., 2006]. In addition, invasive woody riparian species such as Tamarisk (hybrids of *Tamarix ramosissima* and

Tamarix chinensis), introduced in the late 19th century, established and spread during this time [Christensen, 1962; Everitt, 1980; Gaskin and Schaal, 2002; Gaskin and Shafroth, 2003; Glenn and Nagler, 2005]. Together, these factors caused a general narrowing and simplification of channel features, resulting in the loss of rearing habitat important to four federally endangered fish species as well as a decline in the dominance of native plant species within the riparian corridor [Tyus and Haines, 1991; Stevens et al., 1997; Everitt, 1998; Allred and Schmidt, 1999; Schmidt and Brim-Box, 2004; Friedman et al., 2005b; Williams and Cooper, 2005].

Previous studies of channel narrowing and adjustments in the Green River below FGD have used combinations of aerial photos, ground-level repeat photography, and sediment budgets to constrain the mechanisms, timing, and magnitude of channel adjustment [Graf, 1978; Andrews, 1986; Lyons et.al., 1992; Allred and Schmidt, 1999; Merritt and Cooper, 2000; Grams and Schmidt, 2002, 2005]. The details of narrowing are limited by the long time gaps in photos or the uncertainty in the spatial and temporal predictive capabilities of sediment budgets [Grams and Schmidt, 2005].

Only Allred and Schmidt [1999] obtained a spatially and temporally high-resolution description of channel narrowing by using the extensive hydrologic and channel geometry record at a gaging station in combination with GIS analysis of aerial photos,. Recently, Birken and Cooper [2006] excavated pits through vertically accreted sediment in the Green River downstream from our study area and used the establishment elevation of Tamarisk to obtain the minimum age of floodplain surfaces. However, due to low stratigraphic resolution and age control on individual depositional sequences, Birken and Cooper [2006] were unable to constrain the timing and magnitude of

hydrologic events that deposited the sediment that built the floodplains. The details of channel adjustment, floodplain deposition, and the specific hydrologic events that have shaped the channel, are of particular importance to water resource managers seeking to mitigate or reverse undesirable changes to aquatic and riparian ecosystems downstream from dams.

2.1 Changes in Green River Hydrology

Flood magnitudes between 1906 and 1930 in the Colorado River basin were the highest since the early 1600's [Stockton and Jacoby, 1976; Woodhouse et al., 2006]. Hereford and Webb [1992] and Webb et al. [2004] reported a general decline in the occurrence of anomalously wet years after 1940 thereby causing a gradual decline of mean annual flows of the Colorado River at Lee's Ferry. Allred and Schmidt [1999] reported a 30% decrease in the 2-year return flood magnitude after 1930 at Green River, Utah. At Greendale, Utah (station 09234500), the instantaneous magnitude of the 2-year return flood decreased by 14% after 1930 and by 57% after the closure of FGD (Figure 2.2) [Grams and Schmidt, 2002]. Since the closure of FGD in 1963, peak flood magnitudes in the upper Green River have generally been limited to an annual maximum of 130 m^3/s, the capacity of the power generating turbines (hereafter referred to as "powerplant capacity"). Floods in excess of powerplant capacity (hereafter referred to as "bypass floods") have occurred in 1983, 1984, 1986, 1997, 1999, 2005, and 2006.

2.2 Style of Green River Channel Adjustment

In confined rivers or rivers with low migration rates, lateral accommodation space is limited unless deposition within the corridor is balanced by erosion [Brackenridge, 1984; Moody et al., 1999]. Thus, the maximum elevation to which the floodplains build

is limited by the stages of floods or erosional thresholds [Nanson, 1986]. Most of the annual sediment load of the upper Green River is carried in suspension [Andrews, 1986]. Channel narrowing in the upper Green River below FGD is caused by the deposition of inset floodplains [Grams and Schmidt, 2002]. Grams and Schmidt [2005] showed that post-dam bar and new floodplain construction approximately balanced bank erosion, and that sediment was still accumulating in reaches below the dam. Additionally, Grams and Schmidt [2005] showed that no evidence of bed incision is apparent where pre-dam records of bathymetry exist. The floodplains in Browns Park have formed by the expansion of point bars and the stabilization and the bank attachment of channel alternate and compound bars [Allred and Schmidt, 1999; Merritt and Cooper, 2000; Grams and Schmidt, 2005]. In Lodore Canyon, fine sediment has accumulated in side channels, eddies, and on previously active gravel bars. Aggraded floodplain surfaces typically have been colonized by native and non-native woody and/ or herbaceous vegetation [Cooper et al. 2003; Larson, 2004].

Grams and Schmidt [2002] identified and mapped three floodplain surfaces present throughout the upper Green River (Figure 2.3). The three surfaces were termed the Cottonwood-Boxelder terrace (CB), the intermediate bench (IB), and the post-dam floodplain (PF). Grams and Schmidt [2002] presumed that these surfaces were related to pre-dam floods, post-dam bypass floods, and post-dam powerplant flood regimes, respectively. Because these surfaces can be readily identified in the field, are found throughout the upper Green River, and are generally occupied by woody riparian vegetation, the upper Green River provides an ideal setting to apply high-resolution dendrogeomorphology in trenches to constrain rates of floodplain accretion.

3. Methods

We combine three approaches in our stratigraphic analysis of trenches. We use dendrogeomorphic data to obtain minimum and discrete years of deposition of individual floodplain sedimentary units. Second, we use local stage-discharge relationships and the hydrologic record to verify if the maximum flow in a discrete year could have inundated (and therefore deposited) the sedimentary unit. Third, we use aerial photographs to confirm or reject evidence interpreted from the trenches.

We excavated four trenches in two different reaches. One trench was excavated in lower Browns Park and three were excavated in Lodore Canyon. In canyons with abundant debris fans, such as Lodore Canyon, floodplains formed by fine-sediment deposition are restricted to the banks in backwaters and the eddies near constricting debris fans [Schmidt and Rubin, 1995; Hazel et al., 2006] Recirculating eddies exist in areas where channel flow expands downstream of a constriction [Rubin et al., 1990]. Deposition within the eddy is restricted vertically by the elevation of the water surface of floods and horizontally by the location of the shear zone between the eddy and the downstream flow (eddy fence) [Schmidt and Rubin, 1995].

In meandering reaches, the river flows primarily in an alluvial channel and bedrock controls are absent or rare; inset floodplains associated with narrowing are formed through expansion of point bars, the bank attachment of compound and alternate bars, and the filling of side channels [Grams and Schmidt, 2002]. These geomorphic environments are the two broadly occurring channel and floodplain types of the study area described by Grams and Schmidt [2005].

3.1 Site Selection and Floodplain Trenching

Floodplain excavation sites were located based on the following criteria: (1) presence of older Tamarisk for longer-term age control; (2) presence of younger Tamarisk on most surfaces for shorter-term age control; (3) absence of tributaries immediately upstream; (4) limited hillslope sediment contributions; (5) width of floodplain surfaces of about 30 m, and (6) availability of historical ground-level photographs. Field evidence of the age of the Tamarisk stand at each site was obtained by slicing the stem at the surface and performing a preliminary count of rings. Not all of the selection criteria were met at each site. The most important criteria were the presence of an old Tamarisk and the absence of an upstream tributary to assure that observed rates of deposition were not affected by nearby sediment sources or by local and unique depositional patterns.

Trenches were dug by hand across the CB, IB, and PF floodplain surfaces of Grams and Schmidt [2002] (Figure 2.4A). We did not excavate lower than the top of coarse hillslope debris exposed in each trench, the field-inferred establishment elevation of the oldest Tamarisk, the water table, or the practical limits of hand excavation.

3.2 Field Interpretation of Trench Stratigraphy

Field stratigraphic interpretations of each trench focused on tracing the horizontal and vertical continuity of sedimentary units. Composite samples of most stratigraphic units were taken, and texture, sedimentary structures, and gradation described and recorded. Particle size analysis of sampled units was performed in the laboratory in two stages (1) wet sieve separation of sand and fines (2) sieve analysis of sand-sized particles.

Individual stratigraphic units were isolated by defining the upper and lower bounding contacts, and contacts were traced into the stems of adjacent Tamarisk. Abrupt, erosional, or cross-cutting stratigraphic boundaries were traced until they reached the ground surface, were truncated by another unit, or became gradational. In the gradational cases, the boundaries of units ended by integration into other units.

Past observations of FGD high-release flood deposits indicate that they are generally characterized by a distinct silt or clay base that coarsens upward to very fine and fine sands (Figure 2.4B) [Martin et al., 1998]. Inverse grading of flood deposits is typical of suspended sediment rivers which experience sediment supply limitation over the flood period [Iseya, 1989; Rubin et al. 1998].

After the trench stratigraphy was described, lateral trenches were dug from the main trench to adjacent Tamarisk stems. Stratigraphic contacts were traced from the walls of the main trench into the lateral trenches and to the interface with the buried stem or root of each plant (Figure 2.4C). Permanent marks were made on each stem to record the elevation of the stratigraphic contact. Each contact on each plant was surveyed into the local topographic grid so that the discharge of that stage could be estimated. Sampled individuals were chosen for their location near the trench and their stem size. Larger diameter stems were favored to smaller stems, because their ring widths and wood anatomy are generally more easily interpreted.

3.3 Dendrogeomorphic Interpretations of Trench Stratigraphy

Because the temporal scale of channel adjustment in the upper Green River is on the order of decades, few geochronology tools exist that allow for fine-scale aging of

sediments aggraded in the floodplain. Recently developed dendrogeomorphic methods allow for temporal constraint of aggraded sediments using burial signals in the annual growth rings of Tamarisk and Sandbar Willow [Friedman et al., 2005a]. Anatomical evidence of burial in trees has been shown to be a more accurate method of dating individual stratigraphic deposits than using other dendrogeomorphic methods such as the elevation and age of adventitious root growth [Strunk, 1997]. Tamarisk is a federally designated noxious weed that can be removed under DNM management policy. Because many recently aggraded fine-sediment deposits contain at least some established Tamarisk, it is an ideal candidate for use in dendrogeomorphic interpretation of floodplain stratigraphy of the upper Green River.

Trees harvested from each trench were sliced horizontally into discs 2 to 12 cm in thickness at each stratigraphic contact and the ground surface interface. Slabs between contacts were cut when additional ring data were necessary for cross dating. The upper surface of each slice was sanded and compressed air blasts were applied between sanding intervals to prevent clogging of xylem vessels. Methods of slab preparation followed those outlined in Scott et al. [1997] and Friedman et al. [2005a].

The establishment elevation of the Tamarisk was assumed to be within the sanded slab whose upper surface contained pith and whose lower surface was absent of pith [Scott et al., 1997; Friedman et al. 2005a]. Stratigraphic deposits lying above the establishment elevation were assumed to be at most the age of the Tamarisk. In some cases, the exact establishment elevation of a Tamarisk stem could not be precisely determined. Three plants were found to have been flood trained (leaning over in the direction of flow during burial), and the bottom slab contained a small amount of pith.

These plants were all flood trained between 1963 and 1982 on surfaces nearly equivalent to the stage of the powerplant capacity releases from FGD. We approximated the establishment elevation for these plants by assuming that the surface on which the plant had been flood trained was in fact the same surface that the plant had established on. The establishment elevation was also approximated for five plants recovered at the Gates of Lodore trench where the establishment slab either did not correspond to an adjacent stratigraphic horizon or because the establishment slab was tall and fragile, and further cutting was impossible.

Two radii were drawn on each cut slab and ring width patterns were described using a dissecting microscope by two technicians working independently. Anatomical and ring-width suppression burial signals were identified by three individuals working independently. Burial signals in Tamarisk annual growth rings were interpreted in two ways: (1) reduction in annual ring width below the ground surface after burial and (2) anatomical shift from stem to root characteristics in buried stem wood (Figure 2.5A). Ring widths were digitized along the radii using the Measure J2X © program. The average ring widths along the two radii were exported and the timeseries of growth plotted for interpretation of anatomical shifts (Figure 2.5B). Growth rates of rings show suppression in many slabs in or following years of burial. However, in the years following burial, slabs that are buried deeply will continue to show suppressed growth rates, while the growth rates in shallow or sub-aerial slabs typically recover. Stem damage from sediment abrasion was also used as an indicator of flow direction and evidence of sedimentation in a discrete year (Figure 2.5A).

3.4 Interpretation of Trench Stratigraphy Using Local Stage-Discharge Relations

Grams [1997] established permanent cross sections at 1-km intervals throughout DNM. Regular monitoring of cross-section geometry and water-surface elevation began at these stations in 1994 and include measurements at baseflow, bankfull (powerplant) and bypass flood discharges. During our excavations, water-surface elevation at each trench were surveyed daily and related to the previous day's average daily discharge at FGD. Stage discharge relationships were computed for each excavation site using the historical data for the nearest monitoring cross section located within the same backwater reach. The stage computed for the nearby cross section was adjusted to the excavation site using the difference in elevation between measurements taken at a common discharge.

Although floodplain aggradation and channel narrowing have changed the shape of the channel margins, there is no evidence for bed elevation change in the study area [Grams and Schmidt, 1999, 2002, 2005]. Additionally, several small tributaries intersect the Green River between the Greendale, Utah gage and the trench excavation sites. To account for potential shifts in the stage-discharge rating relation and minor tributary inputs, we assumed an uncertainty of 10% in discharge when using the rating relationship to assign a stage to discrete flood events, a conservative assumption in the absence of bed incision [Moody and Troutman, 2000].

3.5 Calculation of Floodplain Accretion Time Series

Deposition of inset floodplains through vertical accretion has both horizontal and vertical components. Although the dominant orientation of the bedding in vertically

accreted floodplains is sub-horizontal, the simple elevation of the upper contacts is an inadequate measure of floodplain growth at a discrete time, because the surface may be sloping or uneven. Additionally, elevation skews growth to those units whose upper contacts were not eroded by subsequent floods. Thus, to compare the relative depositional magnitudes of hydrologic events, we calculated the minimum fractional cross sectional area (MFA) above a reference elevation for each floodplain excavation site (Figure 2.6). The MFA is defined as:

$$MFA = A_t / A_p \quad (1)$$

where A_t is the floodplain cross-sectional area above a reference elevation at time t and A_p is the floodplain cross-sectional area present today above the reference elevation.

To describe floodplain building associated with both the high and low magnitude floods, we calculated the MFA above two reference elevations, the mean annual discharge (57 m^3/s), which is essentially unchanged between pre- and post-dam periods, and the discharge of the post-dam, 2-yr return flood (142 m^3/s). Depositional magnitudes of narrower stratigraphic units were grouped with those bounding units whose field interpretation of structure, texture, and color were most similar. The MFA for undifferentiated deposits, whose discontinuous stratigraphic structure indicated accretion from several annual floods, were assumed to be evenly distributed amongst the period of years constrained by available dates.

4. Results

Below, we describe the sequence of floodplain building within each of our trench excavations. We use the trenches at the Gates of Lodore, GTS-1 and GTS-2, to illustrate

the stratigraphic details identified by our methods. We describe the general patterns of floodplain structure and the hydrologic events associated with floodplain building for the trenches of Lodore Canyon. The detailed stratigraphy in the Lodore Canyon trenches and the dendrogeomorphic analyses of Tamarisk stems can be found in the Appendix A.

4.1 Detailed Site Descriptions

4.11 Gates of Lodore Trench in Browns Park

In lower Browns Park, we trenched through the vegetated portion of a channel bar complex downstream from a large point bar, approximately 1.5 km upstream from the Gates of Lodore boat ramp (Figure 2.7). A bedrock outcrop marks the shoreward boundary of the alluvial valley at the trench. Historical aerial photos demonstrate that this bar has been in the same place since at least 1938 (Figure 2.7). The excavation at the Gates of Lodore is composed of two trenches, separated by a side channel, excavated along a single cross section profile. One spans the 14 m between the bedrock outcrop and the eastern bank of the side channel (GTS-1). The second trench begins at the western bank of the side channel and spans the vegetated portion (22 m) of the mid-channel bar along the cross section (GTS-2). The side channel has been active in all historical aerial photos (Figure 2.7).

Floodplain surfaces classified by elevation and woody riparian vegetation at the Gates of Lodore are equivalent only to the IB and PF, although the elevation of the IB is not uniform across the trench surfaces. The highest elevation of the ground surface at GTS-1 is equivalent to the transition between the IB and CB terrace on the opposite bank of the river, suggesting the surface of GTS-1 is somewhere between the CB and IB

elevations. The oldest nearby Tamarisk established on the GTS-1 bar and dates to approximately 1950. Shadows from the bedrock cliff obscure the left margin of the channel in the 1938 and 1954 aerial photos, but the location of GTS-2 and the side channel are visible and absent of vegetation in the 1954 aerial photos.

4.1.2 Eddy Bars of Lodore Canyon: Dellenbaugh, Trailer, and Dunn Cliff Trenches

Grams and Schmidt [1999] divided Lodore Canyon into three segments: a low-gradient upstream segment, a high-gradient middle segment with abundant tributary debris fans, and a low-gradient downstream segment. We excavated two trenches within the lower-gradient upstream part of Lodore Canyon, and one trench within the steeper middle segment.

Trenches in Lodore Canyon were excavated through fine sediment deposits within eddy recirculation zones similar to those described by Schmidt [1990] (Figure 2.8). Historical aerial photos taken in 1952 show bare, active bars at all trench sites. A ground-level historical photo was also available at each site that allowed partial verification of the pre-dam depositional environment, channel boundaries, and vegetation at each excavation site (Figure 2.9). Trenches within Lodore Canyon were excavated through the three defined floodplain surfaces, except at the Dellenbaugh site where colluvial gravels prevented deep excavation into the CB surface.

4.2 Floodplain Stratigraphic Facies

Three general stratigraphic facies were observed (1) basal sands (2) deposits of discrete floods, and (3) undifferentiated deposits. Basal sands were located at the bottom

of some trenches and were well-sorted, fine-to medium sands with ripple-drift cross stratification. These sands occurred at approximately the same stage as modern flows and were assumed to be former bars of a larger channel. Discrete flood deposits have a sharp or erosional basal and upper contact that could be traced for significant lateral distances. Discrete flood deposits typically coarsen vertically, but some fine. Undifferentiated deposits consist of sediments whose upper or lower boundaries could not be traced for long distances. Undifferentiated flood deposits typically did not obviously fine or coarsen vertically and occurred as lenses in some places.

4.3 Floodplains of Browns Park - Gates of Lodore Trench

Floodplain deposition in the meanders of the Green River in lower Browns Park occurred in two modes: (1) episodic emplacement of significant volumes of sediment by infrequent floods and (2) progressive deposition of smaller volumes by frequent floods. Figure 2.10 shows the cross-sectional stratigraphy of the two trenches at the Gates of Lodore, including the locations and assigned numbers of the tamarisk stems used in our dendrogeomorphic analysis. We sampled and analyzed twelve Tamarisk plants, six in GTS-1, and six in GTS-2.

GTS-1 spans two natural levees (L1 and L2) the upper surfaces of which are just below the transition between the CB and IB surfaces preserved on the opposite bank (Figure 2.10A). Stratigraphic sequences of GTS-1 are both vertically stacked and inset, with bedding and contact orientations parallel or sub-parallel and horizontal. The core sediments (Lc) of the onshore levee (L1) consist of horizontally bedded silts (D_{50} = 50 μm), the finest sediments of all units in the GTS-1 trench (Table 2.1). The uppermost

elevations of the Lc unit can only be inundated by floods greater than 555 m^3/s, and no flood of this magnitude has occurred since 1921. The offshore face of the L1 core is truncated by stratigraphic units which dip steeply offshore (Cs, Cg, D, and E in Figure 2.10). These inset units overlie the basal sands (BS in Figure 2.10), which span from the bottom of L1, to the modern left bank of the side channel and consist of well-sorted fine sands (D_{50} = 220 μm).

Our interpretation of this stratigraphy is that vertical accretion of sandy floodplain units began prior to 1950 with the deposition of units A and Cs (Figure 2.10C). The oldest Tamarisk (G1) to establish along this transect germinated in 1950 on the offshore face of L1 near the top of the Cs unit. The five Tamarisk individuals offshore from L1 (G2-G6), established in 1953, 1952, 1956, 1955, and 1956, respectively. Burial signals within these six plants and the stage-discharge relationship constrain subsequent deposition of units C to G to between 1950 and 1962. Thus, the upper surface of GTS-1 is almost entirely a pre-dam feature. Units A to G each generally coarsen upward from an abrupt silty clay base, have ripple-drift cross-stratification, and have median grain sizes ranging from 68 to 100 μm, except for unit G, which has a D_{50} of 61 μm.

The largest volume of sediment deposited at GTS-1 was emplaced by the large magnitude floods between 1956 and 1958. The flood of 1957 was the largest flood since 1921 and the fourth largest instantaneous value on record (Figure 2.2). The most recent flood to deposit significant volumes of sediment at GTS-1 was the flood of 1962, which occurred just before closure of FGD.

Conversion of the unit bar at GTS-2 into a floodplain began with the deposition of poorly sorted fine sands within unit O over well-sorted basal channel sands. This process began after 1954 because aerial photos taken in that year confirm that the location of GTS-2 was an active bar (Figure 2.8B). The exact timing of deposition of units I through L_lu cannot be confirmed through dendrogeomorphology, because no Tamarisk stems established at these elevations prior to 1983. Aerial photos taken in 1980 confirm that a unit bar was not emergent above the elevation of the 94 m^3/s water surface elevation (Figure 2.7C). In addition, the "mounded" stratigraphic structure of units I, Ku and Lu are capped by an 8-cm thick bed of buried organics (O horizon) whose upper elevation is nearly equivalent to the stage of powerplant capacity (Figure 2.10B). This seam of organics contained well-preserved, in-place rhizomes of Rush (*Juncus spp.*), a species reported by Merritt and Cooper [2000] to be widespread on low floodplain surfaces equivalent in elevation to the stage of powerplant capacity in Browns Park. These observations suggest that the unit bar at GTS-2 emerged above the 94 m^3/s stage shortly after 1980 and became a floodplain equivalent in elevation to the PF.

The six sampled Tamarisk plants within GTS-2, G7 to G12, established in <1991, 1984, 1984, 1985, 1985, 1986, respectively (Figure 2.10B). These establishment elevations constrain the deposition of continuous units O through R_l between 1983 and 1991. The local stage-discharge relation suggests the only floods with magnitudes capable of inundating the upper GTS-2 surface during that time period are the floods of 1983, 1984, and 1986. Burial signals and stem damage in G8 and G9 constrain the deposition of unit R to 1986. Units O to R_l have coarsening upward grading and are generally coarser and better sorted than sediments below the organic horizon. Units Q to

Q_3 are further distinguished by their distinct ripple-drift cross-stratification. At GTS-1, ring suppression and stem damage to G5 and G6 suggest that unit H was deposited by the flood of 1983, the only post-dam bypass flood capable of overtopping the floodplain surface at GTS-2.

The distinct upper and lower boundaries of the units emplaced by large dam releases in the 1980's grade laterally into equivalent undifferentiated units beneath the low benches at the margins of the GTS-2 trench. These benches are equivalent in elevation to the stage of the powerplant capacity of FGD and are now inundated by annual post-dam floods, slightly less than the 2-year return interval. The discontinuous boundaries, textures, and structure of these units, including discontinuous clay ribbons, beaded sand seams, and buried cutbanks, is consistent with frequent cycles of erosion and deposition of fine sediment caused by frequent, low magnitude floods.

4.4 Floodplains of Lodore Canyon – Dellenbaugh, Trailer, and Dunn Cliff Trenches

The floodplains in Lodore Canyon have also been primarily constructed by discrete, large flood events. These floods have aggraded eddy bars above the elevation of the most frequently occurring floods in the post-dam era. As a result, these surfaces have been abandoned and vegetated, causing a transformation from active channel bars, to floodplains. The three eddy bars that were excavated have somewhat different geometry, resulting in different local stage-discharge relations, space available for deposition, and localized hydraulics. Thus, the trenches differ in stratigraphic detail, but are similar in terms of the role of large versus small flood events in building the floodplain. Detailed descriptions stratigraphic units and panels of trench stratigraphy in the eddy bar

excavations, similar to those shown in Table 2.1 and Figure 2.10B, can be found in Appendix A.

The oldest Tamarisk at each floodplain excavation germinated at the margin of the CB terrace (Figure 2.11A, B, C). The resolution of the pre-dam aerial photos is too coarse to verify the specific presence of young Tamarisk near our trenches, but the presence of new vegetation aligned in a thin strip along the channel margin is consistent with analysis of other historic aerial photos that showing that Tamarisk developed on the margin of a larger, former channel [Larson, 2004; Cooper et al., 2003].

Vertical accretion of the CB terrace continued to at least 1957. Stage-discharge relations at the Dellenbaugh and Trailer trenches suggest that the elevation of the CB terrace could have only been deposited by floods equal to or greater in magnitude than of 1957. At Dunn Cliff, the CB terrace is inundated by floods greater than 475 m^3/s. Excavations of the CB terrace at the Trailer and Dunn Cliff trenches reveal that these deposits are composed of several vertically stacked, horizontally bedded, discrete deposits varying in thickness from 10 to 50 cm, and composed of coarsening upward silts and fine sands. Dendrogeomorphic analysis of the oldest Tamarisk in each trench indicates that these sediments are older than 1963, the year of completion of FGD. Burial signals in the oldest Tamarisk (T1-established in 1950) at the Trailer excavation suggest that 1957 was the last flood to aggrade the CB terrace.

Much of the intermediate bench in the eddy bars of Lodore Canyon was deposited in two distinct flood events, the 1962 flood just prior to closure of FGD, and the 1983 flood, the largest post-dam flood. At the Dellenbaugh excavation, the D1 stem

established in 1960 and was buried deeply in 1962. This observation, as well as the establishment elevation of nearby Tamarisk (D2, D3) that established in 1962, suggest that the flood of 1962 deposited up to a meter of coarsening upward fine and very fine sands. At Dunn Cliff, the C1 Tamarisk established near the bottom of the pre-dam active-channel bank, 1 m above the stage of the peak flow of 1963, probably on a 1962 deposit. Further evidence of deposition in 1962 is substantiated by the T2 Tamarisk sample at the Trailer excavation. T2 established prior to 1980, and was later flood trained. Flow directions, interpreted from sedimentary structures and landforms, indicate that the reattachment bar platform on which T2 germinated is a pre-dam feature. While there is no definitive dendrogeomorphic evidence of the platform being created in 1962, the stage-discharge relation indicates that 1962 is the only flood that could have inundated this deposit within the period constrained by other data.

Evidence of inset deposition by powerplant discharges between 1963 and 1982 is present in a discrete, fining-upward deposit at the Dellenbaugh excavation. The top of this deposit is composed of red clay which is truncated near the elevation of FGD powerplant discharge. In addition, a flood trained Tamarisk (D5) established at the upper elevation of the deposit in approximately 1973. At Trailer Draw, the establishment elevation of the T2 Tamarisk near the stage of powerplant discharge, suggests that powerplant flows prior to 1983 either reworked or wetted the onshore part of the 1962 deposit. No other evidence of deposition by FGD powerplant capacity floods between 1963 and 1983 exists in the Lodore Canyon excavations.

Tamarisk establishing on eddy bars between 1963 and 1982 show evidence of stem damage and/or anatomical evidence of deep burial by the 1983 bypass flood. At the

Dellenbaugh excavation, damage to the downstream face of the flood-trained D5 stem indicates abrasion by suspended sediment transported in the upstream direction in 1983 (Figure 2.5B). Deep burial signals in the same plant show up to 85 cm of deposition by the 1983 flood. Flood training and burial signals in the T2 stem at Trailer Draw substantiate deposition of up to 50 cm by the 1983 flood. Damage to the stem of the C1 Tamarisk at Dunn Cliff is apparent on the side of the stem facing the river, indicating abrasion by onshore currents during the 1983 flood event. In addition to burial signals in the C1 stem in 1983, the discrete deposit burying the C1 stem by up to 80 cm has a top elevation above the stage of 300 m^3/s, further suggesting it was deposited by the 1983 flood.

Floods of 1984, 1986, and 1999 also caused vertical accretion, however, deposition was limited by the small difference between the stage of each flood and the elevation of the 1983 deposit. The horizontal extent of each deposit was limited by the distance between the margin of the 1983 deposit and the location of the eddy fence. Deposition in 1999 was greatest at Trailer Draw, where ring suppression in the T5 stem and the 1999 aerial photograph verify deposition of bare sand spanning offshore end of the trench location. Subsequent floods scoured the channel margin to the elevation of powerplant flows, forming a new PF level (Figure 2.11B). At Dunn Cliff, the PF level formed after 1986, although the exact timing of emplacement of this thin deposit cannot be constrained by the flood trained Tamarisk (C2). No other evidence of deposition by post-FGD flows less than powerplant capacity was observed in the Lodore Canyon excavations.

4.5 Grain-Size Variation of Floodplain Deposits

The distribution of grain sizes from samples of trench deposits reflect the range of flow magnitudes that deposited them. Figure 2.12 shows the grain size distributions for the basal sands, pre-dam deposits, post-dam bypass flood deposits, and post-dam powerplant regime deposits. Basal sands deposits are the coarsest deposits sampled and are composed of well-sorted fine-sands with median particle sizes varying between 150 μm and 340 μm, a size distribution similar to the bedload and active modern eddy bars reported by Martin et al. [1998] for the same reach. Post-dam powerplant flow deposits are the finest and most poorly sorted units sampled, with mean D_{50} of 57 μm and an average geometric standard deviation of 2.13 (>1.6 is poorly sorted).

The particle-size distributions of pre-dam floods and post-dam bypass floods show large areas of overlap. However, pre-dam floodplain deposits are generally finer and exhibit more variation than post-dam bypass flood deposits. The average D_{50} of pre-dam flood deposits in trench excavations is 81 μm and the average D_{50} of post-dam bypass floods is 97 μm, with geometric standard deviations of sandy units (>50% sand) ranging from 1.47 to 2.0 and 1.34 to 1.83, respectively. Pre-dam flood deposits also exhibit large areas of overlap with post-dam powerplant regime deposits, which are generally composed of poorly sorted silts and clays with an average geometric standard deviation of 2.14 and a D_{50} <62.5μm.

The significant overlap of the pre-dam flood deposits with both powerplant and post-dam bypass flood regimes reflects the larger flow variability in the pre-dam river. Pre-dam annual maximum flood magnitudes varied from 85 to 635 m^3/s. With the

exception of 1963, post-dam annual maximum flood magnitudes have varied from 105 to 388 m^3/s. Thus, the pre-dam sediments reflect the greater year-to-year variability in the annual flow regime.

4.6 Floodplain Accretion Time Series

The floodplains of the study area were primarily constructed by rare, large floods (Figure 2.13). Table 2 defines the return period and proportion of the CB and IB deposits built by floods. Pre-dam depositional patterns, illustrated by MFA curves at the Gates of Lodore and Trailer excavations, were marked by slow, progressive accretion as well as high magnitude accretion caused by larger, less frequent floods. In lower Browns Park, up to 14% of the floodplain was emplaced by the flood of 1957 alone, whereas the 1962 flood left up to 42 percent of the sediment within floodplains of Lodore Canyon.

Floodplain deposition after closure of FGD has been dominated by a stepwise pattern whereby most floodplain growth has occurred during the short intervals dominated by infrequent bypass floods. Trench observations of post-dam floodplain building in the periods without bypass floods is restricted to the only undifferentiated deposits at GTS-2 and a fining upward continuous deposit at Dellenbaugh. These patterns are represented on Figure 2.13 by the gradual increase in MFA values above average annual flows during the time period between closure of FGD and 1982 at the Gates of Lodore, and an episodic increase in MFA values at the Dellenbaugh excavation in 1964.

Deposition by the flood of 1983 accounts for up to 24% of the floodplain sediments visible in Lodore Canyon (Table 2.2). At the Gates of Lodore, flood

deposition during the 1980's accounted for up to 10% of the total floodplain sediments at the PF and IB level. With the exception of the Trailer excavation, bypass flood deposition during 1983, 1984, and 1986 increased floodplain accretion to 90 percent or greater of modern levels at all sites, leaving little vertical space for deposition by bypass floods of the late 1990's.

5. Discussion

Vertical accretion of the floodplain prior to closure of FGD is apparent in all trench excavations for this study. Our time series of floodplain accretion show that pre-dam floodplain depositional patterns closely mimicked the hydrology, with lower-flow years depositing small amounts of sediment at lower elevations and bigger floods triggering large depositional events. This accretion was limited to the parts of the channel with the highest divergence in flow velocities the channel margins and persistent bar features. In the case of the Gates of Lodore, the levee that existed after 1952 limited vertical accretion to only the least frequent floods. The floodplain building began here with the deposition of finer sediments inset to the levee, followed by the establishment of riparian vegetation. In Lodore Canyon, the CB terrace was still an active feature until 1957, and its upper surface excluded deposition except by large floods.

After closure of FGD, the gaps between high-magnitude floods became much larger, and the decrease in flood magnitudes shifted the areas of flow divergence to locations inset to the previously active channel. This shift is best illustrated by the Lodore Canyon excavations, where flooding in 1962 left large amounts of sediment in bars, which were abandoned after closure of FGD. In lower Browns Park the shift caused abandonment of the higher IB surface near the channel margin, and vertical accretion of

in-channel features such as the GTS-2 unit bar. These deposits became vegetated prior to 1982 and likely served as stable platforms for high-magnitude deposition during the bypass floods of the 1980's.

The pattern of floodplain deposition during high-magnitude floods of the early and late 1950's, 1962, and the bypass floods of the early 1980's are consistent with those reported downstream of the Yampa River confluence. Allred and Schmidt [1999] reported vertical accretion and narrowing at Green River, Utah during the same years. Additionally, Allred and Schmidt described a similar floodplain-building process whereby the areas of the channel with the largest velocity divergence (i.e. bars and channel margins) were also the areas of greatest vertical accretion during the large flood events. This correlation suggests a basin-wide narrowing behavior along the Green River that is closely linked with lower-frequency, high magnitude floods.

5.1 Comparison with Other Reports of Floodplain Building

The sequence of floodplain building in the upper Green River is comparable with other studies of floodplain building where vertical accretion is the dominant depositional process. Pre-dam floodplain growth in the CB terrace of Lodore Canyon, and at the shoreward margin at the Gates of Lodore fit a conceptual overbank sedimentation model proposed by Wolman and Leopold [1957], and later described by other authors [Ritter et al., 1973; Brakenridge, 1984; Nanson, 1986; Moody et al., 1999; Moody and Troutman, 2000]. In this model floodplain inundation and subsequent sedimentation decreases as the elevation of the floodplain rises. However, our data also show that this process should not be gradual, but is episodic because large floods can play a disproportionate

role is depositional magnitudes. Moody et al. [1999], highlighted the importance of both erosion and deposition, as well as the sequence of hydrologic events in shaping the floodplain and controlling the rate of floodplain aggradation. While our data only track deposition, our stratigraphic results reflect the influence of erosion via the sloping and re-worked floodplain deposits near the river-side margins of the floodplain.

The style of floodplain growth initiation in lower Browns Park is also similar to those reported for channel narrowing following a channel widening event [Schumm and Lichty, 1963; Burkam, 1972; Friedman et al., 1996; Moody et al., 1999], and recovery from channelization [Hupp and Simon, 1991]. In all cases, floodplain growth was initiated by deposition of sediments on a sub-horizontal bench in the areas of the channel that were either slightly elevated within the recovering channel or sheltered from subsequent erosion. This study reinforces those findings, but it also highlights the potential of large floods to cause punctuated growth in the extent and elevation of the floodplain.

5.2 Channel Narrowing and Riparian Vegetation

The locations and age distribution of Tamarisk in Lodore Canyon and Browns Park are closely associated with the shifts in hydrology described above. Our Tamarisk distribution data, although limited, show that prior to closure of FGD, these plants were restricted to the margins of the channel and highest bar surfaces (Figure 2.14). The abandonment of IB deposits emplaced in 1962, resulted in widespread recruitment of Tamarisk in 1962 and 1963 [Cooper et al., 2003]. The creation of new PF surfaces inset to the IB deposits between 1963 and 1982, was coincident with periods of dam

management which did not favor the seed window of native woody species, with high flows sometimes occurring in the late summer, fall or winter. The offset of annual peak flows likely had profound effects on the ability of native plants to compete. This claim is substantiated by the paucity of recruitment years favoring Cottonwood relative to Tamarisk in lower Browns Park between 1963 and 1982 [Merritt and Cooper, 2000]. In Lodore Canyon, the oldest Tamarisk were limited to the shoreward margins of eddy bars, a finding similar to those reported for eddy bars by Cooper et al. [2003], and by Birken and Cooper [2006] for Grays Canyon.

Our stratigraphic data show that the bypass floods of the 1980's not only further accreted the IB surfaces, but that deposition also occurred on the PF surfaces, burying existing stems by up to 90 cm, effectively isolating them from subsequent high flows (Figure 2.14). Thus, the floodplain built within the pre-dam channel by powerplant flows served as a surface for vertical accretion. Additionally, measured ring increments for some of these plants indicate sustained high growth rates following the year of burial, suggesting burial markedly improved growing conditions.

Recent descriptions of floodplain accretion in reaches of the Green River downstream of the Yampa confluence, used isolated soil profile pits along a transect and Tamarisk establishment dates to pose potential links between floodplain building processes and riparian vegetation [Birken and Cooper, 2006]. The stratigraphic details of our trenches show that the upper and lower boundaries of each deposit may have substantial lateral variation in elevation. Additionally, these boundaries are not always continuous for the extent of each trench. Thus, a laterally continuous trench and complete stratigraphic record of the floodplain architecture at a site, in conjunction with

high resolution floodplain building rates, are paramount to the interpretations of the processes responsible for building them. Our data highlight the importance of lower flows in building lower elevation, in-channel floodplain surfaces which act as platforms for further vertical accretion by large floods.

Inset floodplain building in the pre-dam era created deposits for recruitment of woody species, including Tamarisk, but the rapid expansion of Tamarisk and its establishment on higher floodplain surfaces, was directly correlated to the shift in the flood regime and subsequent management of flows by FGD. This finding contrasts claims by other authors that Tamarisk was the primary driving force in floodplain building in the lower and middle Green River [Graf, 1978; Birken and Cooper, 2006].

5.3 Implications for River Management

Prescriptions to mitigate the undesirable effects of dams include experimental floods of pre-dam magnitudes intended to restore channel features necessary for the success of endangered species and native riparian corridors [Molles et al., 1998; Webb et al., 1999; Richter and Richter, 2000; Rood et al., 2003]. The process of floodplain building in the pre-dam era described above highlights the importance of low-flows in building lower-elevation floodplains which act as platforms for vertical accretion. Prior to closure of FGD, these lower elevation floodplains were limited in spatial extent because larger floods, while depositing sediment on these surfaces, maintained the remaining parts of the channel. Because FGD can hold over two years of the mean annual flow of the Green River, emergency spills are generally avoidable, and thus, channel maintenance is infrequent.

It appears that sediment is available in quantities large enough for in-channel deposition in the upper Green River [Grams and Schmidt, 2005]. The increase in the pre-dam equivalent of low flows (powerplant capacity), and decrease in higher channel maintenance flows after closure of the dam has enhanced the role of low flows in floodplain building processes. The pronounced gaps between large floods have allowed for widespread in-channel floodplain building and riparian vegetation establishment, likely causing enhanced sedimentation during bypass floods, disconnecting these lower floodplains from the post-dam active hydrologic range. The need for increased frequency of channel maintenance flow creates a dilemma for managers balancing diminishing water supplies and power generation revenues against the health of the downstream riparian and aquatic ecosystems.

6. Conclusions

Floodplain building in the upper Green River is caused by both small and large floods. Our data show that frequent, smaller floods build surfaces of finer material inset within higher floodplain levels that are built by large floods. These two flood regimes interact to build floodplains with two levels, one set to the elevation of the highest magnitude floods of a time period and a lower level set to the level of lower-magnitude floods.

Inset floodplain deposition and subsequent channel narrowing in the upper Green River began in the late 1940's and early 1950's. In lower Browns Park, narrowing began when large floods of the 1950's deposited high, spatially extensive deposits. Vertical accretion of a similar deposit also occurred in Lodore Canyon by the 1957 flood. The closure of FGD reduced flood magnitudes, shifting floodplain building to deposits inset

to those of the late 1950's and 1962, thus, increasing the spatial extent of lower floodplains. These lower floodplains acted as substrates for the establishment of riparian vegetation and later served as stable platforms for the vertical accretion of sediments during the bypass floods of the 1980's.

Prescriptive hydrologic scenarios for restoration of aquatic habitat and riparian structure should consider more than just the magnitude of flood events. Infrequent, short duration, high-magnitude flood events on rivers with high suspended sediment loads may further disconnect the riparian corridor from the regulated annual hydrology. Additionally, prescriptive floods should be timed to favor the seed windows of native riparian species if their recruitment is to be encouraged.

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Table 2.1 Descriptions of Stratigraphic Units within the Gates of Lodore Excations GTS-1 and GTS-2

Unit	Description
Lc	Undifferentiated levee core units; D_{50} = <62.5 mm; GSD = 1.78
BS	Basal sand units composed entirely of buff, well-sorted, friable fine to medium sand with occasional ripple-drift cross laminations; average D_{50} = 234 mm; GSD = 1.62
A	Coarsening upward unit with red clay base grading into brown silt and fine sand; occasional bioturbated ripple structure indicating onshore/downstream flow vectors; D_{50} = 178 mm; GSD = 1.79
C_g	Series of thin, vertically stacked units which coarsen upward from gray-brown clay to massive brown silt and very fine sand; average D_{50} = 72 mm; GSD = 1.57
C_s	Series of discontinous units below unit C_g which generally coarsen upward from a grey-brown clay base to massive silts and fine sand; average D_{50} = 84 mm; GSD = 1.7
D	Coarsening upward unit with dark gray/ brown clay base grading into buff fine sand with discontinous, bioturbated low-angle climbing ripples; D_{50} = 70 mm; GSD = 1.67
E	Coarsening upward unit with a gray silty-clay base grading into a buff fine sand with ripple trough cross-stratifications indicating onshore and downstream flow vectors; D_{50} = 78 mm; GSD = 1.51
E_1	Generally fining upward unit grading from well-sorted fine sand to silt and very fine sand with some clay near the top; ripple trough stratification visible near base showing downstream and both onshore and offshore flow vectors; D_{50} = 68 mm; GSD = 1.53
E_2	Fining upward unit composed of buff fine sand near base grading into silty-fine sand; unit coarsens offshore into medium sands with distinct ripple cross laminations indicating both onshore and offshore flow vectors; D_{50} = 103 mm; GSD = 1.52
E_3	Generally fining upward unit grading from brown fine sand to silty clay and clay near the top; sands near base show ripple cross laminations with distinct onshore and downstream flow vectors; D_{50} = 93.4 mm; GSD = 1.56
F	Coarsening upward unit with a gray/brown silty-clay base grading into a buff silty-fine sand which contains some ripple cross laminations near the top but is otherwise massive; D_{50} = 72 mm; GSD = 1.57
G_1	Thin, fining upward unit grading from a buff fine sand into a silty fine sand; climbing ripple structure throughout unit indicating onshore-downstream flow vectors; D_{50} = 85 mm; GSD = 1.47
G	Coarsening upward unit with a brown-gray silty-clay lower boundary grading into a gray-buff silty-fine sand which is generally massive, with some bioturbated laminations and salt precipitate; average D_{50} = 60 mm; GSD = 1.93
H	Thin coarsening upward unit grading from a red clay base into massive silt/ very fine sand with duff near the top*
Ud	Undifferentiated units generally composed of discontinous beds of bioturbated fine sand, silt, and clay with roots; some clays are black and blue-gray indicating reducing conditions with high organic content; D_{50} = <62.5 mm; GSD = 2.26
I	Fining upward unit grading from basal sands near base to very fine sand; ripple laminations throughout; D_{50} = 141 mm; GSD = 2.02
Ju	Unit with abrupt onshore boundary composed entirely of brown fine sand and silt with a clay matrix, some ripple laminations and iron mottling; D_{50} = 69 mm; GSD = 1.92
Ku	Generally coarsening upward unit with a clay gray clay base grading into brown fine sand with ripple laminations throughout; intermittent clay bands and fine sand seams*
Lu	Unit generally composed of silty clay truncated at the upper boundary by interbedded clay and sand lenses capped by a prominent duff seam of maximum thickness of 8cm; margins of unit include discontiuous ribbons of clay and fine sand seams; average D_{50} = <62.5 mm; GSD = 2.50
L_1u	Discontinous unit with graditional upper and lower boundaries composed almost entirely of massive gray-brown silty clay; D_{50} = <62.5 mm; GSD = 2.17
Mu	Unit with abrupt onshore boundary (cutbank) which fines offshore from gray-brown fine sands with ripple structure into gray-brown silty clay with ripples and sand seams; D_{50} = <62.5 mm; GSD = 2.14
Nu	Discontinous unit which fines offshore from fine sand and silt with ripples to silty-clay; D_{50} = <62.5 mm; GSD = 2.13
O	Generally coarsening upward buff unit grading from a clay base into silty-clay and fine sand with some ripple drift cross laminations; D_{50} = <62.5 mm; GSD = 2.03
Pu	Unit composed of of silt and clay with a base of beaded, well-sorted sand lenses*
Q	Unit composed of interbedded buff, well-sorted, friable sands with ripple and dune strucutures and massive, brown beds of silty-clay; D_{50} = 197 mm; GSD = 1.34
Q_1	Generally coarsening upward buff unit composed almost entirely of silty-clay; D_{50} = 72 mm; GSD = 1.57
Q_2	Unit composed entirely of buff well sorted fine sand with climbing ripple structures indicating onshore flow vector; rip-up clasts near base where unit coarsens upward; D_{50} = 97 mm; GSD = 1.51
Q_3	Coarsening upward unit grading from a buff silty-clay base into well sorted fine sand with low-angle climbing ripple structure; D_{50} = 110 mm; GSD = 1.54
R	Generally coarsening upward buff unit grading from silty-fine sand to fine sand with ripple laminations throughout; D_{50} = 82 mm; GSD = 1.45
R_1	Coarsening upward unit grading from a lower boundary of red and gray clay into buff silt and very fine sand with low-angle climbing ripple structures; D_{50} = <62.5 mm; GSD = 1.72
S	Generally massive buff unit composed entirely of silty-fine sand with some clay matrix and iron mottling; D_{50} = <62.5 mm; GSD = 1.59

* not sampled for grain size
GSD - geometric standard deviation

Table 2.2 Floodplain Depositional Episodes in the Upper Green River and their Fraction of the Cross Sectional Area of the Floodplain Above Average Flow

Depositional Episode	Return Period	Gates of Lodore	Dellenbaugh	Trailer	Dunn Cliff
Fraction of Floodplain Present Prior to First Observation		0.49	0.27	0.30	0.73
Period 1930-1962 (n=33)					
1956	8.5	0.06		0.04	
1957	34.0	0.14		0.04	
1958	2.4	0.05			
1959	1.6	0.03			
1962	4.3	0.03	0.42	0.09	0.04
Period 1963-2005 (n=43)					
1983	44.0	0.02	0.24	0.17	0.15
1984	14.7	0.02			
1986	8.8	0.07		0.02	
1999	22.0	0.02	0.04	0.08	
Total Fraction of Floodplain From Depositional Episodes		0.4	0.7	0.4	0.2

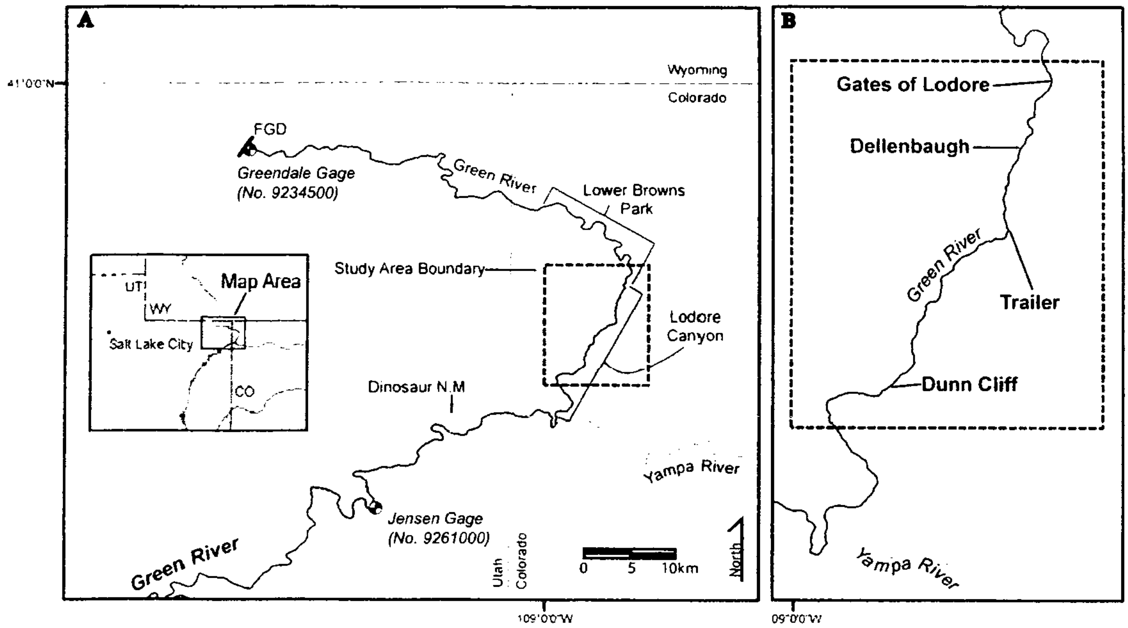


Figure 2.1 (A) Location map of the upper Green River, boundary of study area, and extent of lower Browns Park and Lodore Canyon (B) Locations and names of floodplain trench excavations within the study area

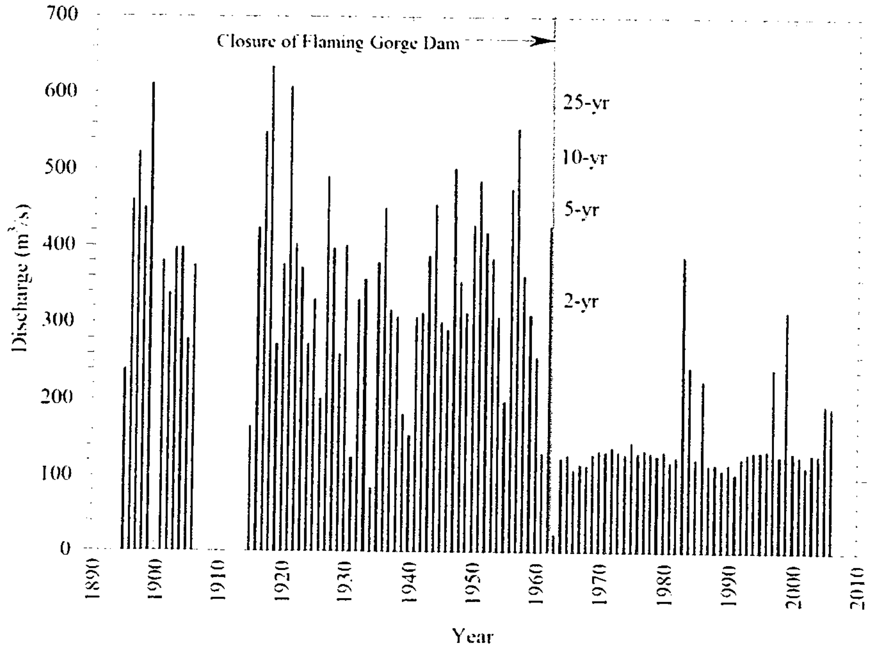


Figure 2.2 Annual maximum flood series for the upper Green River at Greendale, Utah, including the magnitudes of the 2, 5, 10, and 25 year recurrence flows as determined using a log-Pearson Type III probability distribution function. After 1930, the 2-year return flood decreased by 15 percent following a climatic shift. Since 1963, flood flows have been generally limited to the power generating capacity of Flaming Gorge Dam (~130 m^3/s). Measurements at Greendale began in 1950, and estimates of earlier floods are from Grams and Schmidt (2005)

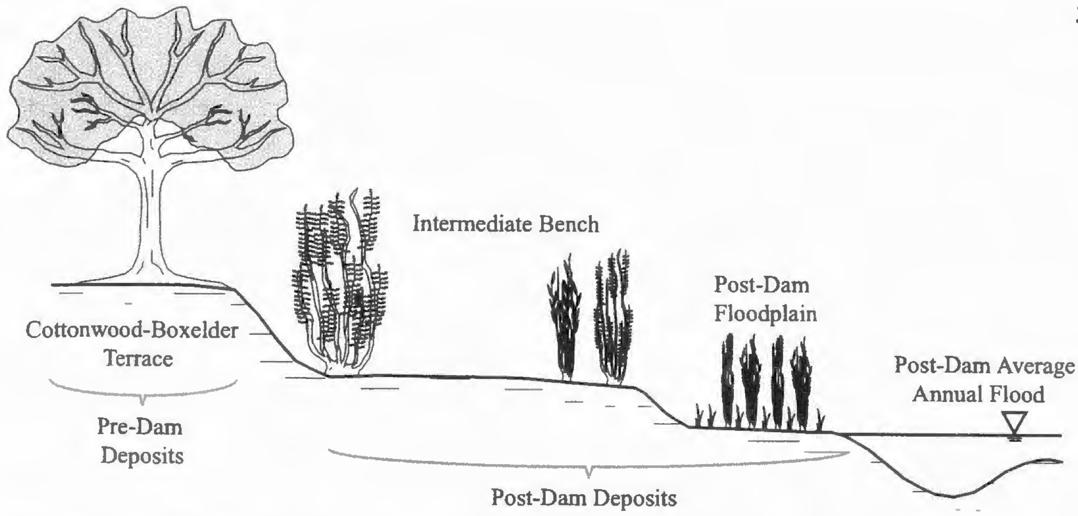


Figure 2.3 Sketch of mapped floodplain surfaces relative to the post-dam average annual flood in the upper Green River. Adapted from Grams and Schmidt [2002].

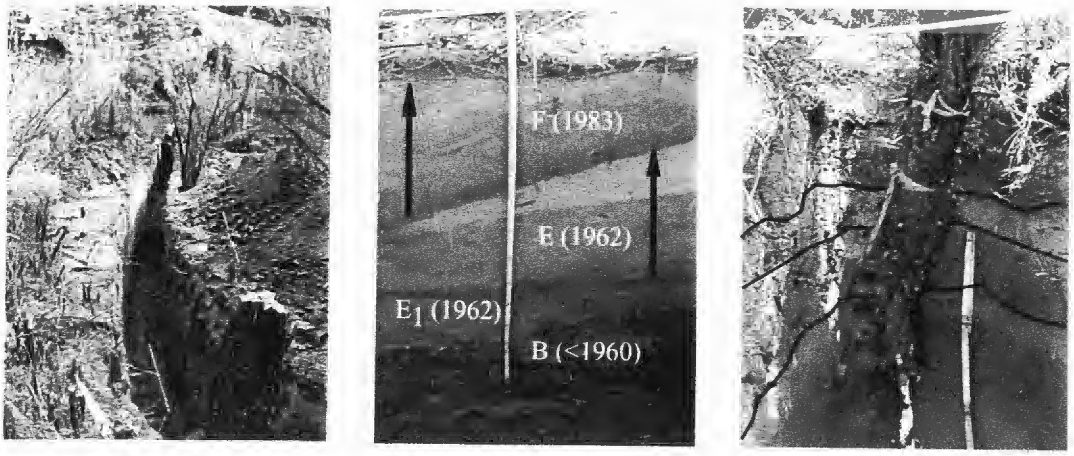


Figure 2.4 (A) Photo of the trench at the Dellenaugh site from the shoreward end of the trench looking offshore. The total trench length is approximately 22 m and depth varied from 1 to 2 m. The stump in the foreground is the oldest Tamarisk on the bar and it germinated in 1960. The Tamarisk in the middle of the photo on the right side of the trench established in 1962, just prior to closure of FGD. (B) close-up of trench stratigraphy showing discrete units; the location of this photo is marked on Figure 10A; offshore is to the left. The length of the measuring tape is approximately 1.3 m. The arrows show the direction of grain coarsening in two deposits with sharp upper and lower boundaries. The median grain sizes of units F, E, E1, and B are 90, 128, 145, and <62.5 microns respectively; (C) Photo close up of a Tamarisk in a lateral trench off the main trench. The ruler is approximately 30 cm. Nails in the tree mark the elevation of the adjacent stratigraphic sequences which were traced from the main trench into the lateral trench.

A

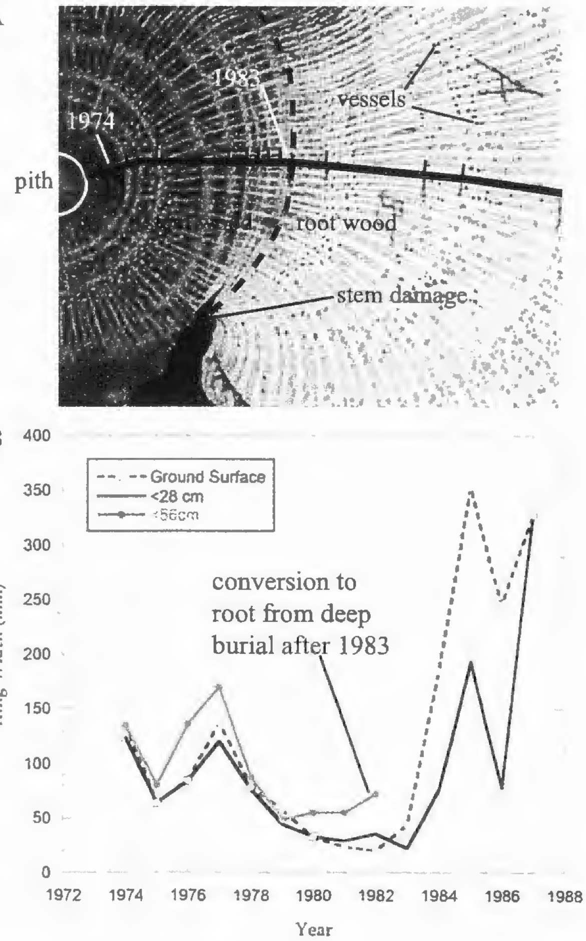


Figure 2.5 (A) Photo of annual growth rings in a slab cut perpendicular to the stem of Tamarisk D5 from the Dellenbaugh trench. The slab was approximately 28 cm below the 2005 ground surface. Tick marks along the line represent annual ring widths. Note the distinct change in wood anatomy from dense stem wood to the more vesicular anatomy of root wood after 1983. The anatomical change was due to burial from the 1983 flood. Additional evidence of flooding and sedimentation in 1983 at this elevation is evident from stem damage. The location of this tree is marked on Figure 10. (B) Time series of the average width of annual growth rings in three different slabs of Tamarisk (D5): the current ground surface slab, and slabs 28 and 56 cm below the current current ground surface. Each line represents the average of two radii on each slab. Prior to 1983, growth rates in all three slabs follow similar paths. After 1982, annual rings in the slab 56 cm below the surface become indistinct because stem wood was converted rapidly to root wood. The slab 28 cm below the surface shows growth suppression in 1983, followed by continued suppresed growth rates relative to the ground surface slab until 1987. These growth patterns suggest deep burial of the slab 56 cm below the surface, and shallow burial of the slab 28 cm below the surface in 1983.

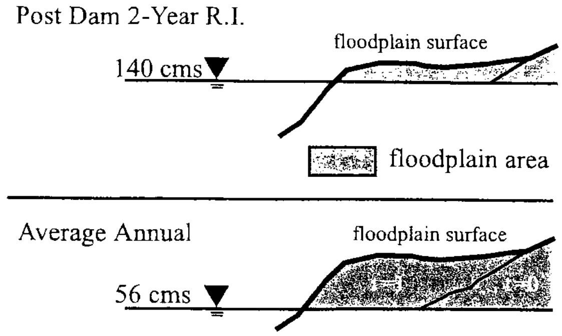


Figure 2.6 Schematic diagram of the method for calculating the minimum fractional cross section area (MFA) of a floodplain from trench stratigraphy. Flooplain deposit cross-sectional area is then calculated for each observation time (t) above a reference water surface elevation. The calculation is a minimum estimate of sediment in the floodpain at the observation time because subsequent erosion may reduce the area of previous deposit.

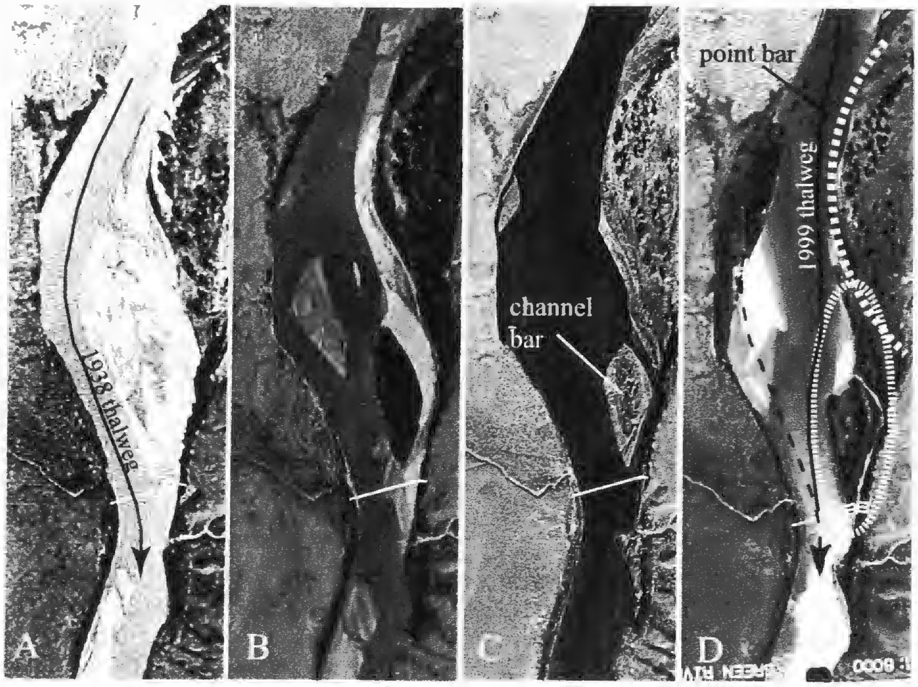


Figure 2.7 Aerial photo sequence of the Gates of Lodore trench. Flow is from top to bottom. The white line is the cross section along the excavation and is approximately 157 m long. The two boxes represent the locations of GTS-1 (right) and GTS-2 (left). The right margin of the cross section ends at bedrock. (A) 1938, 31 m^3/s (B) 1954, 31 m^3/s (C) 1980, 94 m^3/s (D) 1999, 39 m^3/s. Note the presence of an active bar along the cross section in 1938 and 1954. In 1980 the sand bar at the margin of the channel is visible and vegetated while the downstream end of the large vegetated mid-channel bar was submerged. In 1999, both bars are vegetated and emergent.

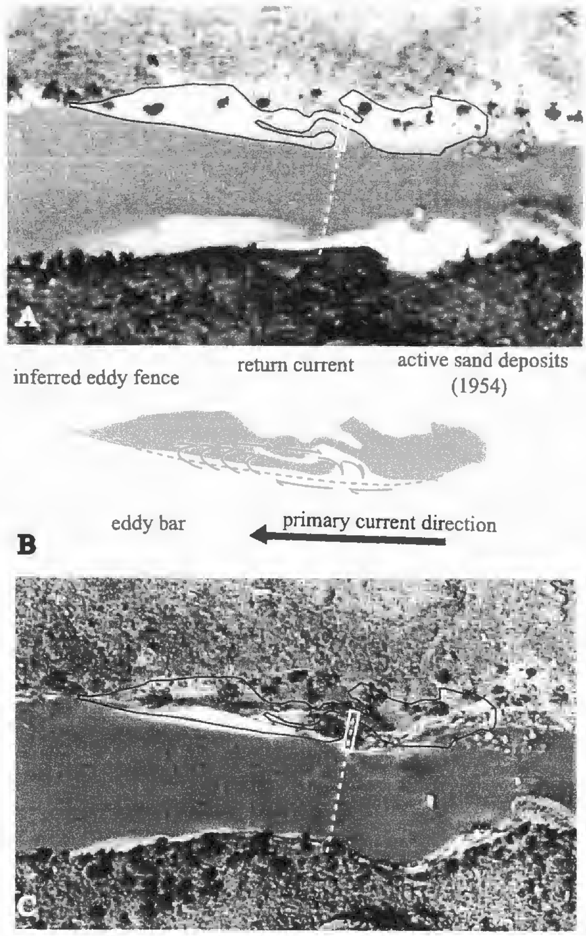


Figure 2.8 Aerial photo sequence and diagram of inferred flow directions of the Dellenbaugh trench. The dashed white line is the projection of the trench across the channel where the trench was dug and is approximately 75 meters across; the white box shows the extent of the trench excavated through eddy bar and eddy return channel (A) 1954, 31 m^3/s. (B) Inferred flow directions and estimated location of eddy fence. (C) 1999, 39m^3/s. Note the stabilized primary eddy sand features in the 1999 photo. The woody vegetation in the 1954 photo is Boxelder (*Acer Negundo*); in the 1999 photo, the woody vegetation is dominated by Tamarisk.

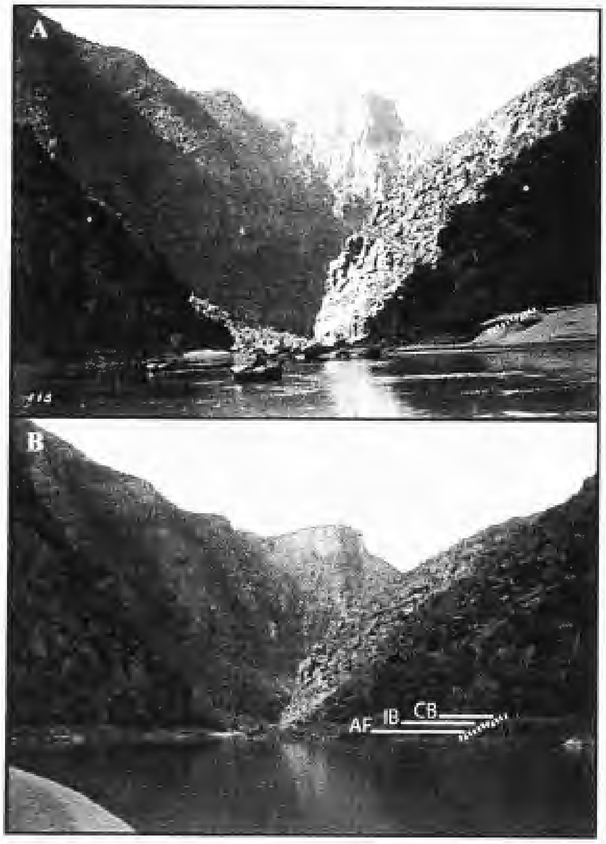


Figure 2.9 Dunn Cliff trench site. View is looking downstream. The dashed line is the location of the trench; horizontal lines show elevation of post-dam floodplain levels (A) Stone-Galloway expedition, 1909 (B) Photo by Paul Grams, 1995. The distinct vertically stacked sediments in the upper photo are similar to those observed in the excavation of the CB level at this site. The vegetation on the eddy bar in the lower photo is almost entirely Horsetail (Equisetum spp.) with some Tamarisk establishment.

Figure 2.10 (A) Complete cross section and total scale of the Gates of Lodore floodplain excavation with locations of unit bars GTS-1 and GTS-2 within the active compound bar complex; cross section is looking downstream. The upper horizontal surface in GTS-1 is between the elevations of the IB and the CB terrace. The lower benches of GTS-2 are the AF surface. (B) Stratigraphic details of the trench excavations including the locations and establishment elevations of Tamarisk trees used in the dendrogeomorphic analysis; gray lines indicate the density and orientation of sedimentary structures. Unit descriptions including grain size and sorting are in Table 1. (C) Dendrogeomorphic interpretation of stratigraphic units indicating approximate years of deposition; narrow units were grouped with those surrounding large units whose field interpretation of texture and structure was most similar.

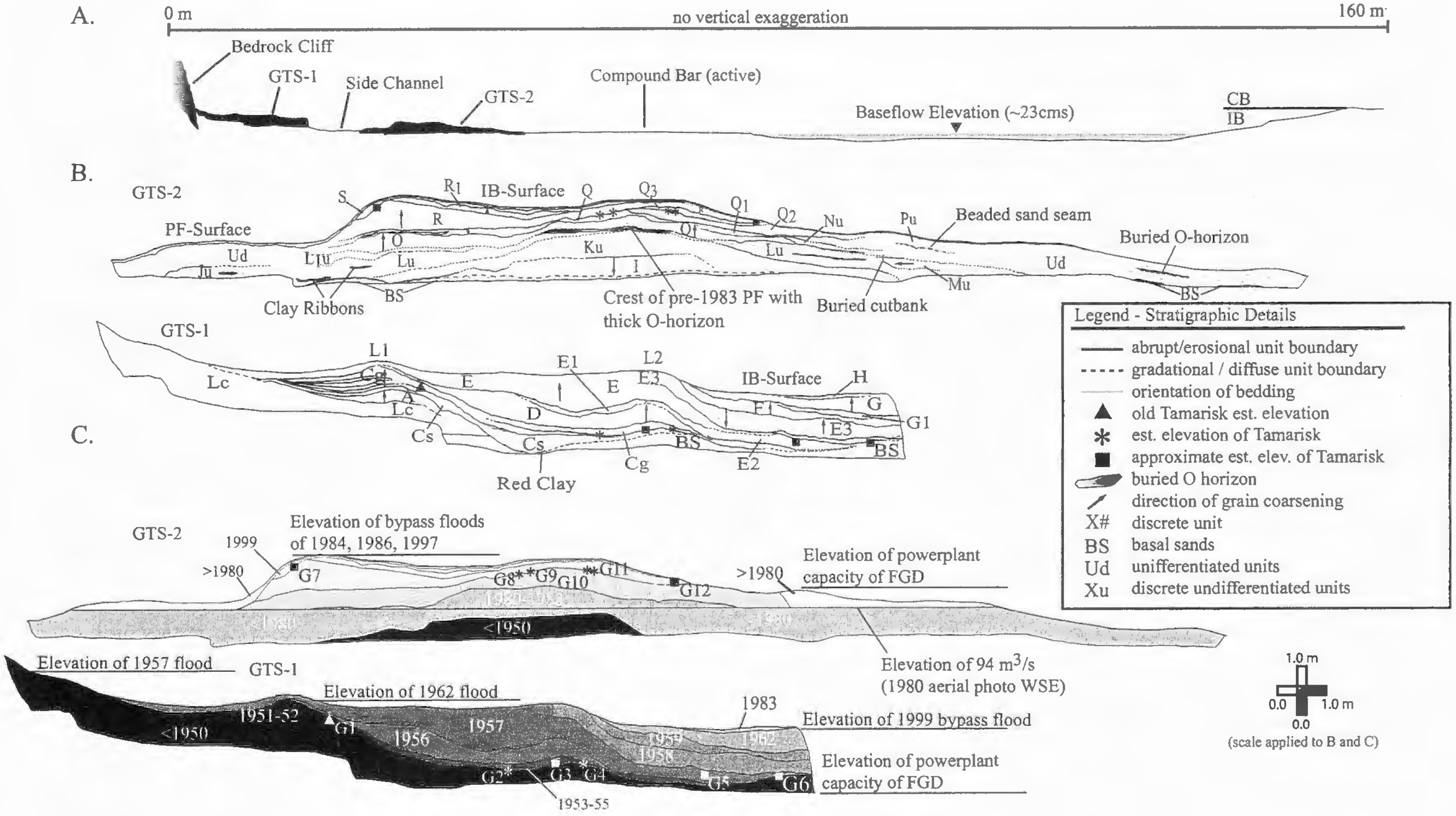
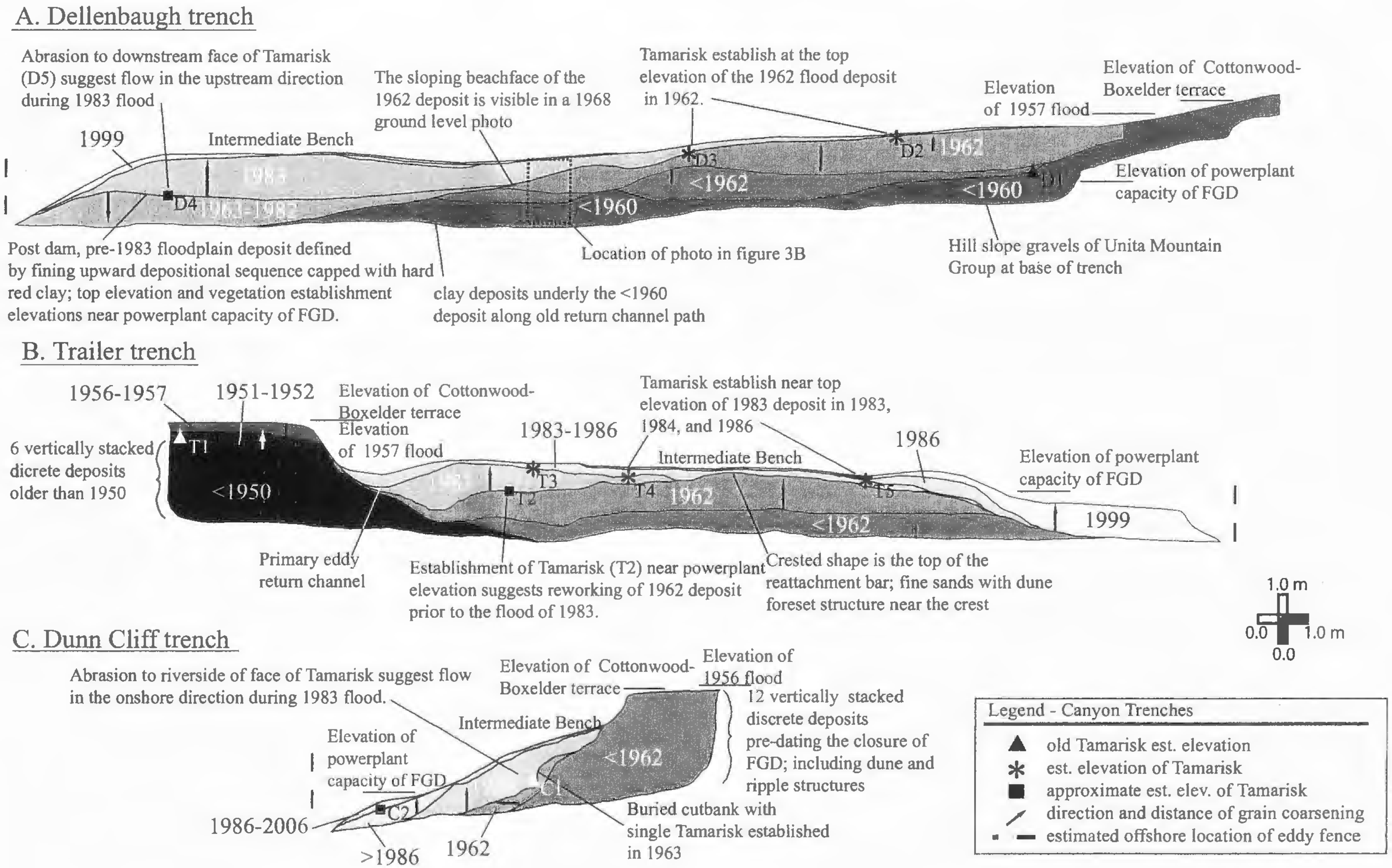

A.
0 m
no vertical exaggeration
160 m
Bedrock Cliff
GTS-1
Side Channel
GTS-2
Compound Bar (active)
Baseflow Elevation (~23cms)
CB
IB
B.
GTS-2
S
R1
IB-Surface
Q
Q3
Q1
Q2
Nu
Pu
Beaded sand seam
PF-Surface
R
O
Ku
Ud
Ju
Llu
Lu
I
Mu
Buried O-horizon
BS
Clay Ribbons
Crest of pre-1983 PF with thick O-horizon
Buried cutbank
GTS-1
L1
E1
L2
E3
IB-Surface
H
G
G1
Lc
E
D
F1
E3
Cs
Cg
BS
E2
Red Clay
C.
Legend - Stratigraphic Details
abrupt/erosional unit boundary
gradational / diffuse unit boundary
orientation of bedding
old Tamarisk est. elevation
est. elevation of Tamarisk
approximate est. elev. of Tamarisk
buried O horizon
direction of grain coarsening
X# discrete unit
BS basal sands
Ud unifferentiated units
Xu discrete undifferentiated units
GTS-2
Elevation of bypass floods of 1984, 1986, 1997
1999
>1980
G7
G8
G9
G10
G11
G12
>1980
Elevation of powerplant capacity of FGD
<1980
<1950
Elevation of 94 m³/s (1980 aerial photo WSE)
Elevation of 1957 flood
GTS-1
Elevation of 1962 flood
1983
Elevation of 1999 bypass flood
<1950
1951-52
G1
1956
1957
1959
1962
1958
G2
G3
G4
G5
G6
1953-55
Elevation of powerplant capacity of FGD
1.0 m
0.0
1.0 m
0.0
(scale applied to B and C)

Figure 2.11 Dendrogeomorphic interpretation of stratigraphic deposits in the floodplain excavations of eddy bars in Lodore Canyon. Time designations represent years or periods of deposition determined from annual growth rings, stem damage, and establishment elevation data from Tamarisk as well as aerial and ground-level photographs (A) Dellenbaugh (B) Trailer (C) Dunn Cliff. All views are facing in the downstream. Eddy fence locations were estimated based on the projection of a line between the upstream constriction apex and edge of the bank near the downstream reattachment point.


A. Dellenbaugh trench
Abrasion to downstream face of Tamarisk (D5) suggest flow in the upstream direction during 1983 flood
The sloping beachface of the 1962 deposit is visible in a 1968 ground level photo
Tamarisk establish at the top elevation of the 1962 flood deposit in 1962.
Elevation of 1957 flood
Elevation of Cottonwood-Boxelder terrace
1999
Intermediate Bench
1983
D4
1963-1982
<1960
D3
<1962
D2
1962
D1
<1960
Elevation of powerplant capacity of FGD
Post dam, pre-1983 floodplain deposit defined by fining upward depositional sequence capped with hard red clay; top elevation and vegetation establishment elevations near powerplant capacity of FGD.
clay deposits underly the <1960 deposit along old return channel path
Location of photo in figure 3B
Hill slope gravels of Unita Mountain Group at base of trench
B. Trailer trench
1956-1957
1951-1952
Elevation of Cottonwood-Boxelder terrace
Elevation of 1957 flood
1983-1986
Tamarisk establish near top elevation of 1983 deposit in 1983, 1984, and 1986
1986
Elevation of powerplant capacity of FGD
6 vertically stacked dicrete deposits older than 1950
T1
<1950
T3
T2
T4
Intermediate Bench
1962
T5
<1962
1999
Primary eddy return channel
Establishment of Tamarisk (T2) near powerplant elevation suggests reworking of 1962 deposit prior to the flood of 1983.
Crested shape is the top of the reattachment bar; fine sands with dune foreset structure near the crest
1.0 m
0.0
1.0 m
0.0
C. Dunn Cliff trench
Abrasion to riverside of face of Tamarisk suggest flow in the onshore direction during 1983 flood.
Elevation of Cottonwood-Boxelder terrace
Elevation of 1956 flood
12 vertically stacked discrete deposits pre-dating the closure of FGD; including dune and ripple structures
Intermediate Bench
Elevation of powerplant capacity of FGD
<1962
C1
C2
1986-2006
>1986
1962
Buried cutbank with single Tamarisk established in 1963
Legend - Canyon Trenches
old Tamarisk est. elevation
est. elevation of Tamarisk
approximate est. elev. of Tamarisk
direction and distance of grain coarsening
estimated offshore location of eddy fence

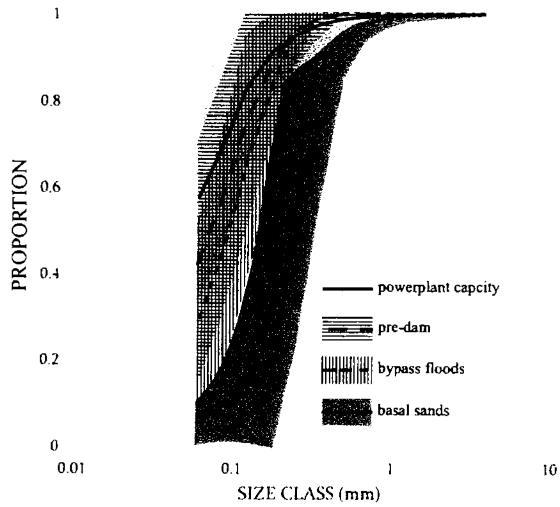


Figure 2.12 Grain size distributions of floodplain deposits; each distribution polygon represents +/- 1 standard deviation about the mean. The pre-dam floodplain sediment show strong distributional overlap with both the powerplant capacity and bypass flood sediments, a reflection of the pre-dam annual variablilty in flood magnitude.

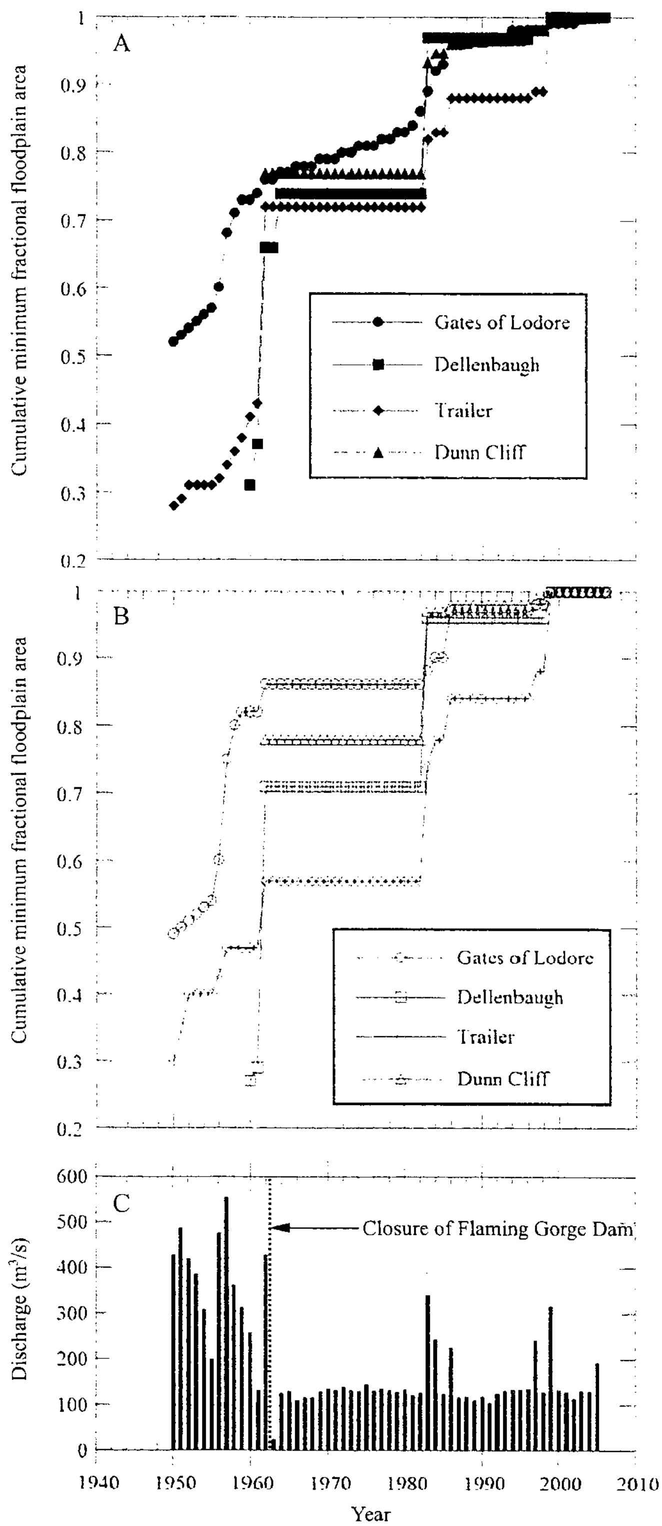


Figure 2.13 Time series of cumulative minimum floodplain growth (A) above average annual flow (~57 m^3/s) (B) above post-dam 2-year return flood (~140 m^3/s). (C) annual maximum flood series for Greendale Utah. Note that large floodplain depositional events correspond closely with the largest floods of each era. Progressive depositon of floodplain surfaces between the average and powerplant flow stages after dam closure occured only in the meanders of lower Browns Park (Gates of Lodore trench site).

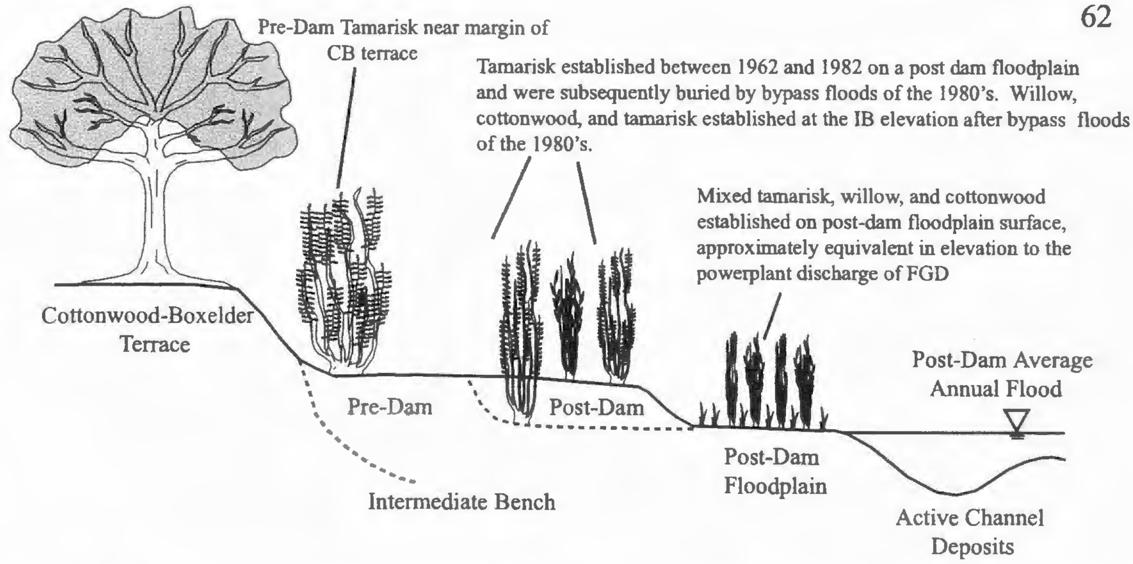


Figure 2.14 Generalized distribution and stratigraphic relationships of floodplain deposits and associated woody riparian vegetation within the upper Green River, modified from Grams and Schmidt [2002]. Woody riparian vegetation distributions after Larson [2004] and Cooper et al. [2003]. Prior to this study, both the intermediate bench and the post-dam floodplain were assumed to be post-dam features, while the Cottonwood-Boxelder terrace was considered a pre-dam feature. In the restricted meanders of Browns Park, the Intermediate Bench is both a pre-and post-dam feature. In Lodore Canyon, the Intermediate Bench was created by the floods of 1962 and 1983.

CHAPTER 3

RECENT CHANNEL ADJUSTMENTS TO RESTORATIVE FLOODS IN THE UPPER GREEN RIVER IN LODORE CANYON, COLORADO

Abstract

Analysis of repeat measurements at 36 cross sections along a 20 km reach in Lodore Canyon show that the sand storage condition in 2006 was no different than the condition observed in 1994, despite an increased frequency of high magnitude floods. Four high magnitude floods occurred in 1997, 1999, 2005, and 2006, but only one, the 1999 flow, triggered channel adjustments to the bed and banks that were significantly different than those of the post-dam 2-year return flood. This condition of relative equilibrium is in stark contrast to the Colorado River in Grand Canyon, a river with similar geomorphic organization, regulatory constraints and habitat management goals. Because of this, managers need to approach restoration and rehabilitation in the upper Green River with a different strategy than those used on the Colorado River.

1. Introduction

The response of river channels to regulation is complex and generally hinges on the relative change in the sediment supply in relation to the change in sediment transport capacity [Williams and Wolman, 1984; Church, 1995]. Resulting conditions of sediment deficit or surplus create channel changes that manifest differently amongst rivers with different geomorphic organization. When exploring potential mitigation or rehabilitation strategies to reverse undesirable conditions in a river corridor below a dam, resource managers may develop dam release schedules and other strategies that are informed by

experiences on similar rivers, with similar geomorphic organization and management goals [Grant et al., 2003]. In this way, the collective practice of restoration of rivers regulated by of dams is advanced. Whereas individual accounts of specific case studies of specific restoration strategies in particular geomorphic settings have been reported, few efforts have been made to compare the response of rivers with similar geomorphic organization to similar restoration strategies.

The planform and profile of canyons with abundant debris fans is determined by the streamwise abundance of coarse hillslope debris and tributary debris fans, which are the primary controls on large-scale hydraulic patterns [Howard and Dolan, 1981; Kieffer, 1985; Webb et al., 1989]. Fine sediment deposition primarily occurs in eddies, ponded backwaters, and pools created upstream and downstream from these fans [Schmidt, 1990; Schmidt and Rubin, 1995; Grams and Schmidt, 1999]. Debris fan dominated canyons include the Colorado River in Grand and Cataract Canyons, the Snake River in Hells Canyon, and the Green River in Lodore, Desolation, and Gray Canyons. Highly publicized and costly attempts to restore and manage the volume and abundance of fine sediment deposits have been attempted in the Grand Canyon of the Colorado River below Glen Canyon Dam [National Research Council, 1996; Rubin et al., 1998; Webb et al., 1999; Topping et al., 2000a, 2000b, 2005; Webb et al., 2000; Rubin and Topping, 2001; Flynn and Hornewer, 2003; Schmidt et al., 2004; Hazel et al., 2006]. The use of large dam releases timed to coincide with tributary sediment inputs have been the main restoration tool used to redistribute fine sediment from the channel bed to shoreline eddies and margins. Despite these attempts, the volume and area of fine sediment deposits in Grand Canyon continues to decline, because the post-dam transport capacity

greatly exceeds the sediment supply from tributaries [Rubin et al., 2002; Schmidt et al., 2004].

Although less widely publicized, similar operational changes have been instituted on in the Green River below Flaming Gorge Dam (FGD) (Figure 3.1A). These changes have been driven by the decline in the abundance of native fish species, and have included restoring the timing of spring floods and scheduling flood releases to achieve target magnitudes and durations for fish habitat in reaches downstream of the Yampa River confluence [U.S. Department of the Interior, 2005]. The operational changes have been monitored for over a decade by repeat cross section surveys within Dinosaur National Monument (DNM), with the intention of tracking bed and bank adjustments.

In this paper we explore the nature of channel adjustment in the Green River below FGD in The Canyon of Lodore (hereafter called Lodore Canyon) (Figure 3.1). We use measurements of channel cross-section geometry at 36 locations within a 20-km reach to develop metrics of fine sediment storage since 1994. We contrast these data with similar metrics reported for the Colorado River below Glen Canyon Dam. These data are of both management and general scientific interest. Although no specific restoration goals were established in this reach, high-magnitude floods have occurred as hydrologic emergencies or to meet the objectives of the target flows mentioned above.

2. Background

The channel of the Green River below FGD has narrowed between 10 and 30% since 1930 [Graf, 1978; Andrews, 1986; Lyons et al., 1992; Grams and Schmidt, 1999; Allred and Schmidt, 1999; Merritt and Cooper, 2000; Grams and Schmidt, 2002].

Regulation, multi-decadal climatic shifts, and invasive woody riparian species have all been implicated as stressors causing narrowing. The reach of the Green River between FGD and the Yampa River [hereafter referred to as the "upper Green River"], has undergone larger changes in streamflow than reaches downstream of the Yampa River, because no large tributaries enter the river upstream from the Yampa. Power-generating capacity of FGD typically limits annual maximum floods to 130 m^3/s, a 57% decrease in the 2-year recurrence flood compared to the unregulated condition. Floods requiring the use of bypass and spillway facilities (hereafter referred to as "bypass floods") have occurred when inflows to Flaming Gorge Reservoir are large and the reservoir is full.

Although Flaming Gorge Reservoir traps all of the sediment from upstream tributaries, sediment contributions from downstream tributaries have been sufficient to supply the deposition of inset floodplains [Grams and Schmidt, 2002]. Channel narrowing has led to the reduction of in-channel rearing habitat important to the four federally protected fish species of the Colorado River system [Tyus and Haines, 1991]. These floodplain surfaces are also home to the invasive woody shrub Tamarisk (*Tamarix spp.*), a federally designated noxious weed [Cooper et al., 2003].

Ecological maintenance flows to re-activate stabilized floodplain deposits, expand aquatic habitat, and reduce the coverage of invasive plants species are a potential restoration solution in the upper Green River. However, little is known about the interaction between regulated hydrology and fine sediment dynamics in this reach. Thus, the potential for the success of restorative floods is unknown, making costly "managed" floods less likely.

2.1 Fine Sediment Supply in Lodore Canyon and Grand Canyon

The Green River in Lodore Canyon and the Colorado River in Grand Canyon are both below dams that have ratios of reservoir storage to annual water supply greater than two and reductions in annual flood magnitudes of roughly 60%. Regulation of both rivers began at nearly the same time. The annual sediment loads of the Green and Colorado rivers are carried primarily in suspension. During the pre- and post-dam periods, both rivers show evidence of annual supply limitations with respect to fine sediment, indicated by higher concentrations during the rising limb relative to the receding limb of the annual flood [Topping et al., 2000a; Grams and Schmidt, 2002]. These supply limitations are manifested in coarsening upward flood deposits, which have been observed in the floodplains and bars of both rivers [Martin et al., 1998; Rubin et al., 1998; Topping et al., 2000a].

Topping et al. [2000a], showed that the Colorado River at Lees Ferry, Arizona (station 09380000), experienced a 99.5% decrease in mean annual fine sediment supply after closure of Glen Canyon Dam, from 57 $\pm$ 3 million Mg, to 0.24 $\pm$ .01 million Mg. Topping et al. [2000a, b] concluded that the seasonal fine sediment storage in the channel typically occurring between August and the following April was eliminated, because post-dam flows exceeded the sediment conveyance and erosion threshold for most of the year. Hazel et al. [2006] showed that the areas of seasonal storage on the bed in Marble Canyon has been reduced to small patches of fine sediment, and eddies. The result of the severe sediment deficit has been the erosion of eddy bars, winnowing of sand from gravel

bars on the bed, and net export of fine sediment [Kearsley et al., 1994; Rubin et al., 2002; Schmidt et al., 2004].

FGD reduced mean annual fine sediment supply below the dam at the Greendale, Utah gage (station 09234500) from 1.2 ± .115 million Mg to .008 ± .008 million Mg, a reduction of 99.3% [Grams and Schmidt, 2005]. Although Andrews [1986] calculated that the Green River in the study reach was in sediment deficit, Grams and Schmidt [2005] showed that the uncertainty in the sediment budget does not allow for either a deficit or surplus condition to be determined, but the budget is in equilibrium at Jensen (station 9261000) within the uncertainty of the calculation. Grams and Schmidt [2002] noted that the bed of the Green River in the 36-km reach segment immediately upstream of the study area is sand, and annual scour from floods was refilled after flood recession. Grams and Schmidt [2002] also showed that the bed had not incised anywhere that pre-dam records were available. Channel narrowing has occurred by deposition of inset floodplains and stabilization of previously active channel deposits, including accumulation of sand on gravel bars and the volume of post-dam deposition was estimated by Grams and Schmidt [2005] to be within the uncertainty of the annual sediment budget for this reach. Thus, the Green River in Lodore Canyon and the Colorado River in the Grand Canyon both have sediment budgets that are indeterminate within the uncertainty of the transport relations, but contrasting reports in their respective adjustments.

2.2 Time Series of Fine Sediment Storage in Eddies in the Grand Canyon

Geomorphic mapping of aerial photos in the Grand Canyon since 1990 suggest that size of sandbars in eddies continues to decrease (Figure 3.2) [Rubin et al., 2002]. The combined measurements of sandbar areas have been averaged and divided into two storage zones, a high elevation zone above 708 m^3/s (flood zone), and a mid elevation zone between 227 m^3/s and the flood zone (the fluctuating flow zone) [Schmidt et al., 2004]. The slopes of the lines between first and last measurements in Figure 3.2 suggest higher rates of erosion in the mid elevation zone (~ -850 m^2/year) than the high elevation (~ -60 m^2/year), but the long-term trend is erosional in both. This long-term negative trend in sand storage persists with short-term variations within the flood and fluctuating flow zones associated with higher flows. The exception to this is the controlled flood of 1996, which temporarily increased storage in the flood zone, but at the expense of the fluctuating flow zone. These time series define the fine sediment, and subsequent dam management strategy for the Glen Canyon Adaptive Management Program.

3. Calculation of Fine Sediment Storage Time Series for Lodore Canyon

Grams and Schmidt [1999] divided Lodore Canyon into three segments, a lower gradient upper segment, a steeper middle segment, and a lower gradient downstream segment (Figure 3.1B). Our study reach spans the upper and middle segments. In our analysis, we make comparisons between fine sediment storage metrics in both segments to identify potential differences in channel adjustment. These metrics are then combined to construct time series of fine sediment storage for the study reach.

3.1 Data Sources

Permanent channel cross sections (hereafter referred to as "reference" cross sections) were established at 1-km intervals in 1994 [Grams, 1997]. Thirty-two cross sections spaced 40 to 150 m apart were established in 1999 and 2001 within four fan-eddy complexes in the upper and middle segments, as part of a Tamarisk removal experiment (hereafter referred to as "experimental" cross sections) (Figure 3.3). Experimental and reference cross sections span eddy bars, channel margin deposits, point bars and include the geometry of channel bed [Grams, 1997; Larsen and Schmidt, 2003].

Cross section surveys were performed using a total station. Channel bathymetry beyond wadeable depths was determined using an echo sounder mounted on a raft. The topographic dataset includes measurements before and after bypass floods in 1997, 1999, 2005, and 2006. Thirty-six cross sections, nine reference and 27 experimental, were surveyed in 2006 to capture a common temporal reference condition.

3.2 Calculation of Fine Sediment Cross-Sectional Area Time Series

The 36 experimental and reference cross sections span 58 fine sediment deposits, because deposits may occur on either or both banks (Table 3.1). The right and left endpoints of each cross section were generally positioned near the interface between two geomorphically significant surfaces, the Cottonwood-Boxelder Terrace and the intermediate bench. These two surfaces were defined by Grams and Schmidt [2002] as the pre-dam floodplain and post-dam bypass floodplains, respectively, and are easily located in the field. Depositional environments were classified using the system of Grams [1997]. Cross sectional area (*CSA*) of each deposit was calculated above two

reference planes (1) the stage of FGD powerplant capacity releases, and (2) the stage of typical base flow (22 m^3/s) (Figure 3.4A). The lower *CSA* was calculated between the two reference planes. These two areas represent the post-dam bypass flood zone (hereafter referred to as the "flood zone") and the active zone of reworking by dam releases that occur each year (hereafter referred to as the "fluctuating flow zone"), respectively.

3.3 Calculation of Mean Bed Elevation at Cross Sections

Mean bed elevation (*MBE*) was calculated at the 34 Lodore Canyon cross sections for each available measurement and used as a proxy for fine sediment bed storage (Figure 3.4B). Increases in *MBE* values indicate bed sediment evacuation and decreases indicate bed sediment accumulation. *MBE* was evaluated as

$$MBE = \frac{A_c}{W_w} \qquad (1)$$

where A_c and W_w are the channel area and wetted width at 130 m^3/s, respectively. The powerplant capacity of FGD was used as the reference plane, because it is approximately the post-dam 2-yr recurrence flood.

3.4 Calculation of Fine Sediment Storage and Bed Elevation Timeseries

Both spatial and temporal gaps exist in the Lodore Canyon monitoring data. Reference cross sections have been measured intermittently since 1994. Experimental cross sections been measured intermittently since 1994, 1997, 1999, and 2001. Thus, experimental cross sections have higher temporal resolution than reference cross sections (Table 3.1). To calculate a time series that accounts for the temporal and spatial gaps in

survey observations, a fine sediment storage weighted observation (SWO) was calculated for each observation period and applied as a measure of fine sediment storage for the entire study reach. *CSA* values were referenced to the 2006 survey by

$$A_{ti}^{*} = \frac{A_{ti}}{A_{2006i}} \tag{2}$$

where A_{ti}^{*} is the normalized fine sediment cross-sectional area, t is the observation period, i is the fine sediment storage site. Each storage site was assigned a weight value by

$$S_i = \frac{A_{i\max}}{\sum_{i}^{N} A_{i\max}} \tag{3}$$

where S_i is the storage weight value for site i, A_{imax} is the maximum cross sectional fine sediment area ever observed at site i, and N is the total number of storage sites. So that temporal trends in fine sediment storage were not skewed to sites with small A^{*} values, and thus potentially large fluctuations of relative sediment storage, observations were re-normalized to their respective weights by:

$$SWO_t = \sum_{i}^{n} A_{ti}^{*} \frac{S_i}{\sum_{i}^{n} S_{ti}} \tag{4}$$

where *SWO* is the storage weighted observation and n is all of the sites surveyed during observation period t. Observation periods with less than 5% of the total sample storage surveyed or two or less observations were excluded from the SWO calculation.

To compare the temporal pattern of bed adjustment with SWO values, *MBE* values were normalized by:

$$E_{ti}^{*} = \frac{MBE_{ti}}{MBE_{2006i}} \tag{5}$$

where E_{ti}^{*} is the normalized mean bed elevation at cross section i at time t. The simple average of E_{ti}^{*} values at each observation period was used to calculate the time series of bed adjustment in the study reach since 1994. Whereas increases in *SWO* values suggest increases in sand storage, increases in *MBE* values suggest a decrease in fine sediment storage on the bed.

3.5 Assignment of Error Bounds and Statistical Tests of Population Means

For purposes of statistical assignment of error and comparison of population means from each observation period, fine sediment storage sites were assumed to be a sample drawn from a normally distributed population whose sample mean at observation time t reflect the changes in the mean of the population of all fine sediment storage sites. Error bounds on *SWO* and average E^* values were constructed by assigning confidence bounds using a two-sided t-interval at the .01 confidence level, calculated with the n and standard deviation of A^* and E^* values associated with each observation period. Error bounds for the normalized values in 2006 could not be calculated with the procedure above, because each observation is equal to 1. Thus, confidence intervals for the 2006 observation periods were assumed equal to other observation periods with equal or less numbers of observations.

SWO and average E^* values were further tested for their differences relative to the 2006 reference condition using a two-sample t-procedure, which assumed unequal population variance between samples. For each observation period, two sided-confidence

intervals at the .01 level and P-values were calculated as measures of difference relative to 1, the reference condition.

4. Results

4.1 Spatial and Temporal Trends of Fine Sediment Storage in Eddies, Margins, and the Bed in Lodore Canyon

Fine sediment storage at measured sites in Lodore Canyon has changed very little since 1994. Figure 3.5 shows the time series of *CSA* values calculated at each fine sediment storage site for the post-dam bypass flood zone and fluctuating flow zone by location and depositional environment in Lodore Canyon. Storage sites within the flood zone show either weak positive or negative slopes in *CSA* values between 1994 and 2006 at all locations and depositional environments (Table 3.2). Deviations from the equilibrium trend generally occur in eddies during bypass floods, however, only the 1999 bypass flood caused significant shifts in *CSA* values. Eddy deposition in the flood zone during the 1999 bypass flood was followed by a gradual decrease in *CSA* values during years without bypass flooding, a trend that was nearly complete at most sites by 2001. Eddy and margin deposit response to the bypass floods of 1997, 2005, and 2006 is generally constrained to low-magnitude shifts, including both scour and deposition.

Fine sediment storage sites within the lower fluctuating flow zone show greater temporal variability in *CSA* values between observations than the flood zone, but there is no long term, site specific trend, regardless of depositional environment (Table 3.2). Eddy storage sites in the upper canyon show greater variability in *CSA* values between measurements and during bypass and powerplant floods than eddy bars in the middle canyon. Fluctuating flow *CSA* values in margin deposits show less temporal variability

than eddies, but respond similarly in both the upper and middle canyon. Large deviations from the equilibrium trend are generally associated with bypass floods; however, some sites show similar or greater variations in storage in years without bypass floods.

Temporal trends in *MBE* values suggest that the pools above and below channel constrictions in both the upper and middle canyon, generally do not experience large magnitude adjustments in seasonal or long-term storage (Table 3.2). Cross sections which have measurements before, during, and after bypass floods indicate that bed adjustment to each flood is typically less than a 1 m (Figure 3.6). The exception to this trend is the ponded backwater in the Winnies reach (cross sections W1 to W3), which scoured between 1 and 3 m during the 1999 bypass flood. This response was followed by a progressive filling that persisted through 2006 at W1. Patterns of bed adjustment during bypass flood are also site specific and show tendencies for some pools to aggrade and others to scour under the same discharge, regardless of location upstream or downstream from a rapid.

4.2 The Pattern and Trend of Fine Sediment Storage in Lodore Canyon Since 1994

Fine sediment storage in the flood zone, fluctuating flow zone, and the bed of the study reach has trended around equilibrium over the course of the study period (Figure 3.7). Between 1994 and 1997, average storage in fine sediment bars and the bed of the river showed little variation from year to year. Increases in fine sediment storage in the fluctuating flow zone, reflected in temporary, high-magnitude increases in *SWO* values during the 1997 and 1999 floods, were only apparent in the flood zone for the 1999 flood.

The increases in eddy and margin bar storage during these floods, were accompanied by decline in overall bed sediment abundance, reflected by higher average *E** values.

Between 1999 and 2002, fine sediment storage slowly declined in bars in both the flood and fluctuating flow zones, while bed sediment storage increased at nearly an equal rate until 2001. Additionally, the lowest *SWO* values in the fluctuating flow zone and the highest average *E** values occur simultaneously in 2002, these patterns suggest that sediment eroded from the fluctuating flow zone is a potential source of the fine sediment put into storage on the bed during this time period. After 2002, the trend of fine sediment storage again showed low magnitude variations around equilibrium, similar to measurements prior to the bypass flood of 1997. Between 2004 and 2006, declines in fluctuating flow storage after the annual peaks in 2004 and 2005, are accompanied by a general increase in bed sediment storage.

The trends and patterns of fine sediment storage displayed by the SWO and average *E** time series reflect the same behavior of the raw *CSA* and *MBE* values, but few of these values show statistically significant differences at the .01 confidence level from their respective 2006 values of 1.0 (Table 3.3). Within the flood and fluctuating flow zones, significant deviations from 1.0 are obtained for only two values, located within the 1999 surveys. Average *E** values significantly differ from 1 for only a single measurement. The failure of nearly all *SWO* and average *E** values to vary from their respective 2006 values further suggests that fine sediment storage in Lodore Canyon has generally trended around equilibrium since measurements began in 1994.

5. Discussion

The data incorporated into the *SWO* and average E^* values are both temporally and spatially scattered, and broad assumptions were incorporated to make their calculations. First we assumed that the behavior of fine sediment deposits with short measurement records were the same as those with long measurement records. Second we did not discriminate between active channel and floodplain fine sediment depositional environments.

Our first assumption is reasonable, because storage locations which have topographic measurements during the 1997 and 1999 bypass floods behave similar to storage sites whose measurement record begins after 1999. For example, the eddies that responded with the largest changes in storage for the 1999 flood, share similar low-magnitude changes as the eddies which experienced low-magnitude changes during both 1997 and 1999. After 2001, most eddies and margin deposits respond with similar changes in flood and fluctuating flow storage during the 2005 bypass flood, further suggesting the assumption of a linear scaling between storage locations with short measurement records and storage locations with long measurement records is sound.

With regards to the second assumption, no discrimination between active and stabilized fine sediment is made because our metrics already capture any potential changes in the geometry of the active channel. *SWO* values above the powerplant capacity generally reflect the post-dam bypass and powerplant floodplain zone, while *SWO* values in the fluctuating flow zone track changes in storage of active bars. If bypass floods were increasing the size of the active channel, this would be reflected in more variation in *SWO* values between measurements in the flood zone, and likely larger

fluctuations between measurements in the fluctuating flow zone as well. Neither of these behaviors is reflected in the measurement data or calculated *SWO* values.

Regardless of the assumptions made, the time series of raw survey data (Figure 3.5, 3.6) clearly suggest that the fine sediment storage condition in the bars and the bed of the Green River in Lodore Canyon has not changed much since 1994. The exceptions to this rule, both statistically and visually, are the measurement data clustered around the bypass flood of 1999, where temporary increases in fine sediment storage in bars and decreases in bed sediment storage are spatially consistent. The large differences in the bed and bank storage response between the 1999 flood and the 1997, 2005 and 2006 floods suggest that the 1999 flood was acting above a local erosional threshold. If this threshold is driven by the magnitude of discharge alone, as opposed to duration, then the threshold is somewhere between the magnitude of the 1997 flood, 242 m^3/s, and the 1999 flood, 317 m^3/s. Melis et al. [1994] showed that large floods caused greater submergence, or in some cases overtopping, of debris fans in the Grand Canyon, causing significant changes to localized hydraulic patterns. Thus, local hydraulic thresholds defined by the geometry of the impinging debris fan may trigger bed incision above certain discharges. These findings are consistent with a historical floodplain analysis of the upper Green River, which showed that the flood of 1999 was the only flood since the bypass floods of the early and mid 1980's, to deposit significant volumes of sediment in the floodplains of this reach [See Chapter 2].

The equilibrium trend of fine sediment storage in Lodore Canyon starkly contrasts similar data published for the Grand Canyon over the same time period [Schmidt et al., 2004]. Bypass flooding in the Grand Canyon during 1996 and 2004 created a nearly

identical response in eddy storage as the bypass flood data shown here for Lodore Canyon in 1999, however, fine sediment storage data in the Grand Canyon have a persistent negative slope after flooding ceases. Our data show that initial declines in fine sediment storage are followed by weak, generally flat slopes in the storage condition, suggesting the fine sediment storage conditions of the two rivers are very different. These differences could be the result of sustained higher baseflows in the Grand Canyon relative to Lodore Canyon. Topping et al. [2003] showed that baseflows important for the accumulation of fine sediment in storage in the Colorado River in Grand Canyon occurred approximately half of the time prior to closure of GCD, but that sustained flows below the erosional discharge are rare in the post dam regime. Topping et al. [2003] also showed that powerplant operations at GCD increased daily flow variability. In Lodore Canyon, the generally lower magnitude flows and smaller daily powerplant fluctuations likely allow for accumulation of seasonal fine sediment storage.

These differences in the fine storage condition will undoubtedly require different approaches to restoration. Whereas in the Grand Canyon, both sediment supply and water supplies must be managed, seemingly abundant sediment supplies on the Green River give land managers greater flexibility to restore and maintain the ecological integrity of the river corridor.

6. Conclusions

Fine sediment storage in the bed and banks of the upper Green River in Lodore Canyon has trended around an equilibrium condition since at least 1994. Although our data capture fine sediment topography for four bypass floods, significant channel adjustments in these depositional environments were restricted to the bypass flood of

1999. The instantaneous discharge of the bypass flood of 1999 was 75 m^3/s greater than the next largest bypass flood, 1997, which suggests a hydraulic or erosional threshold discharge somewhere between these values for some locations. The effects of the flood of 1999 were persistent in the eddy bars and margin bars and the bed of the river through 2002, when trends in fine sediment storage approximately reflected those between 1994 and 1999. This equilibrium condition is different than those reported for the Colorado River in Grand Canyon, a river system that shares the same geomorphic organization and regulated hydrologic constraints. Managers seeking rehabilitation, restoration, or maintenance of channel features in the upper Green River, must take into consideration these differences in sediment conditions when approaching their management goals.

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Table 3.1 Fine Sediment Storage Sites in Lodore Canyon and Browns Park: Locations, Depositional Environments, and Observation Periods.

		Site[a]	Location (Rkm)[b]	Depositional Environment[c]	Observation Period[d]																												
					22-Apr-94	1-Jun-94	20-Jun-94	30-Jun-94	24-Aug-94	1-Jun-95	18-Aug-95	7-May-96	16-Jun-96	5-May-97	24-May-97	6-Jun-97	19-Jun-97	25-Jul-97	19-May-99	15-Jun-99	27-Jun-99	1-Aug-99	17-Jul-01	29-Sep-01	18-Aug-02	18-Aug-03	5-Jul-04	28-Jul-04	13-May-05	26-Jun-05	7-Jul-05	12-Jun-06	19-Aug-06
Browns Park	Reference Cross Sections	G4L	72.64	CM	x						x																						x
		G4R	72.64	PB	x						x																						x
		G6L	74.40	CM	x	x	x			x	x	x	x			x	x	x									x						x
		G6R	74.40	CM	x	x	x			x	x	x	x			x	x	x									x						x
Lodore Canyon		G7L	75.52	PB	x							x															x						x
		G7R	75.52	PB	x							x															x						x
		G8L	76.88	EB	x		x			x	x	x	x	x			x	x									x						x
		G8R	76.88	CM	x		x			x	x	x	x	x			x	x									x						x
		G9L	77.68	CM			x																					x					x
		G9R	77.68	EB			x																					x					x
		G13L	80.96	CM			x			x	x	x	x			x	x	x															x
		G13R	80.96	CM			x			x	x	x	x			x	x	x															x
		G14R	81.92	CM				x																									x
		G20R	89.52	EB				x																									x
		G21L	90.56	EB				x		x	x	x	x			x	x	x	x	x	x	x	x		/	x		x	x		x		x
	Experimental Cross Sections	WC1R	76.76	EB																			x			x		x				x	
		WC2L	76.80	EB																			x		x	x						x	
		WC2R	76.80	EB																			x		x	x						x	
		WC3L	76.86	EB																			x		x	x			x		x	x	
		WC3R	76.86	EB																			x		x	x			x		x	x	
		WC4L	76.91	EB																			x		x	x			x		x	x	
		WC4R	76.91	EB																			x		x	x			x		x	x	
		WC5L	76.99	CM																			x			x						x	
		WC5R	76.99	CM																			x			x						x	
		WC7R	77.22	EB																			x		/	x		x	x	x		x	
		WC8R	77.26	EB																			x		/	x		x	x	x		x	
		W1R	79.31	EB															x	x	x	x	x			x		x				x	
		W2L	79.38	EB															x	x	x	x	x		/	x			x		x	x	
		W2R	79.38	EB															x	x	x	x	x		/	x			x		x	x	
		W3R	79.42	EB															x	x	x	x	x		x	x			x	x		x	
		W4L	79.47	CM															x	x	x	x	x		x	x						x	
		W4R	79.47	EB															x	x	x	x	x		x	x						x	
		W5L	79.52	CM															x	x	x	x	x			x						x	
		W5R	79.52	CM															x	x	x	x	x			x						x	
		W6L	79.55	CM															x	x		x	x			x						x	
		W6R	79.55	CM															x	x		x	x			x						x	
		W7L	79.70	EB											/			x	x	x	x	x	x		/	x			x	x		x	
		W8L	79.74	EB											/			x	x	x	x	x	x		x	x		x	x	x		x	
		W8R	79.74	EB											/				x	x	x	x	x		x	x		x	x	x		x	
		M2L	90.64	CM															x	x	x	x	x		x	x	x		x		x	x	
		M3L	90.72	CM															x	x	x	x	x		/	x						x	
		M3R	90.72	CM															x	x	x	x	x		/	x						x	
		M4L	90.83	CM					x			x	x	x		x	x	x	x	x	x	x	x			x						x	
		M4R	90.83	CM					x			x	x	x		x	x	x	x	x	x	x	x			x						x	
		M5R	91.01	EB															x				x			x						x	
		M7L	91.23	EB											/				x			x	x		/	x			x	x		x	
		M8L	91.30	EB					x												x	x	x			x			x	x		x	
		M8R	91.30	CM					x												x	x	x			x			x	x		x	
		T1L	91.87	CM																				x		x		x				x	
		T1R	91.87	CM																				x		x		x				x	
		T2L	91.90	EB																				x	/	x		x	x		x	x	
		T3L	92.27	EB																				x	/	x			x		x	x	
		T3R	92.27	CM																				x	/	x			x		x	x	
		T4L	92.35	CM																				x		x						x	
		T5L	92.77	EB																				x	/	x			x	x		x	
		T5R	92.77	CM																				x	/	x			x	x		x	
		T6L	92.80	EB																				x	/	x			x	x		x	
		T6R	92.80	CM																				x	/	x			x	x		x	

x - topography and bathymetry data surveyed

/ - topograhy data surveyed

= upper Lodore Canyon

[a] 'R' and 'L' refer to the right and left banks of the cross section respectively

[b] Location refers to distance below Flaming Gorge Dam

[c] Depositional environments as classified by Grams (1997); EB = eddy bar; CM = channel margin bar; PB= point bar

[d] Observation refers to the 7 day period starting on the date shown

Table 3.2 Range of slopes between first observation and 2006 observation in eddies, margins and the bed at fine sediment storage sites in the upper Green River for storage sites with data originating prior to the bypass flood of 1997

	CSA Eddies (m^2/year)				CSA Margin Deposits[a] (m^2/year)				MBE	
Location	Fluct. Flows	n	Flood Zone	n	Fluct. Flows	n	Flood Zone	n	(m/year)	n
Upper Canyon	0.00 - 0.32	2	-0.12 - 0.13	3	-0.16 - 0.27	7	-0.26 - 0.33	12	-0.02 - 0.01	7
Middle	-0.16 - 0.18	3	-0.21 - 0.11	3	-0.06 - 0.12	3	0.03 - 0.32	2	-0.02 - 0.02	5

[a] margin bars and point bars as classified by Grams (1997)

Table 3.3 Results of Statistical Tests of Difference in *SWO* and E^* Observation Values Relative to 2006 Observation using Students T-Distribution.

Flood Zone[a]	22-Apr-94	1-Jun-94	20-Jun-94	30-Jun-94	24-Aug-94	1-Jun-95	18-Aug-95	7-May-96	16-Jun-96	5-May-97	24-May-97	6-Jun-97	19-Jun-97	25-Jul-97	19-May-99	15-Jun-99	27-Jun-99	1-Aug-99	17-Jul-01	29-Sep-01	18-Aug-02	18-Aug-03	5-Jul-04	28-Jul-04	13-May-05	26-Jun-05	7-Jul-05	12-Jun-06	19-Aug-06
	Observation Period																												
SWO	1.021	n/a	0.962	n/a	n/a	1.001	1.008	0.995	1.003	n/a	1.005	0.980	0.986	1.002	0.994	1.067	1.182	1.145	1.040	1.016	1.032	1.022	1.015	1.017	1.014	1.027	1.020	1.000	1.000
+99% C.I.	0.021	n/a	-0.049	n/a	n/a	-0.001	0.006	-0.005	0.001	n/a	-0.002	-0.023	-0.022	0.001	-0.007	0.066	0.184	0.146	0.039	0.013	0.031	0.022	0.013	0.017	0.013	0.027	0.016		
-99% C.I.	-0.002	n/a	-0.217	n/a	n/a	-0.079	-0.072	-0.050	-0.078	n/a	-0.255	-0.103	-0.173	-0.048	-0.055	-0.021	0.036	0.034	-0.027	-0.094	-0.046	-0.024	-0.086	-0.036	-0.050	-0.019	-0.099		
P-Value	0.015	n/a	0.502	n/a	n/a	0.972	0.794	0.755	0.893	n/a	0.865	0.466	0.759	0.919	0.734	0.039	0.002	0.001	0.111	0.585	0.255	0.198	0.616	0.314	0.540	0.083	0.610		
Fluctuating Flow Zone[a]																													
SWO	0.917	n/a	0.990	n/a	n/a	1.010	0.916	0.978	0.980	1.062	n/a	n/a	1.388	1.006	1.046	1.354	1.228	1.096	0.931	0.865	0.854	0.981	0.993	0.893	0.868	1.005	1.017	1.000	1.000
+99% C.I.	0.249	n/a	0.148	n/a	n/a	0.262	0.265	0.182	0.108	0.335	n/a	n/a	1.184	0.145	0.141	0.630	0.438	0.235	0.044	0.115	-0.033	0.063	0.095	0.033	-0.043	0.081	0.122		
-99% C.I.	-0.415	n/a	-0.167	n/a	n/a	-0.243	-0.434	-0.226	-0.148	-0.212	n/a	n/a	-0.408	-0.133	-0.049	0.079	0.018	-0.042	-0.182	-0.384	-0.258	-0.101	-0.109	-0.247	-0.222	-0.070	-0.087		
P-Value	0.241	n/a	0.830	n/a	n/a	0.830	0.328	0.726	0.582	0.434	n/a	n/a	0.114	0.882	0.181	0.002	0.006	0.062	0.104	0.103	0.001	0.534	0.726	0.036	0.000	0.829	0.619		
Mean Bed Elevation																													
Mean E^*	0.947	n/a	1.005	n/a	0.938	1.007	1.019	0.974	0.995	0.976	n/a	n/a	0.937	1.031	1.093	1.205	1.286	1.247	1.167	1.038	0.687	1.036	1.010	1.101	1.014	0.890	1.090	1.000	1.000
+99% C.I.	0.031	n/a	0.138	n/a	0.239	0.236	0.114	0.146	0.085	0.284	n/a	n/a	0.295	0.241	0.240	0.528	0.664	0.531	0.303	0.446	0.412	0.168	0.186	0.407	0.176	0.038	0.269		
-99% C.I.	-0.137	n/a	-0.129	n/a	-0.363	-0.221	-0.076	-0.199	-0.096	-0.333	n/a	n/a	-0.420	-0.179	-0.055	-0.117	-0.092	-0.037	0.032	-0.369	-1.039	-0.096	-0.166	-0.204	-0.148	-0.258	-0.090		
P-Value	0.035	n/a	0.873	n/a	0.179	0.865	0.402	0.566	0.802	0.671	n/a	n/a	0.466	0.538	0.079	0.074	0.039	0.020	0.002	0.719	0.132	0.456	0.766	0.279	0.801	0.032	0.124		

[a] *SWO* is the assumed mean for the A^* distribution used for the construction of the confidence intervals

n/a - two or less samples or less than 5% of total S_i

(shaded) = observation shown to be significantly different than 2006 observation using both confidence interval and P-value

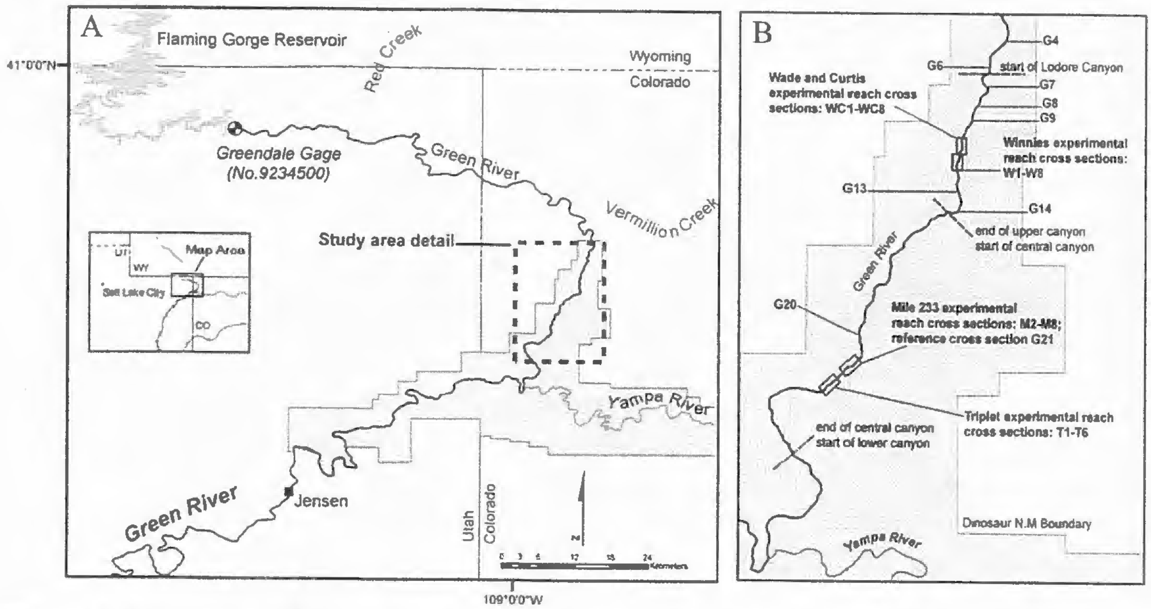


Figure 3.1 (A) upper Green River study area location map (B) locations of reference and experimental cross sections in Lodore Canyon and Browns Park. .

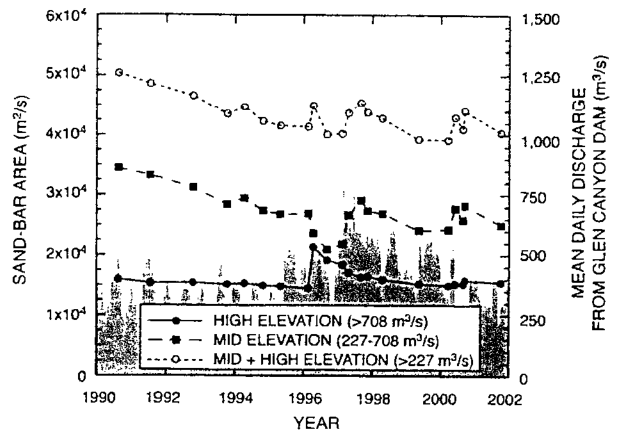


Figure 3.2 Time series of the aerial extent of sand bars in the first 113-km downstream of Glen Canyon Dam on the Colorado River, from [Rubin et al., 2002]. Fine sediment area is used as a proxy for storage. Note the strongly negative slopes in the combined and mid elevation lines, with short-term variations around higher flows. These decreases in fine sediment storage are the result of a persistent sediment deficit condition in this reach.

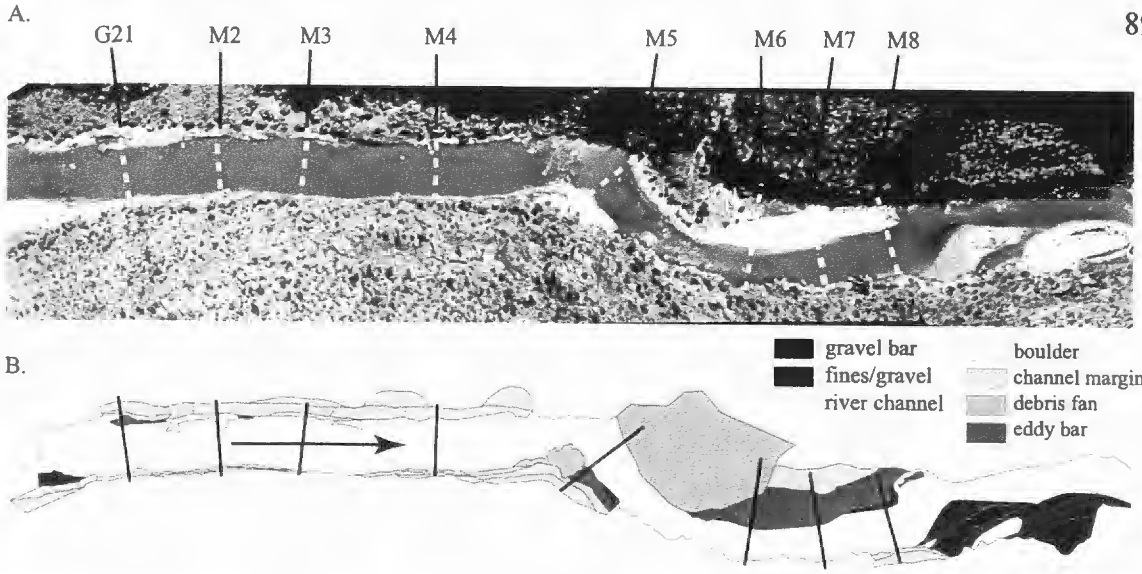


Figure 3.3 Network of cross sections located in the Mile 233 experimental reach. Flow is from right to left. (A) 1999 aerial photo and locations and names of cross sections within the reach.(B) geologic map from [Grams, 1997] showing surficial geology and depositional environments within the reach. Monitoring of the G21, M4, and M8 cross sections began in 1994, surveys at the other cross sections began before the bypass flood of 1999. Cross section M6 was not used in this study because its shape is affected by sediment inputs from the tributary debris fan.

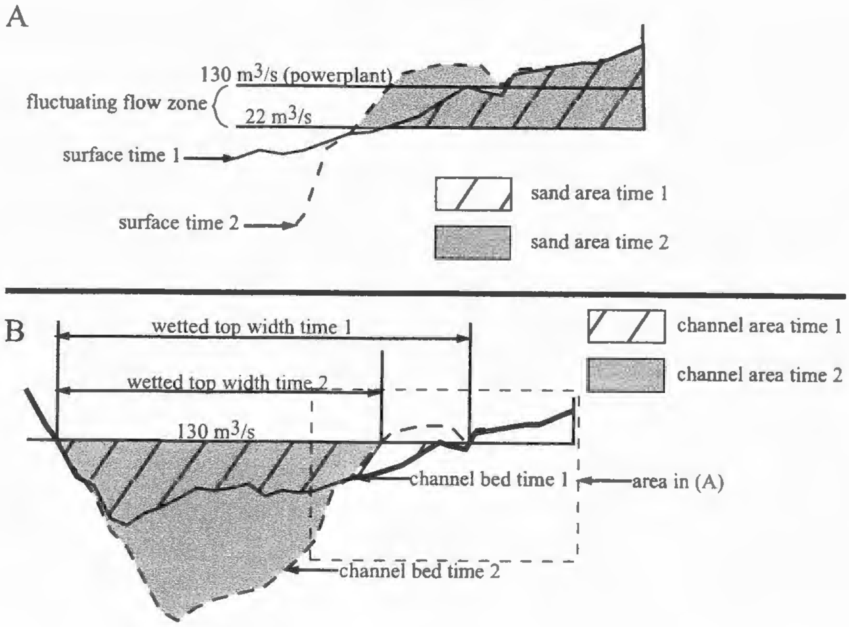


Figure 3.4 Schematic of a river cross section depicting the metrics of fine sediment storage using repeat surveys at cross sections in the upper Green River (A) cross-sectional sand area above the powerplant capacity of FGD and within the fluctuating flow zone (B) mean bed elevation changes calculated using channel area below powerplant capacity and wetted top width at the same dischage.

Figure 3.5 Time series of fine sediment cross sectional area (*CSA*) above reference elevations in Lodore Canyon by depositional environment and location. (A) and (B) above 130 m^3/s in eddies of upper and lower Lodore Canyon respectively; (C) and (D) above 130 m^3/s in channel margin deposits of upper and lower Lodore Canyon. (E) - (H) are the same locations as (A) – (D), but measured within the fluctuating flow zone. Vertical dashed lines represent the time of the flood peaks in years when FGD bypassed the power generating turbines and large than average floods occurred. Sand deposits in the flood zone are generally inactive in years without bypass floods while fine sediment in the fluctuating flow zone regularly scours and fills, however, the slopes between data points prior to 1997 and the 2006 observation are generally flat, indicating a general equilibrium condition at most storage sites.

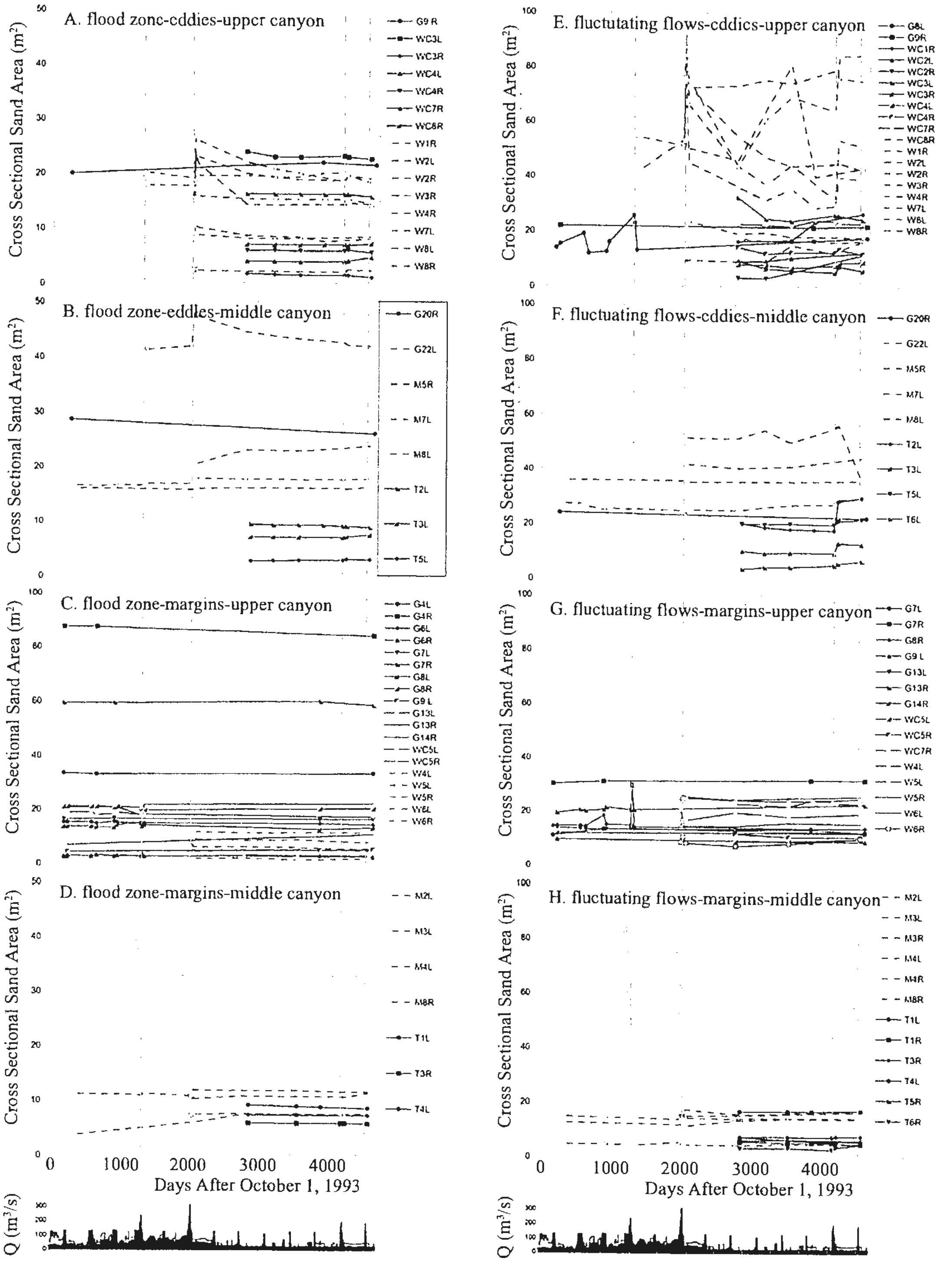

A. flood zone-eddies-upper canyon
B. flood zone-eddies-middle canyon
C. flood zone-margins-upper canyon
D. flood zone-margins-middle canyon
E. fluctutating flows-eddies-upper canyon
F. fluctuating flows-eddies-middle canyon
G. fluctuating flows-margins-upper canyon
H. fluctuating flows-margins-middle canyon
Cross Sectional Sand Area (m²)
Days After October 1, 1993
Q (m³/s)
0
1000
2000
3000
4000
G9 R
WC3L
WC3R
WC4L
WC4R
WC7R
WC8R
W1R
W2L
W2R
W3R
W4R
W7L
W8L
W8R
G20R
G22L
M5R
M7L
M8L
T2L
T3L
T5L
T6L
G4L
G4R
G6L
G6R
G7L
G7R
G8L
G8R
G13L
G13R
G14R
WC5L
WC5R
W4L
W5L
W5R
W6L
W6R
M2L
M3L
M4L
M8R
T1L
T3R
T4L
G8L
G9R
WC1R
WC2L
WC2R
W7L
M3R
M4R
T1R
T5R
T6R

Figure 3.6 Time series of MBE relative to the 2006 condition in Lodore Canyon by location in the canyon and location upstream of downstream of debris fans (A) backwater pools of upper Lodore Canyon and Browns Park (B) backwater pools of middle Lodore Canyon (C) expansion pools of upper Lodore Canyon and (D) expansion pools of middle Lodore Canyon. Negative values suggest less fine sediment on the bed relative to 2006 and postive values suggest more fine sediment on the bed. Vertical gray dashed lines show the timing of bypass floods from FGD. The gray horizontal dashed lines show the precision of the depth sounding instrument. Magnitudes of MBE changes are generally limited to within +/- 1 m at most locations for most floods, and show both scour and fill responses during floods. However, scour of up to 3 m in the Winnies experimental reach was observed during the bypass flood of 1999; this scour was followed by a multi-year bed elevation increase which ended in 2005.

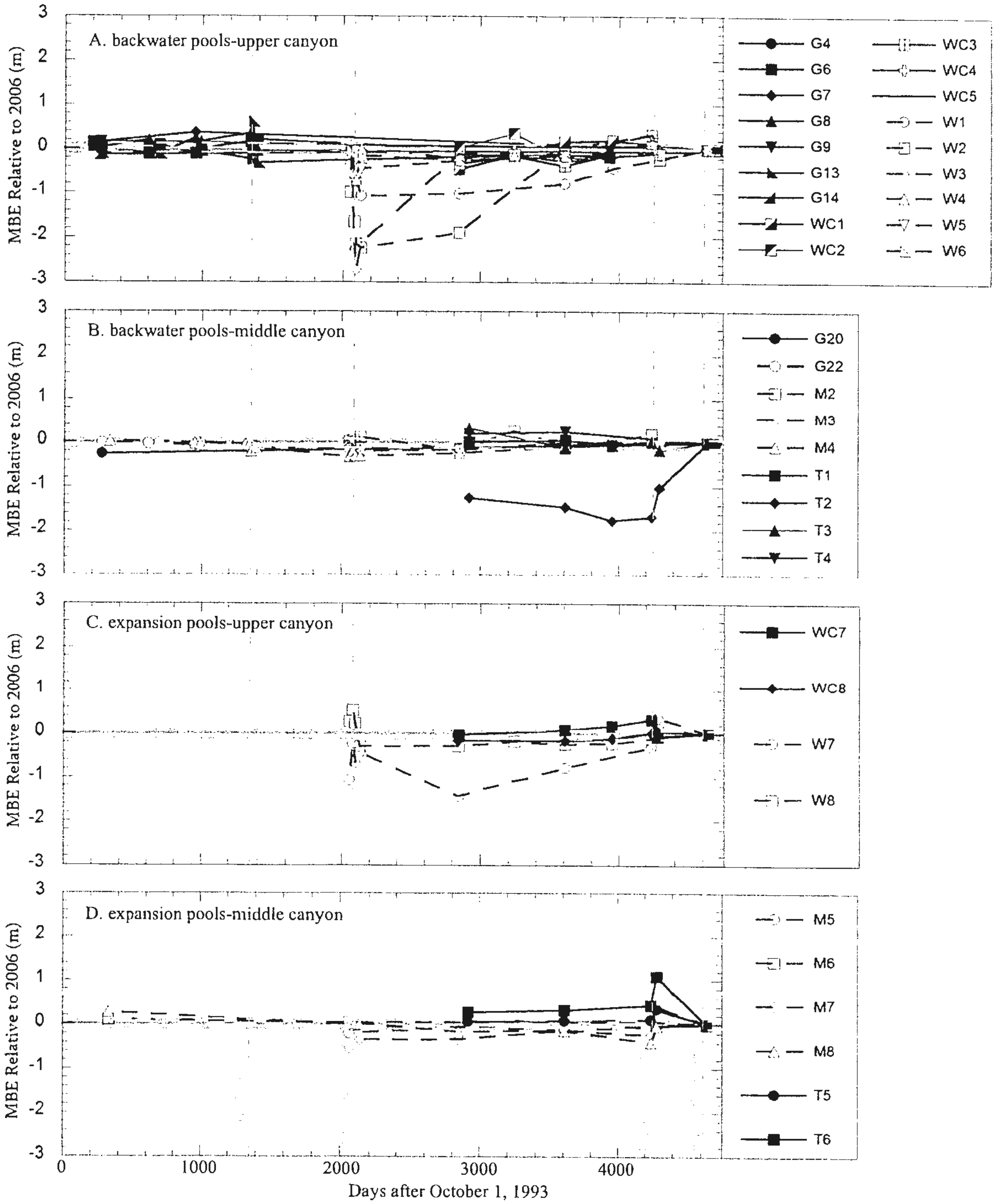
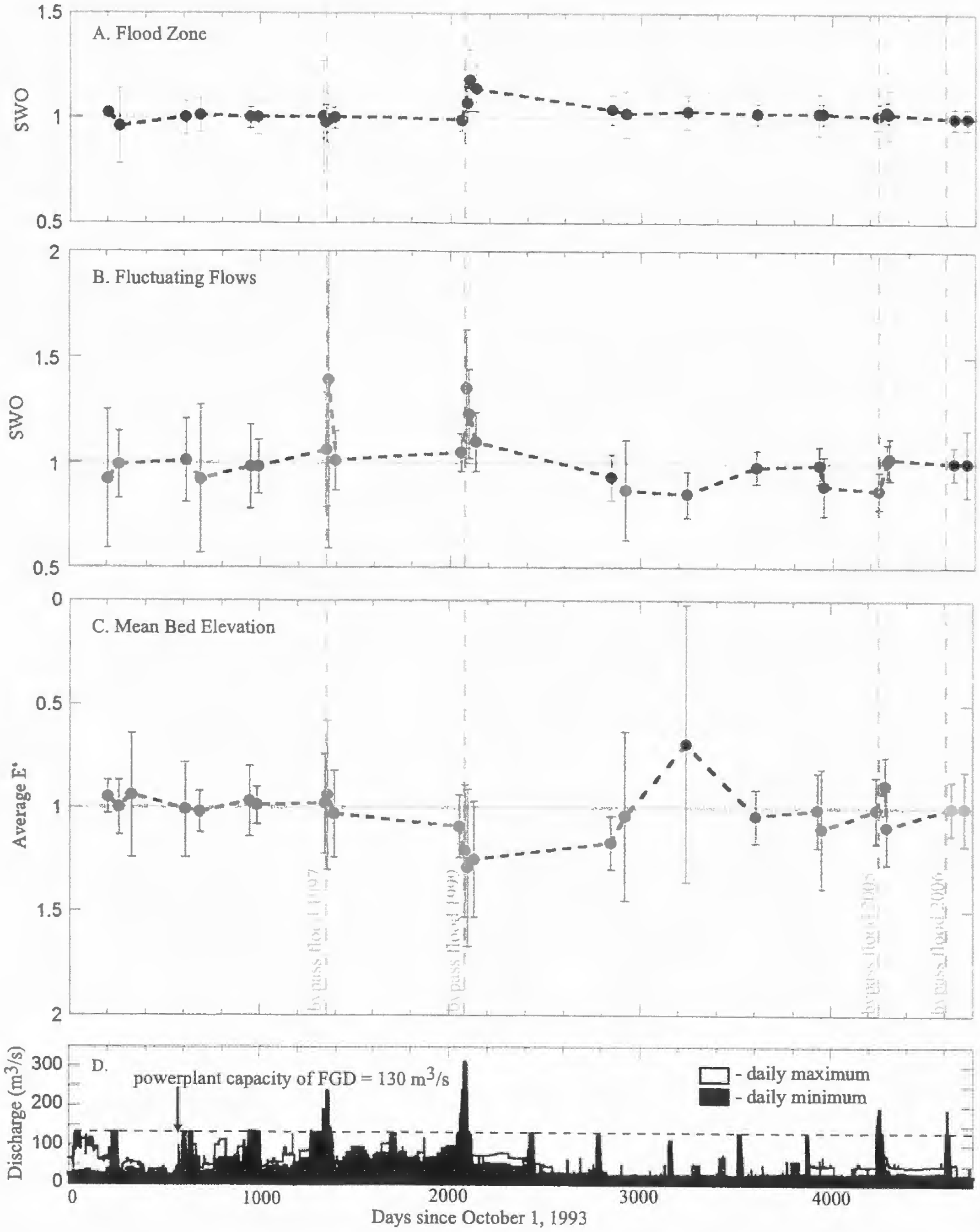

A. backwater pools-upper canyon
G4
G6
G7
G8
G9
G13
G14
WC1
WC2
WC3
WC4
WC5
W1
W2
W3
W4
W5
W6
B. backwater pools-middle canyon
G20
G22
M2
M3
M4
T1
T2
T3
T4
C. expansion pools-upper canyon
WC7
WC8
W7
W8
D. expansion pools-middle canyon
M5
M6
M7
M8
T5
T6
MBE Relative to 2006 (m)
Days after October 1, 1993

Figure 3.7 Time series of bank and bed fine sediment storage in Lodore Canyon. (A) SWO values for the flood zone (B) SWO values for the fluctuating flow zone (C) average of E* values for reference and experimental cross sections (note reverse vertical axis) (D) daily maximum and minimum flows at the Greendale gaging station. SWO values above 1 suggest sediment accumulation and values below 1 suggest sediment evacuation; E* values above 1 suggest bed scour and values below 1 suggest bed aggradation. All values are normalized to the 2006 observation. Error bars are the 99 percent confidence interval of A* and E* observations. Vertical dashed lines show the timing of FGD bypass floods. The bypass flood of 1999, the second largest flood since dam closure, caused both bed scour and sediment accumulation in the flood zone. These responses were followed by a multi-year decline in SWO values in both the flood and fluctuating flow zone, likely providing some of the fine sediment which caused bed aggradation between 1999 and the present. Comparison of sample means from observations indicate that most of the values shown are not significantly different than 1 at the .01 confidence level, indicating that fine sediment storage in Lodore Canyon has not changed over the study period.



A. Flood Zone
SWO
1.5
1
0.5
B. Fluctuating Flows
SWO
2
1.5
1
0.5
C. Mean Bed Elevation
Average E'
0
0.5
1
1.5
2
D.
Discharge (m^3/s)
300
200
100
0
powerplant capacity of FGD = 130 m^3/s
- daily maximum
- daily minimum
0
1000
2000
3000
4000
Days since October 1, 1993

CHAPTER 4

CONCLUSION

Trenching, stratigraphy, and dendrogeomorphic analysis indicate that floodplain building associated with channel narrowing in the upper Green River occurred before and after closure of Flaming Gorge Dam (FGD). Prior to closure of the dam, lower-magnitude floods interacted with big floods to create a floodplain surface in Browns Park approximately equivalent in elevation to the intermediate bench (IB) first reported by Grams (1997). In Lodore Canyon, pre-dam floodplain building was limited to the channel margins, where infrequent, big floods vertically accreted the Cottonwood-Boxelder (CB) terrace until at least 1957. Decreased flood magnitudes after closure of FGD shifted the flow field further away from the channel margins. In Browns Park this shift abandoned the pre-dam floodplain and began building a lower, inset floodplain (PF) equivalent in elevation to the powerplant capacity of FGD. Just prior to dam closure, the flood of 1962 left sand in the eddy bars of Lodore Canyon out of the reach of the regulated flows, shifting these environments to a floodplain setting. Powerplant flows also built a PF surface in Lodore Canyon, but its extent was limited to the confined spaces inset to the deposits of 1962.

Floodplain building in the post-dam hydrologic regime followed a stepwise pattern with small or progressive accretion during the powerplant flows, and abrupt vertical accretion events which coincided with the largest floods of the time period. The large floods of the 1980's emplaced large volumes sediment on the PF surfaces, which acted as stable platforms for vertical accretion. Vertical accretion by the floods of the

1980's expanded the IB surface in Browns Park and Lodore Canyon, and limited subsequent accretion by setting the upper elevation of the IB to the crest of the large floods of 1997, 1999, 2005, and 2006. Dendrogeomorphic analysis suggests that the last flood to emplace sediment at the IB elevation was the 1999 flood, the second largest instantaneous flow since 1963.

These historical floodplain data are in close agreement with 12 years of channel geometry monitoring in the same reaches. At 58 fine sediment storage sites in Lodore Canyon and Browns Park, only minor changes in storage have been observed since monitoring began in 1994. The flood of 1999 stands alone as the flow which caused significant adjustment of eddy and margin environments, an adjustment that was short lived and, if anything, caused further accretion of fine sediment in the floodplains. However, the fact that the 1999 caused bed scour and eddy deposition of magnitudes not observed during other, lesser floods, suggests a threshold erosional discharge between 240 m^3/s and 325 m^3/s. This condition of relative equilibrium in fine sediment storage contrasts the depleting fine sediment storage condition of the Colorado River below Glen Canyon Dam, a river with similar geomorphic organization, flow reductions, and sediment budget.

These data are of both scientific and management interest. Large floods have emplaced most of the sediment in the floodplains observed today, and the stepwise pattern of floodplain building created by FGD appears to exacerbate vertical accretion by creating low, vegetated, inset floodplains in channel environments with strong divergence in the flow field. These floodplains may act as stable platforms for deposition when large floods are released from FGD. Floodplain accretion rates reported for other for other

river systems are generally limited to long-term averages, and do not have the resolution to capture the hydrologic events associated with specific depositional magnitudes presented here. Additionally, where fine-scale accretion rates are reported, they have not identified the interacting role of small and large floods in building floodplains, or the amplification of this interaction by regulation. Thus, the model of floodplain building presented here serves as an addition to the growing scientific interest in these important landforms.

The data presented here also create challenges and dilemmas for restoration of the upper Green River. Observations of channel adjustment during bypass floods show that their ability to cause significant channel adjustments, specifically the reactivation of the stabilized deposits, is limited. These data suggest that infrequent bypass flooding, (i.e. bypass flooding preceded by multiple years of low magnitude flooding) may further disconnect floodplains from the modern hydrologic regime. Reactivation of stabilized deposits and expansion of aquatic environments important to endemic fish species may require more frequent, higher magnitude, annually variable flood regimes, coupled with the continued removal of undesirable woody vegetation species. However, the seemingly replete sediment supply in the Green River presents managers with a wider range of restoration options than those used in the Colorado River below Glen Canyon Dam, where managers are fighting both diminishing sediment and water supplies.

References Cited

Grams, P.E., (1997), Geomorphology of the Green River in Dinosaur National Monument, M.S. Thesis, 140 pp., Utah State University, Logan.

APPENDICES

APPENDIX A

SUPPLEMENTAL STRATIGRAPHIC AND DENDROGEOMORPHIC DATA

APPENDIX A1

SUPPLEMENTAL STRATIGRAPHIC AND DENDROGEOMORPHIC DATA FOR THE GATES OF LODORE TRENCH

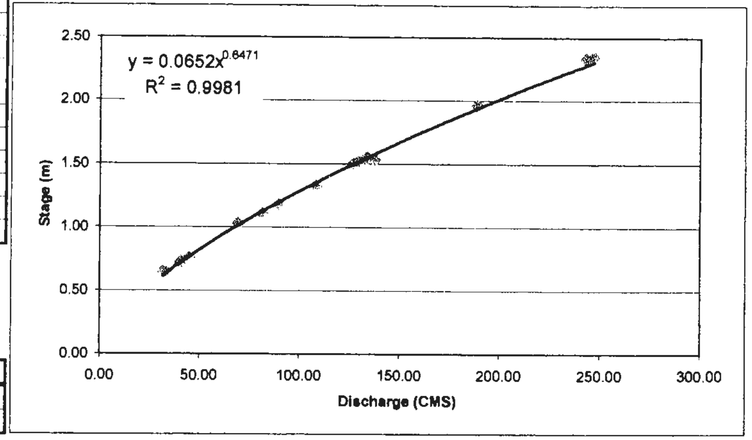
STAGE-DISCHARGE RELATIONSHIP FOR GATES OF LODORE TRENCH

Original Stage Relation for Sediment Gaging Station Established by JCS at Gates of Lodore

FGD_Q_CFS	Meas._Q_CFS	Stage (ft)	Meas_Q_CMS	Stage (m)	Adj Stage_USGS (m)
1040	1178	2.09	33.36	0.64	1626.76
1050	1123	2.11	31.80	0.64	1626.77
1350	1438	2.32	40.72	0.71	1626.82
1360	1439	2.38	40.75	0.73	1626.84
1420	1524	2.40	43.15	0.73	1626.86
1510	1589	2.47	45.00	0.75	1626.87
1560		2.43		0.74	1626.87
2550	2458	3.38	69.60	1.03	1627.16
2990	2880	3.64	81.55	1.11	1627.23
3120	3166	3.86	89.65	1.18	1627.30
3580	3824	4.35	108.28	1.32	1627.45
4650	4576	4.98	129.56	1.52	1627.62
4660	4488	4.92	127.09	1.50	1627.61
4680	4539	4.93	128.53	1.50	1627.63
4730	4859	5.03	137.58	1.53	1627.63
4770	4736	5.09	134.11	1.55	1627.65
5690	4718	5.09	133.60	1.55	1627.68
6680	6678	6.44	189.09	1.96	1628.09
8370	8590	7.66	243.24	2.33	1628.46
8420	8724	7.71	247.04	2.35	1628.48

Stage Relationship for Trench Figure XS

Q(CFS)	Q(CMS)	Stage	Adj. Trench Stage (m)
800	22.7	0.49	88.70
4600	130.3	1.52	89.73
8400	237.9	2.25	90.46
11200	317.1	2.71	90.92
13700	387.9	3.09	91.30
15100	427.6	3.29	91.50
17200	487.0	3.58	91.79
19600	555.0	3.89	92.10



Elevation of USGS BM

1635.865

Field measurements made by JSA

Date	WSE	WSE_Figure	Q (FGD)	USGS Elev	Corrected
8/26/2005	90.429	88.937	1390	99.379	1626.915
8/18/2006	88.622		854	97.887	1626.600

This stage relation is almost entirely based on the stage-discharge relationship established at the Gates of Lodore sediment sampling cross section operated by USU and USGS from 1997-1999. The sampling cross section was location downstream approximatley 430 m, within a straight reach. While the trench was open, I surveyed the water surface elevation twice and also the USGS BM near the cross section (which was used as the elevational control during the sediment sampling). The adjustment was made first using the difference in elevation between the USGS BM and then to the coordinates of the stratigraphy drawing (which was done before the stage relation was established, and therefore has a different elevation grid).

Jason S. Alexander

Tamarisk Tree Nomenclature Key For Gates of Lodore Ring Reading Notes

Chapter 2 –Name	Growth Rate Plots and Ring Reading Notes Name
G1	Tree 1
G2	Tree 2
G3	Tree 3
G4	Tree 4
G5	Tree 5
G6	Tree 6
G7	Trench 2-Tree 1
G8	Trench 2-Tree 2A
G9	Trench 2-Tree 2B
G10	Trench 2-Tree 3A
G11	Trench 2-Tree 3B
G12	Trench 2-Tree 4

Gates of Lodore Tree Interpretations: from Ring Reading Notes and Stage Discharge Relations- reviewed by Mike L. Scott and Julie Roth.

GTS-1_TREE1 (Established 1950)
Slab "E", the first contact, shows burial after 1962 and 1980, conflicting burials are indicated after 1956 and after 1990. The fact that the 1962 ring is wide indicates that the tree was likely not buried in that year. Another year that shows suppression is the 1957 ring at "E" preceded by a wide 1956...indicating it was not buried at that level by 1956. Likely the "E" contact on this tree is the 1957 unit and the narrow unit below is 1956...this is what the next tree (T2) indicates...this is the likely case. The bottom of "D" shows a duff layer indicating a hiatus from flooding...a claim substantiated by the local rating curve...the last flood that would have reached up to that level is the 1953 flood...indicating that the floods of 1954 and 1955 are not part of the sequence of floods between "C" and "D"...with the establishment point set at the "C" contact in 1950, the floods of 1951, 1952, and 1953 likely accreted the sediments making up "C". Everything below "C" is prior to 1950.

GTS-1_TREE2 (Established in1953)
Slab E shows deep burial after 1956...the same at the E1 contact. 1956 is wide at E1 and extremely narrow at contact "D" and below. This indicates that the "E" and "E1" units are 1957, and unit "D" is likely 1956. Contact "C" shows burial after 1955 and 1963. Slab 19 is completely root. The tree below between contacts "C" and "D" could have been buried by any of the flows between establishment in 1953 and the 1956, thus, this unit should be grouped in the 1950-1955 units.

GTS-1_TREE3 (Established <1952)
Slab "E" shows burial after 1955, but "E3" shows burial mainly after 1957. Contacts between D and E1 are not gradational at this tree, it may be that 1956 buried this tree deeper, then 1957 excavated and redeposited resulting in the burial signals after 1955. Multiple burial signals are recorded on the ring reading sheets, the two most common are "after 1958 and after 1955". The ring width data shows burial suppression in 1956 and 1957 in the lower slabs, plus anatomical signals after 1958. If combined with TREE 4 data, then this indicates the additional accretion of "E3" in 1958 adjacent to "E" unit from 1957. This tree also shows burial in the deeper slab below D, this may be similar to the burial reflected in T2 in 1955, this is either due to the 1955 drought or actual burial in 1955... This unit is narrow so I am going to, once again, group these units into the early 50's age class. Pith at bottom of slab 18, `8.5 cm below contact D. Thus, establishment elevation is somewhere below this point in 1952 or earlier.

GTS-1_TREE4 (Established ~1955)
As we move down the stem probable burial signals are called out as 1959, 1958, and 1957. Using the contacts, and assuming that 1959 deposition of the "F" unit, further suppressed stem growth, then we can related burial in 1959 to "F", burial in 1958 to "E3" and burial in 1957 to "E". Establishment is in 1955 near the "C" contact. This is consistent with observations in TREE2. Because the contact at "C" is continuous up to

the onshore levee but the flow in 1955 could not have possibly deposited to the upper elevation, we cannot verify that "C' was deposited by the 1955 flood, thus it will be grouped into the "1950's" category.

GTS-1_TREE5 (Established ~1956)
Uppermost unit "H" is likely 83' since it appears from photos that there is organics and duff near its base, suggesting a hiatus from flooding after 1962 (the unit below "G"). Ground surface slab and first slab show damage in 1983 and contact "G" shows suppression up to 1983…this is likely the low summer flows of 1977-1982 followed by burial in 1983. Likely the unit "H" is the 1983 deposit, with shallow stem damage and suppression in 1983 at the "G" contact. At contact "G" the 1984 and 1985 rings are wide, suggesting that the 1984 flow did not deposit, and the stage-discharge shows that it could not have deposited to that elevation. 1961 and 1962 are narrow at and below slab "G" all the way to slab "F" suggesting that this is likely the effects of the extreme drought in 1961 and the flood in 1962. Both "G" and "G1" are assigned as depositon from 1962 flood because above "G1" the 1962 ring is wide and only 1962, 1956-1958, could have deposited the units to the elevation shown. 1958 and 1959 are wide above "G", suggesting no burial above this and elevations in those years. Burial signals are called out by ring readers after 1964, likely a burial in 1962, extreme drought in 1963 from the dam, and progressive conversion to root after the return of higher water tables after 1964. Below 1At contact "E" the readers call out burial after 1957, 1958, and 1959. This is consistent with TREE 4, where we see burial in all of those years. As we move below "G" we see burial signals called out in after 1964, after 1958, after 1959, and after 1957, very similar to the TREE4. Once again I am assigning "G" to 1962, "G1" could be 1960, "F" is assigned 1959, and "E3" is assigned "E". This is consistent with the contacts and ring data in TREE3. This tree is also extremely flood trained below "F", suggesting significant flood power…also pointing to the 1957 flood as the depositor of "E". If this tree did, in fact, establish in 1956, then it was buried immediately by 1957, even though rings down low suggest lower stress in 1957. However, if we are close to the establishment elevation, then the establishment is near the top of a potential 1956 deposit that may have been eroded by the 1957 flood. Center w/ pith in 1956, indicating establishment is just below contact E, on or before 1956.

GTS-1_TREE6 (Established ~1956)
1962 becomes extremely narrow below contact "G" and ring readers call out burial after 1964…once again the likely effects of draught in 1961 and 1963 with a burial in 1962. It is not clear if the suppression in the 1962 ring continues to "F" because the ring readers do not pay any attention to it, but they suggest burial in units at "F" by or after 1957, 1958, and 1959. This is consistent with TREES 4 and 5, suggesting burial in all of those years; once again "E" is assigned 1957, "E3" is assigned 1953, "F" is assigned 1959, and "G" units are assigned 1962. Center in 1956 in slab 23, cannot cross date below this point. Center with pith on slab 25, therefore establishment is >6 cm below contact E on or before 1956.

<u>GTS-2 TREE1 (Established before 1991)</u>
This tree has multiple unclear years and thus the only conclusion is that is established prior to 1991. The establishment elevation is near "A", but this evidence is not conclusive. No flows would have reached this elevation after 1986 until 1997. Thus, likely this is a 1986 recruit that simply has a rough life history.

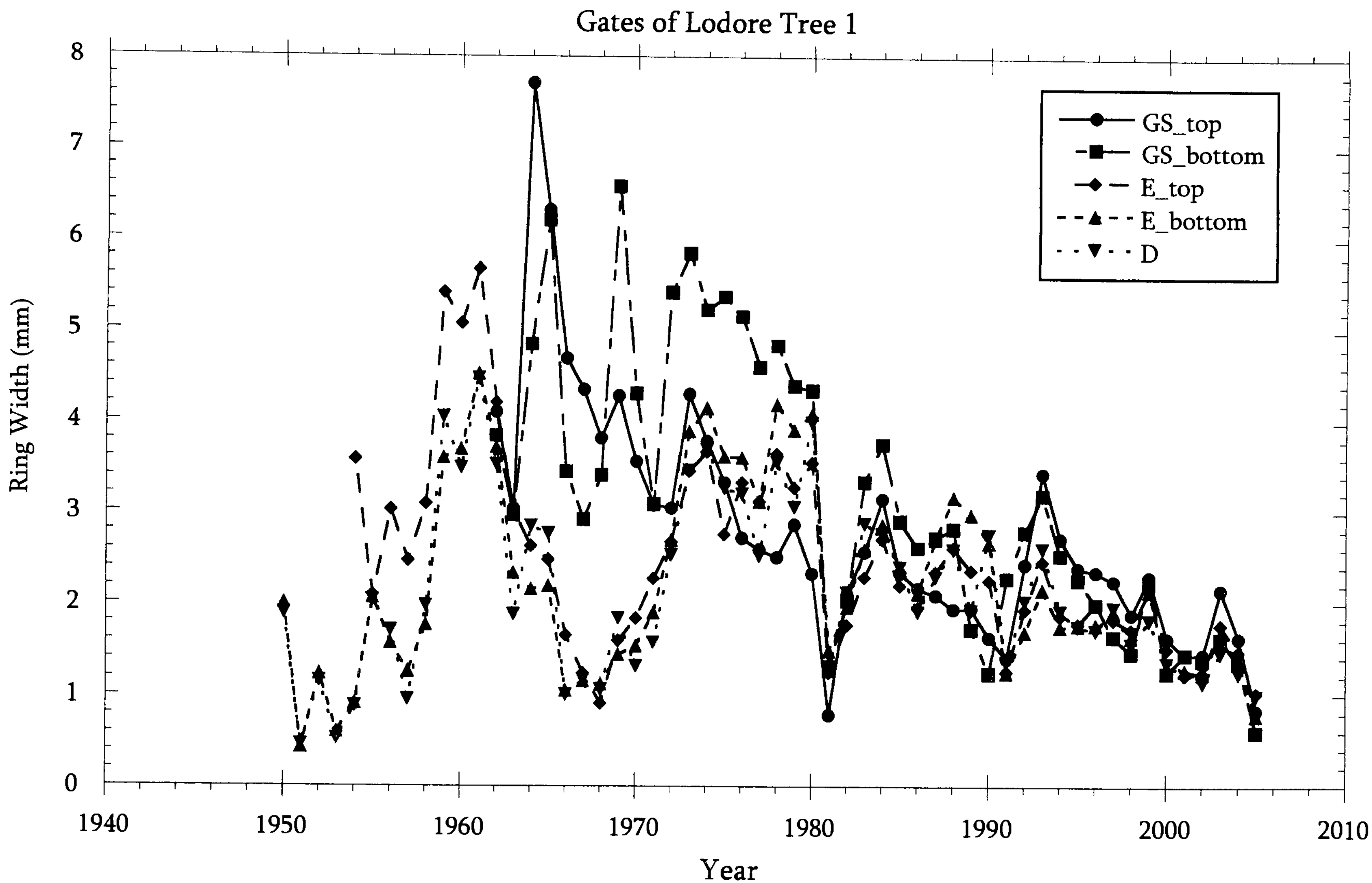
<u>GTS-2 TREE2A (Established 1984)</u>
This tree shows narrow rings in 1986 at the base of the "B" unit, and shows establishment at or near the "B" elevation, suggesting establishment at the top of the "C" unit in 1984 or 1983, with burial by "B" in 1986. 1999 shows suppression, or it is at least narrow, at and below the ground surface, suggesting there was some suppression in 1999 possibly by "A".

<u>GTS-2 TREE2B (Established 1984)</u>
This tree is immediately adjacent to tree 2A and shows similar ring patterns. Establishment is at or near "B" and there is ring suppression in 1986 followed by a wide 1987. Both suggesting establishment in 1984 or 1983 followed by burial in 1986 by "B".

<u>GTS-2 TREE3A (Established 1985 or 1984)</u>
Slab "B" shows no signs of burial in 1986, but the burial at this elevation would have been less than 15cm, especially if the unit "A" did not exist. Establishment is closer to the elevation of C2 and above C1 in 1985. This could have been from 1 of 2 reasons. Either it established in 1984 at the elevation at or near C2 or it was established in 1985 by falling on the bare sand from the 1984 flood. Regardless it shows that the establishment is likely at the 1984 elevation, putting "C2" in the 1986 category and "C1" in the 1984/83 bin. Likely established in 1985, on the 1984 deposit since the stage discharge relation shows that 1985 flood did not get this high, even within error.

<u>GTS-2 TREE3B (Established 1985 or 1984)</u>
Once again, as part of the pair with 3A, 3B shows similar ring patterns. This tree was marked as establishing in 1985 at the "C2" elevation. Thus, this tree marks the top elevation of 1984/83 deposition. Therefore, "C1" is binned as 1984/83 and "C2" and "B" are considered to be 1986.

<u>GTS-2 TREE4 (Established 1986)</u>
Establishment is recorded as 1986 at or above the "C2" elevation. The contacts at this tree are all marked as gradational on the field sketch so the possibility for later re-working or deposition followed by bioturbation at the sloping edge of the trench is probable. If we assume that the establishment elevation is correct. Then the units "B" and "C2" would be binned in the 1999 or 1997 floods. However, given the weight of evidence against this in the trees described above, likely this tree is a 1986 recruit that has had some reworking of sediments around it.


Gates of Lodore Tree 1
Ring Width (mm)
Year
GS_top
GS_bottom
E_top
E_bottom
D
0
1
2
3
4
5
6
7
8
1940
1950
1960
1970
1980
1990
2000
2010

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/16/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005 (actually June)

Tree/Hole ID: 1

Slab ID: GS

(top has 4 main centers!)
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL1J2X.txt

Number of radii measured: 2

J2X Series Names: GL1GSA, GL1GSB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

→ 2 oldest, flanking centers are 1962 - 2005 on Bottom - next page]

(Top) - Radius A - 1966 - 2005   Radius B - 1962 - 2005

- 1968 on 'B' looks weird - doesn't match other radius.

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/17/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 1

Slab ID: GS

-Bottom-

Ring Counts/Notes:

J2X filename: GL/J2X.txt

Number of radii measured: 2

J2X Series Names: GL/GSC, GL/GSD

J.R. - Recorded radii C + D into J2X.

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

Wood Anatomy Change Notes:

Bottom - Radius C - 1962 - 2005 Radius D - 1962 - 2005

center is 1962 w/pith.

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/17/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 1

Slab ID: 2E
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL1J2X.txt

Number of radii measured: 2

J2X Series Names: GL12EA, GL12EB

J.R. - Recorded Radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - buried after 1863 (62a), 1990, 1980

M.S. - buried after '62, '56, '80 ~~+ '83~~, MLS

Wood Anatomy Change Notes: TOP

Radius A - 1954 - 2005

2005 - small
'93 - wider
'91 - slightly narrower
'81 - narrow
'80 - wide
'69 + '70 - similar
'68 - narrow
'59 - '62 - very wide
'55 - '58 - similar
'54 - center w/pith

Radius B - 1954 - 2000

Bottom (Next page)

center is 1951
'51 - narrow
'52 + '53 - widest
'57 + '56 - similar

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/23/06

Site ID: GATES of LODORE

Collection Date: Aug, 2005

Tree/Hole ID: 1

Slab ID: 2E

~ Bottom ~

Ring Counts/Notes:

J2X filename: GL/J2X.txt

Number of radii measured: 2

J2X Series Names: GL12EC, GL12ED

J.R. - Recorded Radii C+D into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes: Bottom

Radius C - 1950 - 2005

'81 - narrow

'63, '66, '68 - narrow

'59-'62 - wide

'57 - narrow

'56 + '58 - Similar

'55 - wider

'54 - decided does not have a false ring

'53 - narrower

'52 - wider

'51 - very narrow

'50 - wide center w/pith

Radius D - 1950 - 2005

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/24/2005

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 1

Slab ID: 3 D (Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL1J2X.txt

Number of radii measured: 2

J2X Series Names: GL13DA, GL13DB

J.R. - Entered radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

J.R. - buried after 1990, '80, '62.
M.S. - buried after '62, '55, ~~'23~~ mls

Wood Anatomy Change Notes:

Top Radius A - 1950 - 1989
- '72 - '80 - wide
- '81 - narrow
- '66 - '68 - narrow
- '59 - '62 - wide
- '57 - narrow

Radius B - 1950 - 2005
- '55 + '56 - similar
- '53 + '54 - narrow
- '52 - wide
- '51 - very narrow
- '50 - center w/pith

bottom - possibly '49 center?

GATES of LODORE - Ring Reading Notes

Ring Reader: J. R.

Reading Date: ———

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 1

Slab ID: 5C
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL1J2X.txt

Number of radii measured: 2

J2X Series Names:

DO NOT RECORD into J2X.

Bottom - Root

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Bottom 1949?

Can't tell what or how many center rings there are.

—Going w/estab. point at 1950.

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: ———

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 1

Slab ID: 7 C2 (=<C)

Ring Counts/Notes:

J2X filename: GL1J2X.txt

Number of radii measured:

J2X Series Names:

ALL ROOT! (Don't Measure into J2X.)

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

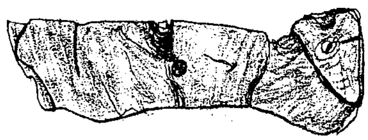
Start Year: Stop Year: Proportion:

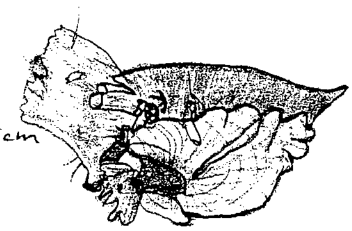
Wood Anatomy Change Notes:

GATES OF LODORE

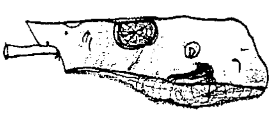
2/2006
J.R.
Pg. 1 of 2

1) TREE 1

3-9cm  GL-1-GS •=nail GS

5.5-7.5cm  GL-1-1

6-8cm  GL-1-2E (has center rot) o=nail=E (sanded)

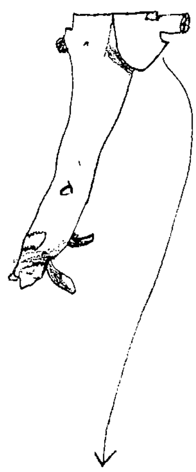
5-7cm  GL-1-3D D=nail (sanded)

5) 4-7.5cm  GL-1-4

3/2006
J.R.
pg. 2 of 2

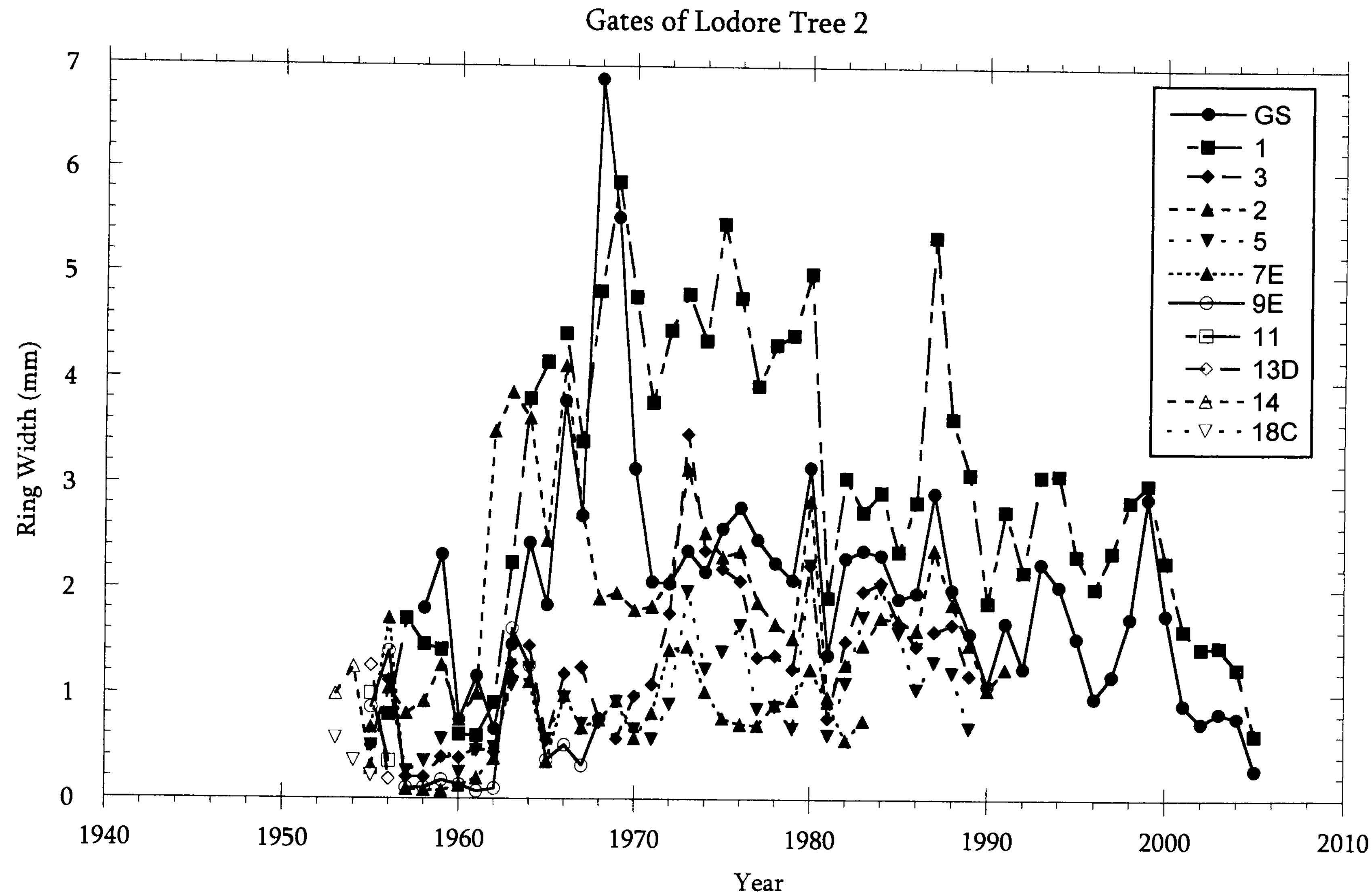
GATES OF LODORE - TREE 1

~5 cm  GL-1-5C ⓒ = nail (sanded) (bottom all root)

~30 cm  GL-1-6

~4.5 cm  GL-1-7-C2 ⓒⓒ = nail (sanded) <u>All Root</u>

~19cm  GL-1-8


Gates of Lodore Tree 2
Ring Width (mm)
Year
0
1
2
3
4
5
6
7
1940
1950
1960
1970
1980
1990
2000
2010
GS
1
3
2
5
7E
9E
11
13D
14
18C

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/24/2006

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: GS

2 centers

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 2

J2X Series Names: GL2GSA, GL2GSB

J.R. - Recorded radii A+B into J2X.

This stem sick.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Top

Wood Anatomy Change Notes:

Radius A - 1958-2005

2005 - very small
'99 - wide
'90 + '92 - narrow
'85 + 86 - narrow
'72 - 84 - similar
'81 - narrow
'80 - wide

~'75 - '78 - similar
'68 + '69 - wide
'64 - '66 - wide
'60 - '62 - narrow
'58 + '59 - similarly wide
'58 is center w/ pith on oldest center.

Radius B - 1958 - 2005

GATES of LODORE – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/24/2006

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: GS

Bottom

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 1

J2X Series Names: GL2GSC

J.R. – Recorded radius C into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Bottom Radius C

1957 – 2005

'57 center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/24/2006

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: 1

[2 centers - bottom sanded]

Ring Counts/Notes:

J2X filename: GLJ2x.txt

Number of radii measured: 2

J2X Series Names: GL21A, GL21B

J.R. - Recorded radii A+B into J2X.

Tree sick.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: ? Stop Year: Proportion:

J.R. - Burial after '81 in part of slab +'91.

M.S. - Buried after '56 possibly + by or after '82 +'95.

Wood Anatomy Change Notes: ? another center ~~year~~ 1956? yes

Radius A 1956 - 2005

2005 - small
'99 - wide
90's - smaller on 'A'.
'87 - wide
'85 + '86 - narrower
'81 - narrow
'80 - wide

Radius B - 1956 - 2005

1975 - 79 - similarly wide
'70 - '74 - similar
68 + 69 - similar
'66 - wide
'65 - narrower
'64 - wide
'60 - '62 - narrow
'57 - '59 - similarly wideish

1956 - w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/26/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: 2
(Bottom Sanded)
(2 pieces, 1st cm falls out) - not needed -

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 2

J2X Series Names: GL22A, GL22B

J.R. Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R - Burial after 1989, + possibly '56.
M.S. - Buried after '56 + '84 + '82, '91 - new center '55.

Wood Anatomy Change Notes:

Radius A - 1955-2005

2005 - small
'99 - wide
'94 + '95 - similarly wide
'87 - wide
'81 - narrow
'80 - wide
'75 - '79 - similar on 'A'.
'75 + '76 - similar on 'B'.
'73 + '74 - wide on 'B'.
'68 + '69 - similar
'66 - wide
'65 - narrower
'64 - wide

Radius B - 1955-1991

'60 - '62 - narrow on 'B'.
'57 - '59 - similar
'56 wide
'55 - center w/pith small

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/26/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: 3

(2 pieces) bottom Sanded

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 2

J2X Series Names: GL23A, GL23B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Buried after ~'89 + possibly '56.

M.S. - Buried by after '56, +'91?

Wood Anatomy Change Notes: - center has pith -

Radius A - 1955 - 1991

'89-'91 - similar
'83-'88 - similarly wide
'81 - narrow
'73-'76 - wide
'68-'70 - similarly narrow

'65 - narrow
'64 - wide
'63 - widest
'60-'62 - narrow
'58+'59 - similar
'57 - narrow

Radius B - 1955 - 1989

'56 - wide
'55 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/26/06

Site ID: GATES of LODORE

Collection Date: Aug, 2005

Tree/Hole ID: 2

Slab ID: 5

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 2

J2X Series Names: GL25A, GL25B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Buried after '89, '66? + '56.
M.S. - Buried after '56, '63, '84 + '89.

Wood Anatomy Change Notes:

Radius A - 1955 - 1990   Radius B - 1955 - 1989

'89 - narrowish
'83-'85 - wide
'81 - narrow
'80 - wide
'77-'79 - similar
'73-'76 - wide

'67-'71 - similarly narrow on 'A'.
'70-'72 - " " " 'B'.
'66 - lil wider
'65 - narrow
'64 - wide
'63 - wide
'60-'62 - very narrow

'59 - wider on 'A'.
'57-'62 - extremely narrow on 'B'.
'56 - wide
'55 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/26/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: 7 E

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 2

J2X Series Names: GL27EA, GL27EB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Buried after '56 + maybe '66.

M.S. - Buried by after '56 + possibly '63

Wood Anatomy Change Notes:

Radius A - 1955-1975 Radius B - 1955-1983

'80 - wide
'75-'79 - similar
'72-'74 - wide
'70 - narrow
'68 + '69 - similar

'67 - narrow
'66 - wide
'65 - narrow
'64 + '63 - wide
'62 - narrow on 'A' - wide on 'B'
'57 - '61 - extremely compressed + narrow
measure?

'56 - wide
'55 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/26/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: 9E1

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 2

J2X Series Names: GL29E1A, GL29E1B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Buried after '56 + '66.

M.S. - Buried after '56 + '63.

Wood Anatomy Change Notes:

Radii A + B - 1955-1968

'55 - center w/pith

'56 - WIDE

Yrs. '57 - '62 extremely compacted + barely readable-measure? NO

'63 + '64 - wide

'67 + '75 - very narrow

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/26/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: 11
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 2

J2X Series Names: GL211A, GL211B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

J.R. - Buried after '56.
M.S. - Buried after '56 + '63

Wood Anatomy Change Notes:

Top

Radii A+B - 1955 - 56

Later years are visible but '57 - '62 are not measurable.

'55 - center w/pith

'56 - narrowing

'63 + '64 - wide

'65 + '67 - very narrow

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/26/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: 13 D

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 2

J2X Series Names: GL213DA, GL213DB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Buried after 1956.
M.S. - Buried after '56.

Wood Anatomy Change Notes:

Radii A + B - 1955 - '56

'55 - wide center w/pith
'56 - very narrow
later years visible but '57 - '62 not measureable.

GATES of LODORE – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/26/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: 14

– Bottom Sanded –

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 2

J2X Series Names: GL214A, GL214B

J.R. – Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

J.R. – Buried after '56 + '63

M.S. – Buried after '56.

Wood Anatomy Change Notes:

Radii A+B - 1954 – '56

– New year added.

center now '54 w/pith

'55 – wide

'56 – very narrow

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/26/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: 18C

(Top + Bottom SANDED)

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured: 2

J2X Series Names: GL218CA, GL218CB

J.R. - Recorded radii A + B into J2X, but didn't draw radii on wood to keep it mostly readable.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Buried after '55 + '63

M.S. - Buried after '56

Wood Anatomy Change Notes: Top

- Radii "A + B" 1953-1955.

- picked up another year.

Center 1953 w/pith.

'54 wide, but narrower than before

'55 - narrow

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/26/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 2

Slab ID: 19

Ring Counts/Notes:

J2X filename: GL2J2X.txt

Number of radii measured:

J2X Series Names:

DON'T MEASURE

Proportion of circumference with secondary growth:

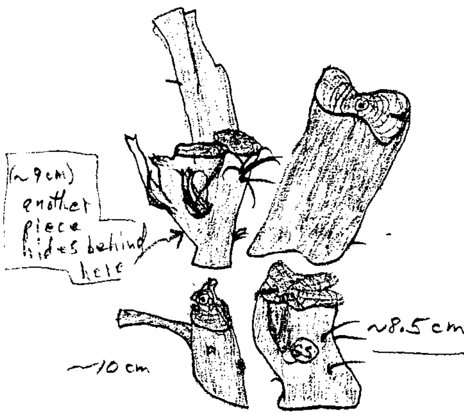
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

Wood Anatomy Change Notes:

end appears to be all Root.
So established in 1953.

4/2006
JR,
pg. 1+3

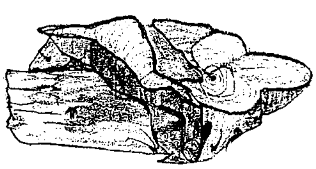
GATES of LODORE - TREE 2



→ GL-2-GS (Top & Bottom Sanded)

→ GL-2-1 (bottom sanded)

→ GL-2-1-1



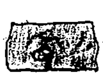
GL-2-2 (bottom Sanded)

5-10 cm 

GL-2-3
(2 pieces) (bottom sanded)

4.5cm 

GL-2-4

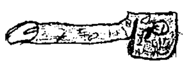
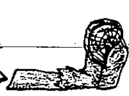
4.5cm 

GL-2-5 (Top Sanded)

cont. →

4/2006
J.R.
Pg. 2 of 3

GATES of LODORE – TREE 2

20 cm		GL-2-6	
3.5 cm		GL-2-7E	(Top Sanded) 0 nail = E
9 cm		GL-2-8	
~4 cm		GL-2-9-E1	(Top Sanded – nail = E1)
6.5 cm		GL-2-10	
3.5 cm		GL·2·11	(Top + Bottom Sanded)
11 cm		GL·2·12	
~3 cm		GL·2·13D	(Top + Bottom Sanded) 0 nail = D
~5 cm		GL·2·14	(Bottom Sended)

cont. →

GATES OF LODORE - TREE 2

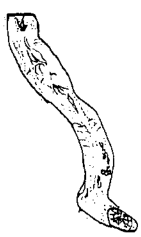
5/2006
J.R.
pg. 3 of 3

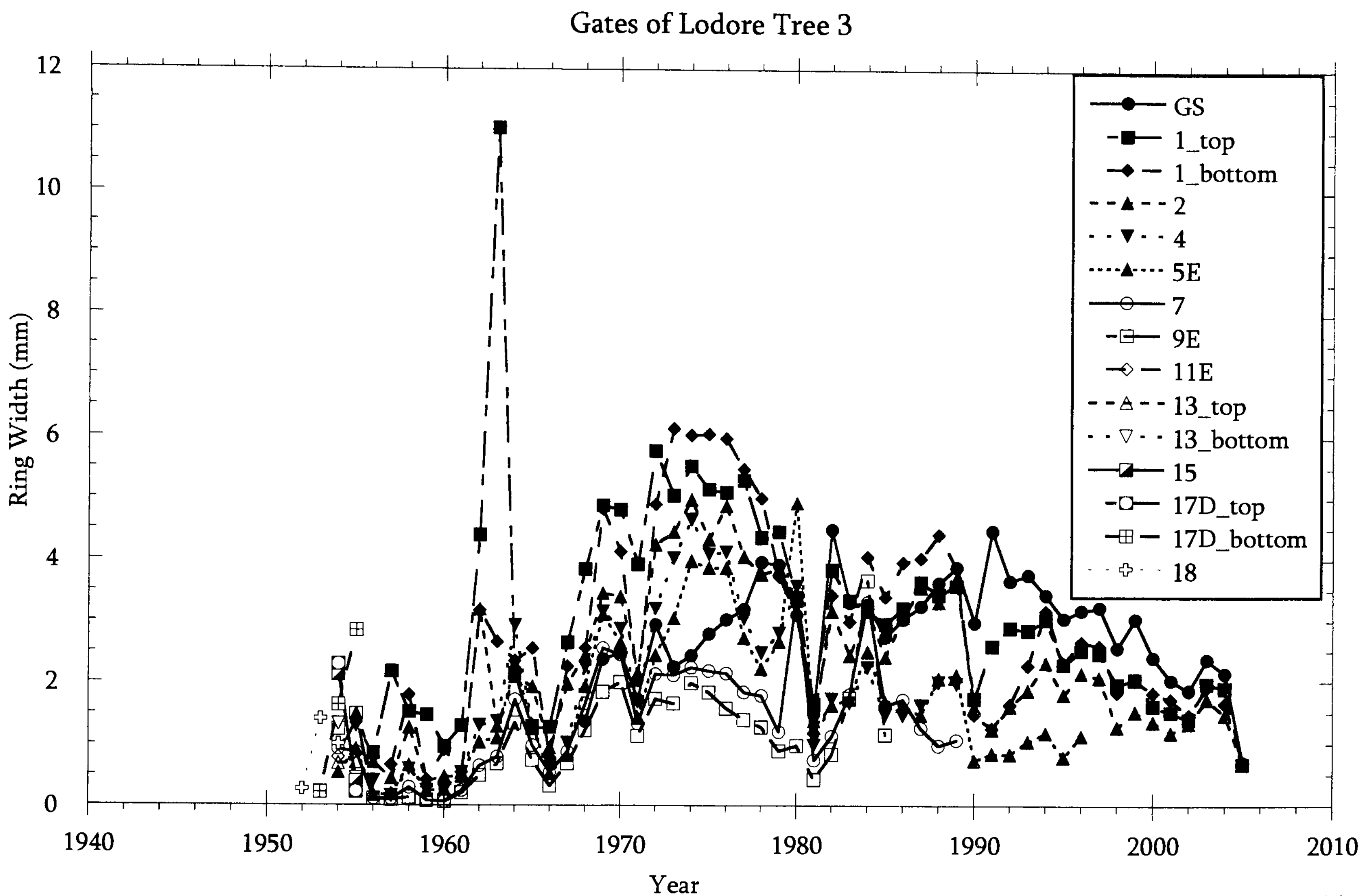
~3cm  GL·2·15

~3cm  GL·2·16 (Top + Bottom Sanded)

8cm  GL-2-17

~3cm  GL-2-18C (had flagging - no nail) (Top + Bottom sanded)

19.5cm  GL-2-19 (end sanded looks rootly)



Gates of Lodore Tree 3
Ring Width (mm)
0
2
4
6
8
10
12
1940
1950
1960
1970
1980
1990
2000
2010
Year
GS
1_top
1_bottom
2
4
5E
7
9E
11E
13_top
13_bottom
15
17D_top
17D_bottom
18

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: July 13, 2006

Site ID: GATES OF LODORE

Collection Date: ~Aug. 2005

Tree/Hole ID: 3

Slab ID: GS

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL3GSA, GL3GSB

→ Recorded Radii A+B into J2X
–JSA

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Radius A – 1968 – 2005

2005 – narrow
'90's – are similar
1990 – smaller on 'A'
'85 – narrower
'81 – narrow
'73+'74 – similarly narrow

Radius B – 1968 – 2004

'71 – narrow
'69+'70 – wide
'68 – center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J, R,

Reading Date: 7/13/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 3

Slab ID: 1
(Top + Bottom SANDED)

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL31A , GL31B

Recorded Rad.. A+B into J2X - JSA

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Top Wood Anatomy Change Notes:

Radii A + B - 1956 - 2005

2005 - narrow
'90 - narrower
'81 - narrow
'71 - narrower
'69 + 70 - wide
'66 - narrow
'63 - wide
'62 - narrower
'61 - narrow
'60 - narrow
'58 + '59 - wide
'56 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R. Reading Date: 7/13/06

Site ID: GATES OF LODORE Collection Date: ~Aug, 2005

Tree/Hole ID: 3 Slab ID: 1
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL31C, GL31D

Measured Radii C+D into J2X
-JSA

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Bottom Wood Anatomy Change Notes:

Radius C - 1955 - 2005 Radius D - 1955 - 2005

2005 - narrow
'91 - narrow on D
'90 - narrower
'87-'89 - WIDE
'81 - narrow
'71 - narrow
'69 + '70 - wide
'66 - narrow
'62 - '65 - wide
'61 - narrow
'59 - narrow
'58 - WIDE
'56 + '57 - similarly narrow
'55 - Center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date:

Site ID: GATES OF LODORE

Collection Date: ~Aug. 2005

Tree/Hole ID: 3

Slab ID: 2 (Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL32A, GL32B

GL32A - J2x'd in on 7/17/06 by JSA → Note 2005 Ring Probably Not Constant

GL32B - J2x'd in on 7/17/06 by JSA

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial - no definite burial signal.

TOP

Wood Anatomy Change Notes:

Radii A + B 1955 - 2005

2005 - narrow
'91 - narrow on 'A'
'90 - narrower on 'B'
'89 - wide
'81 - narrow
'71 - narrow

'69 + '70 - wide
'66 - narrow
'64 + '65 - Similarly wide
'63 - narrower
'62 - WIDE
'59 - '61 - very narrow

'58 - wide
'57 - very narrow
'56 - narrow
'55 - center w/pith

GATES of LODORE – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/17/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 3

Slab ID: 4 (Top Sanded)

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL34A, GL34B

Recorded in J2X on 7/17/06 JSA

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. – Buried after '89, '80, '58

M.S. – Burial after '80, '58 + '56.

Wood Anatomy Change Notes:

Radius A – 1953 – 2005   Radius B – 1955 – 1989

'96 + '97 – wide

'90 – narrow

'81 – narrow

'80 – wide

'73-'76 – similarly wide

'71 – narrow

'69 + '70 – wide

'66 – very narrow

'64 – WIDE

'60 + '61 – very narrow

'59 – less narrow than '60.

'58 – wider

'57 – very narrow

'56 – wide

'55 – center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/17/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 3

Slab ID: 5 - E3

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL35E3A, GL35E3B

Entered into J2X on 7/17/06 - JSA

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Buried after '89, '80?, '58 + '55

M.S. - Burial after possibly '80, '58 & '55 suppressed after '89, '80

Wood Anatomy Change Notes:

Radius A - 1954 - 2005 Radius B - 1954 - 1996

'90's - similar
'81 - narrow
'80 - wide
'79 - less wide
'71 - narrow
'69 + '70 - wide
'66 - very narrow
'65 - wider than '66
'64 - WIDE
'62 + '63 - similar
'61 - narrow
'59 + '60 - very narrow
'58 - wide
'57 - extremely narrow
'56 - narrower
'55 - wide
'54 - new center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/17/06

Site ID: GATES OF LODORE

Collection Date: ~Aug. 2005

Tree/Hole ID: 3

Slab ID: 7

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL37A GL37B

Entered into J2X on 7/17/06 - JSA

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial after '55, '58 unburial after '79 +82, reburial after '80 + '85.

M.S. - burial by/after '55, '58, unburied b/a '79, reburied after '80, unburied after '82, reburied after 84 or '85.

Wood Anatomy Change Notes:

Radius A - 1954 - 1989

Radius B - 1954 1985

'84 - wide

'83 - narrower

'81 + '82 - narrow

'80 - wide

'71 - narrow

'69 + '70 - wide

'66 - narrow

'64 - wide

* '56 - '60 - estimate in J2X (extremely narrow) on 'A'.

'58 - wide

* '56 + '57 + '59 + '60 estimate in J2X - (extremely narrow) on 'B'.

'55 - wideish

'54 - center w/pith.

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R. Reading Date: 7/17/06

Site ID: GATES OF LODORE Collection Date: ~Aug. 2005

Tree/Hole ID: 3 Slab ID: 9E

Ring Counts/Notes:

J2X filename: GL3J2X.TXT

Number of radii measured: 2

J2X Series Names: GL39EA, GL39EB

Entered Into J2X on 7/17/06 by JSA

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Burial after 55, unburied after '82, reburial after '85.

M.S. - Burial after '55; unburied after '82, reburied after '85 or possibly '84.

Wood Anatomy Change Notes:

Radius A - 1954 - 1985 Radius B - 1954 - 1985

1985 - narrow
'84 - wide
'83 - narrower
'81 - narrow
'71 - narrow
'69 + '70 - wide
'66 - very narrow
'65 - wider
'64 - wide
'63 - narrower
'56 - '60 - Compacted - estimate in J2X, on 'A' + 'B'.
'55 - WIDE
'54 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/17/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 3

Slab ID: 11-E1

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL311E1, GL311E1B

\# Forgot to Add in the "A" for Radius Series name

Entered Into J2X by JSA 7/17/06

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Burial after '55.

M.S. - Burial after '55

Wood Anatomy Change Notes:

Radii A+B 1954 - 1955

'55 - WIDE

'54 - center w/pith

GATES of LODORE – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/17/06

Site ID: GATES of LODORE

Collection Date: ~Aug. 2005

Tree/Hole ID: 3

Slab ID: 13
(Top + Bottom SANDED)

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL313A GL313B

Entered into J2X by JSA 7/17/06

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Top
J.R. - Burial after '55.
M.S. Burial after '55.

Wood Anatomy Change Notes:

Radii A + B - 1954-55.

'55 - wide, but narrowing.
'54 - center w/ pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/17/06

Site ID: GATES of LODORE

Collection Date: ~Aug. 2005

Tree/Hole ID: 3

Slab ID: 13

(Top + Bottom SANDED)

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL313C GL313D

Entered into J2X by JSA on 7/17/06

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial after '55

(Bottom) M.S. - Buried after '55

Wood Anatomy Change Notes:

Radii C + D - 1954-55.

'55 - narrow

'54 - center w/pith - big pith!

GATES of LODORE – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/17/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 3

Slab ID: 17 D

(Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL 317D A, GL317DB

Entered into J2X by JSA on 7/17/06

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. – Still buried after '55.

M.S. – Buried after '55

Top

Wood Anatomy Change Notes:

Radii A + B – 1954 – '55

'55 – extremely narrow

'54 – very wide w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/17/06

Site ID: GATES OF LODORE

Collection Date: ~Aug. 2005

Tree/Hole ID: 3

Slab ID: 17 D
(Top + Bottom SANDED)

Ring Counts/Notes:

J2X filename: GL3 J2X.txt

Number of radii measured: 2

J2X Series Names: GL317DC, GL317DD

Entered into J2X by JSA on 7/17/06

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

M.S. — Burial after '55 possibly after '54 as well.

Wood Anatomy Change Notes:

Bottom

Radii C + D - 1953 - '55.

'55 - visible but extremely small
'54 - WIDE
'53 - New center w/pith. Agree! ✓

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/17/06

Site ID: GATES OF LODORE

Collection Date: ~Aug. 2005

Tree/Hole ID: 3

Slab ID: 15

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: G1315A, G1315B

Entered into J2X by JSA on 7/17/06

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Burial after '55

M.S. - Buried after '55.

Wood Anatomy Change Notes:

Radii A+B - 1954-'55.

'55 - narrow

'54 - wide center w/pith

GATES of LODORE – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/17/06

Site ID: GATES of LODORE

Collection Date: ~Aug. 2005

Tree/Hole ID: 3

Slab ID: 18

(Bottom + Side branch Sanded)

Ring Counts/Notes:

J2X filename: GL3J2X.txt

Number of radii measured: 2

J2X Series Names: GL318A, GL318B

Entered into J2X by JSA on 7/17/06

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. – Burial after 1954.

M.S. – Buried after '54.

Wood Anatomy Change Notes:

Bottom

Radii A + B – 1952 – '54

(SIDE STEM IS All ROOT. YES!)

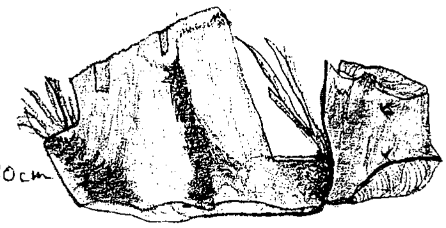
'54 – wide

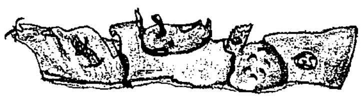
'53 – wide

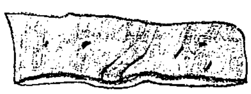
'52 – New center, small w/pith. Agree! ✓

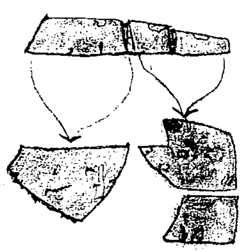
GATES of LODORE
TREE 3

J. Roth
6/2006

~20cm  GL 3-0 — 2 pieces

6-8cm  GL-3-GS — nail = GS

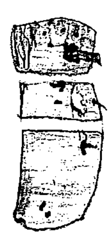
6-8.5cm  GL-3-1 (Top + Bottom Sanded)

2-4cm  GL-3-2 (Top + Bottom Sanded) 2 centers

2-7cm — GL-3-3 (2 pieces)

→ GL-3-4

4-6.5cm  GL-3-5-E3 — nail = E3



7.5cm — GL-3-6

~5.5cm — GL-3-7

8.5cm — GL-3-8

cont. →

GATES OF LODORE
TREE 3

J. Roth
7/2006

3cm  GL-3-9 E nail = E

~3cm  GL-3-10

3cm  GL-3-11-E1 nail = E1

10.5cm  GL-3-12

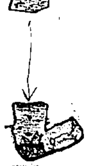
5cm  GL-3-13 (Top + Bottom SANDED)

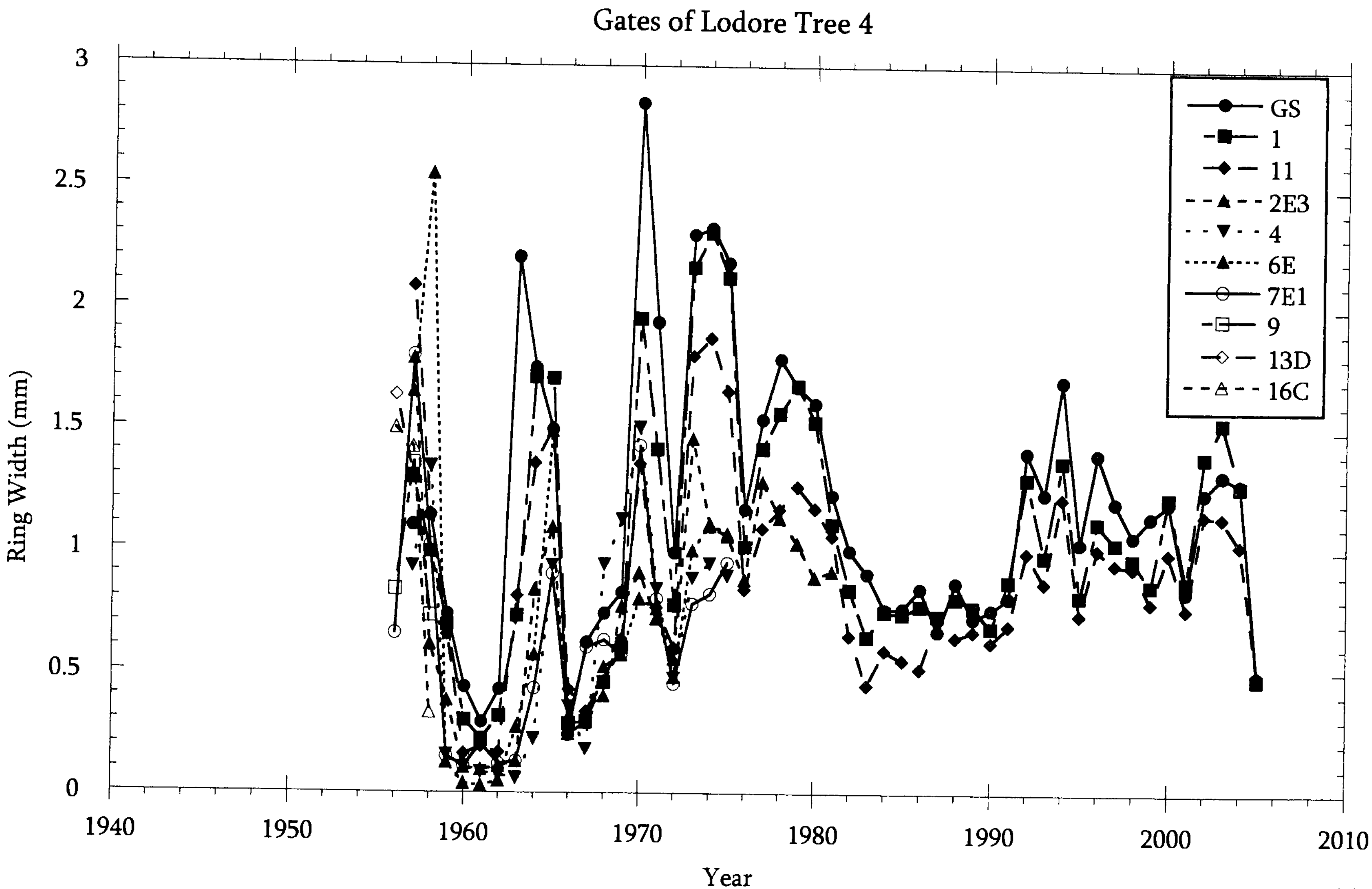
~10cm  GL-3-14

3cm  GL-3-15 (Top SANDED)

4cm  GL-3-16

3.5cm  GL-3-17 D (Top + Bottom SANDED) nail = D

~4.5cm  GL-3-18 (Side stem + Bottom SANDED)


Gates of Lodore Tree 4
Ring Width (mm)
Year
0
0.5
1
1.5
2
2.5
3
1940
1950
1960
1970
1980
1990
2000
2010
GS
1
11
2E3
4
6E
7E1
9
13D
16C

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/2/06

Site ID: Gates of LODORE

Collection Date: Aug, 2005

Tree/Hole ID: 4

Slab ID: GS

Ring Counts/Notes:

J2X filename: GL4J2X.txt

Number of radii measured: 2

J2X Series Names: GL4GSA, GL4GSB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

Wood Anatomy Change Notes:

Radii A+B - 1957 - 2005

2005 - narrow
2002 - 2004 - similar
2001 - narrower
'96 - wider
'92 - '94 - similarly wide
'83 - '91 - Similarly narrow
'82 - wide lot of early year wood,
'77 - '81 - wide
'76 - narrow
'73 - '75 - WIDE
'72 - narrow
'70 + '71 - wide
'67 - '69 - narrow
'66 - extremely narrow
'63 - 65 - WIDE
'61 + 62 - narrow
'60 - narrow (oblongated)
'58 + '59 - wide (oblong
'57 - center w/ pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/2/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 4

Slab ID: 1

Ring Counts/Notes:

J2X filename: GL4J2X.txt

Number of radii measured: 2

J2X Series Names: GL41A, GL41B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R.F. - burial looks like after '81, '75

M.S. - buried after '81 + '75

Wood Anatomy Change Notes:

Radii A + B - 1957 - 2005

'92 - '94 - wide

'67 - '69 - narrow

'66 - extremely narrow

'63 + '65 - wide

'77 - '81 - wide

'73 - '75 - wide

'72 - narrow

'60 - '62 - similarly very narrow

'70 - wide

'58 + '59 - WIDE

'57 - center w/ Tiny pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F. | Reading Date: 5/2/06

Site ID: Gates of Lodore | Collection Date: Aug, 2005

Tree/Hole ID: 4 | Slab ID: 1-1 (Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL4J2X.txt

Number of radii measured: 2

J2X Series Names: GL411A, GL411B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R.F. - Buried after 1981, + maybe earlier 75 + 59?

M.S. - Buried after '81, '75, '59. '61-drought

Wood Anatomy Change Notes: Top + bottom are 1957-2005

Top Radii A+B

2005 - pretty narrow

'92-'94 - wide

'83-'91 - similarly narrow

'82 - widest w/a lot of early wood.

'77-'81 - wide

'76 - narrower

'73-'75 - WIDE

'72 - narrow

'70 - wide

'66-'69 - narrow (very tight on 'B')

'63-'65 - wide

'60-'62 - extremely narrow,

'57-'59 - wide

'57 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/2/06

Site ID: GATES OF LODORE

Collection Date: Aug, 2005

Tree/Hole ID: 4

Slab ID: 2 E3

Ring Counts/Notes:

J2X filename: GL4J2X.txt

Number of radii measured: 2

J2X Series Names: GL42E3A, GL42E3B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ___ Stop Year: ___ Proportion: ___

Start Year: ___ Stop Year: ___ Proportion: ___

Start Year: ___ Stop Year: ___ Proportion: ___

J.R.F. - Buried after 1981, '75, '59?

J.M. - Buried after '81, '75, '59.

Wood Anatomy Change Notes:

Radii A+B - 1957 - 1981

'77 - '81 - wide
'76 - narrower
'73 - '75 - wide
'72 - narrow
'70 - wide

'66 - '68 - narrow (especially on 'B')
'64 + '65 - WIDE
'60 - '63 - very tiny - undistinguishable - will estimate when reading
'59 - narrow
'57 + '58 - wide
'57 - center w/ tiny pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/2/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 4

Slab ID: 4
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL4J2X.txt

Number of radii measured: 2

J2X Series Names: GL44A, GL44B

J.R. - Recorded radii A + B into J2X

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R.F. - Buried after '75, 59

M.S. - buried after '75, 59.

Wood Anatomy Change Notes:

Radii A + B - 1957 - 1975

1973 - '75 - wide
'72 - narrow
'70 - wide
68 + '69 - Similar ('69 a little wider)
'66 + '67 - very tiny
'65 - wide

'64 - narrow on 'A'
* '59 - 63 - very narrow - (estimate for measuring)
'58 - wide
'57 - center w/pith

GATES of LODORE – Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/4/06

Site ID: GATES OF LODORE

Collection Date: Aug, 2005

Tree/Hole ID: 4

Slab ID: 6 E

Ring Counts/Notes:

J2X filename: GL4J2X.txt

Number of radii measured: 2

J2X Series Names: GL46EA, GL46EB

J.R. – Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R.F. – Buried after 1975, '58, '64

M.S. – Burial after '75, '58 + 60 – possibly

Wood Anatomy Change Notes: Radius A – 1957-1975 Radius B – 1957 – 1959

1973 -'75 – wide

72 – narrow

'70 + '71 – wide

'68 + '69 – similarly narrow

'66 + '67 – very narrow on 'A'

'65 – wide

'64 – narrow

'60 - '63 – barely visible

'59 – very narrow

'58 – WIDE

'57 – center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/4/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 4

Slab ID: 7E1

Ring Counts/Notes:

J2X filename: GL4J2X.txt

Number of radii measured: 2

J2X Series Names: GL47E1A, GL47E1B

J.R. - recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R.F. - Buried after 1975, 58
M.S. - buried after '58 + 75

Wood Anatomy Change Notes:

Radius A - 1956-1975 Radius B - 1956-58

1958 - wide
57 - wide
'56 - new center w/tiny pith.

'75 - wide
'72 - narrow

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/4/06

Site ID: GATES OF LODORE

Collection Date: Aug, 2005

Tree/Hole ID: 4

Slab ID: 9

Ring Counts/Notes:

J2X filename: GL4J2X.txt

Number of radii measured: 2

J2X Series Names: GL49A, GL49B

J.R. - recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R.F. - Buried after 1958.

M.S. - buried after '58 & '60

Wood Anatomy Change Notes:

Radii A + B 1956 - '58

'57 - wide

center is 1956 w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/4/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 4

Slab ID: 13 D

Ring Counts/Notes:

J2X filename: GL4J2X.txt

Number of radii measured: 2

J2X Series Names: GL413DA, GL413DB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. buried after 1957.

M.S. - buried after '57

Wood Anatomy Change Notes:

Radii A + B

1956 - 1957

'57 - wide

'56 - center w/pith ✓

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 5/4/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 4

Slab ID: 16 C
(Both sides sanded)

Ring Counts/Notes:

J2X filename: GL4J2X.txt

Number of radii measured: 2

J2X Series Names: GL416CA, GL416CB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Buried after 1958.

M.S. - buried after '58

Wood Anatomy Change Notes:

Top - Radius A - 1956 - '58 Radius B - 1956 - '57.

'57 - wide

center is '56 w/pith - no clear pith - either absent or very small

Bottom

new year? '55 yes

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date:

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 4

Slab ID: 17

Ring Counts/Notes:

J2X filename: GL4_J2X.txt

Number of radii measured:

J2X Series Names:

NOT Recorded

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

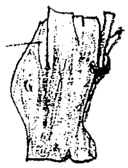
Wood Anatomy Change Notes:

ALL ROOT ☺

ON SIDE.

GATES OF LODORE TREE 4

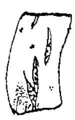
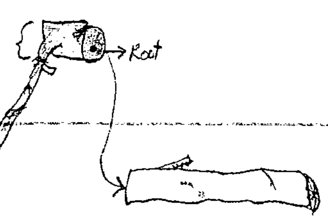
Jan. 2006
J.R.F.
pg. 1 + 2

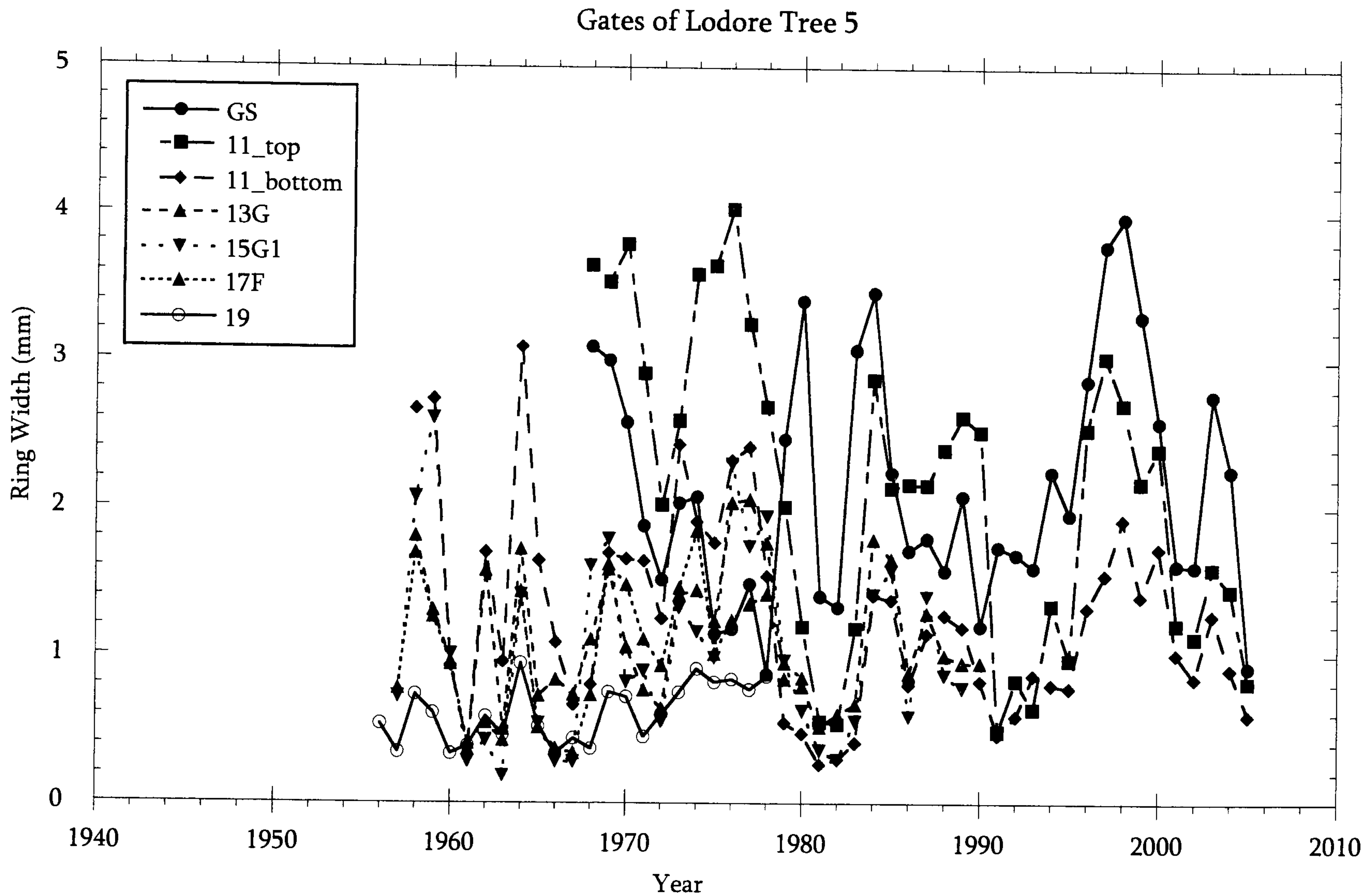
15 cm		GL-4-0	
3.5-4.5 cm		GL-4-GS	nail = GS
~3.5 cm		GL-4-1	(Top Sanded)
4 cm		GL-4-1-1	(Top + Bottom Sanded)
		GL-4-1-2	
~4.5 cm		GL-4-2 E3	nail = E3
~12 cm		GL-4-3	
4-5 cm		GL-4-4	(Top + Bottom Sanded)
11.5 cm		GL-4-5	
2.5-3 cm		GL-4-6 E	nail = E

cont. →

GATES OF LODORE TREE 4

Jan, 2006
J. R. F.
pg. 2 of 2

~3cm		GL-4-7-E1	• nail = E1
~4cm		GL-4-8	
~3.5cm		GL-4-9	(Top Sanded)
~14cm		GL-4-10	
~4.5cm		GL-4-11	(Top Sanded)
		GL-4-12	
~3.5cm		GL-4-13 D	• (Top Sanded nail = D)
~3.5cm		GL-4-14	(Top + Bottom Sanded)
~4cm		GL-4-15	
~3cm		GL-4-16 C	(Top + Bott. Sanded, • nail = C)
3cm		GL-4-17	
		GL-4-18	(all root)


Gates of Lodore Tree 5
GS
11_top
11_bottom
13G
15G1
17F
19
Ring Width (mm)
Year
0
1
2
3
4
5
1940
1950
1960
1970
1980
1990
2000
2010

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 6/28/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 5

Slab ID: 1- GS
(3 centers)

Ring Counts/Notes:

J2X filename: GL5J2X.txt

Number of radii measured: 2

J2X Series Names: GL51GSA, GL51GSB

Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Some signs of burial on other centers

Wood Anatomy Change Notes: Oldest Radial Center

Radius A - 1968-1990 Radius B - 1968 - 2005

2005 - narrow
2003 - wider
'97-'99 - wide
'90-'95 - similar
'83 + '84 - WIDE
'81 + '82 - narrow
'80 - wide

'75-'78 - Similarly narrowish
'79 - wider
~~'68-'70 - wide~~
'68 - center w/pith

*stem injury after 1982.

GATES of LODORE – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 6/28/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 5

Slab ID: 1-1
(Top + Bottom SANDED)

Ring Counts/Notes:

J2X filename: GL5J2x.txt

Number of radii measured: 2

J2X Series Names: GL511A, GL511B

Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. – Burial after '80?

Wood Anatomy Change Notes:

Top – Radius A – 1968–2005

2005 – narrow
2001+02 – slightly narrower
~~'96 – 2000 – wider~~
'95 – narrow
'91+'92 – narrower
'84–'90 – similarly wide(?)

Radius B – 1968–2005

'81+'82 – narrow
'80 – wider
'68–'78 – similarly wide
'68 – center w/pith
*stem injury after 1982 on 'A'.

GATES of LODORE - Ring Reading Notes

Ring Reader: J. R.

Reading Date: 6/28/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 5

Slab ID: 1-1 (Top + Bottom SANDED)

Ring Counts/Notes:

J2X filename: GL5TJ2X.txt

Number of radii measured: 2

J2X Series Names: GL511C, GL511D

Recorded radii C + D into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Buried after '78, '90

M.S. - growth supression after '78.

Wood Anatomy Change Notes:

Bottom Radius C - 1958-2005 Radius D - 1958-2005

2005 - narrow
'96-2000 - wider
'93-'95 - narrow
'91 + '92 - narrower
'86 - narrower
'84-'89 - similar
'79-'83 - very tiny (will estimate when measuring rings)

'73-'77 - similarly wide
'72 - narrower
'67 + '68 - very narrow
'66 - narrow
'64 - wide
'63 - narrow

'62 - wide
'61 - very narrow
~~'59 - wide~~
'58 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R. Reading Date: 6/28/06

Site ID: GATES of LODORE Collection Date: Aug. 2005

Tree/Hole ID: 5 Slab ID: 1-3G

Ring Counts/Notes:

J2X filename: GL5IJ2X.txt

Number of radii measured: 2

J2X Series Names: GL513GA, GL513GB

Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

J.R. - Burial after '80 + '90

M.S. - growth supression after '78. burial or something after '90.

Wood Anatomy Change Notes:

Radius A - 1958-1990 Radius B - 1958-1978

'86 - narrow
'84&85 - wide
'81-'83 - very narrow
'80 - narrow
'76-'78 on 'A' - wide

'71 + 72 - narrow
'67 + 68 - very narrow
'64 - wide
'63 - narrow
'61 - very narrow

'60 - wider
'59 - wide
'58 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/5/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 5

Slab ID: 1-5-G1

Ring Counts/Notes:

J2X filename: GL5JJ2X.txt

Number of radii measured: 2

J2X Series Names: GL515G1A, GL515G1B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ___ Stop Year: ___ Proportion: ___

Start Year: ___ Stop Year: ___ Proportion: ___

Start Year: ___ Stop Year: ___ Proportion: ___

J.R. - Burial after 1978? + '85, '89

M.S. - Burial after '85

Wood Anatomy Change Notes:

Radius A - 1957-2005 Radius B - 1957-1989

2003 - wide
'95 - narrower
'91 - narrow
'87-'89 - wide
'86 - narrow
'84 + '85 - wide

'81 - '83 - very narrow
'79 + '80 - similar, though smaller on 'A'.
'76 wide 73-75 - similarly wide
72 - narrow
'65 - '67 - narrow (estimate on 'A' when reading)
'64 - wide
'61 - '63 - very narrow

'58 - '60 - wide
'57 - new center w/pith

GATES of LODORE – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/5/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 5

Slab ID: 1 – 7F
(Top + Bottom SANDED)

Ring Counts/Notes:

J2X filename: GL5J2X.txt

Number of radii measured: 2

J2X Series Names: GL517FA, GL517FB

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

J.R. – Buried after 1982
M.S. – Buried after '82 + possibly '84

Wood Anatomy Change Notes:

Top
Radius A – 1957 – 1980

'75 – '77 – similar on A.
'73 – wide
'71 + '72 – narrower
'70 + '69 – wide

Radius B – 1957 – 1965

'65 – '67 – narrower
'64 – WIDE
'63 – very narrow
'61 + '62 – narrow
'58 + '59 – wide
'57 – small center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/5/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 5

Slab ID: 1-9 (Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL51J2X.txt

Number of radii measured: 2

J2X Series Names: GL519A, GL519B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial after 1964

M.S. - Burial after 1964

Top

Wood Anatomy Change Notes:

Radius A - 1956-1978

'69-'78 - similar

'65-'68 - narrow

'64 - wide

'61-'63 - narrow

'60 - narrower

Radius B - 1956-1964

'58 + '59 - wide

'57 - narrow

~~'56 - near center w/pith~~

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/6/06

Site ID: GATES of LODORE

Collection Date: Aug, 2005

Tree/Hole ID: 5

Slab ID: 1-11 (Top + Bottom Sawed)

Ring Counts/Notes:

J2X filename: GL51J2X.txt

Number of radii measured: 2

J2X Series Names: GL511A, GL511B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial after 1964 + '59.

M.S. - Serious burial after '64.

Wood Anatomy Change Notes:

Top

Radii A+B - 1956 - 1964

'63+'64 - wide

'62 - narrower

'61 - very narrow

'59 - wider

'58 - WIDE

'57 - narrow

'56 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J. R.

Reading Date: 7/6/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 5

Slab ID: 1-13

Ring Counts/Notes:

J2X filename: GL51J2X.txt

Number of radii measured: 1

J2X Series Names: GL5113A

J.R. - Recorded radius A into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - burial after '59, '64.

M.S. - burial after '57 or '58. + '64

Wood Anatomy Change Notes:

Radius A - 1956-1964

63+'64 - wide

'62 - narrower

'61 - very narrow

'59+'60 - similarly narrow

'58 - wider

'57 - WIDE

'56 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/6/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 5

Slab ID: 1-14
(Top + Bottom SANDED)

Ring Counts/Notes:

J2X filename: GL51J2X.txt

Number of radii measured: 2

J2X Series Names: GL5114A, GL5114B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial after '59
M.S. - potential Burial after '57 or '58.

Wood Anatomy Change Notes:

Bottom Radius A - 1956-1959. Radius B - 1956-1959.

'58 + '59 - Similar

~~'57 - WIDE~~

'56 - Center w/ pith

GATES of LODORE – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 7/6/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 5

Slab ID: 1-1 E

Ring Counts/Notes:

J2X filename: GL51J2X.txt

Number of radii measured: 2

J2X Series Names: GL511EA, GL511EB

J.R. – recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. – Burial after 1957.

M.S. – Burial after '57.

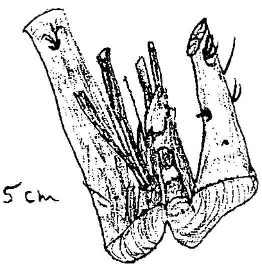
Wood Anatomy Change Notes:

Radii A+B – 1956 – 1957

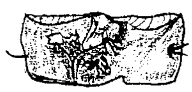
'56 – center w/pith still

GATES OF LODORE
TREE 5, STEM 1

J.R.
5/2006
Pg. 1 of 2

~25 cm  GL-5-1-0

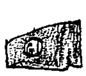
4.5 cm  GL-5-1-GS nail = GS

7 cm  GL-5-1-1 (Top & Bottom Sanded)

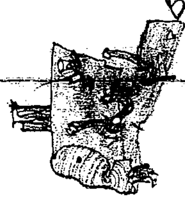
4 cm  GL-5-1-2

4-5 cm  GL-5-1-3G nail = G

5 cm  GL-5-1-4

3-5 cm  GL-5-1-5-G1 nail = G1

STEM 2 CONNECTS HERE
Slabs are labled, but Did NOT Sand or draw them.

15-18 cm  GL-5-1-6

cont. →

GATES OF LODORE

TREE 5, STEM 1

J.R.
5/2006
Pg. 2 of 2

4 cm  GL-5-1-7F nail = F (Top + Bottom Sanded)

9.5 cm  GL-5-1-8

4 cm  GL-5-1-9 (Top + Bottom Sanded)

2.5 cm  GL-5-1-10

4.5 cm  GL-5-1-11 (Top + Bottom Sanded)

4 cm  GL-5-1-12

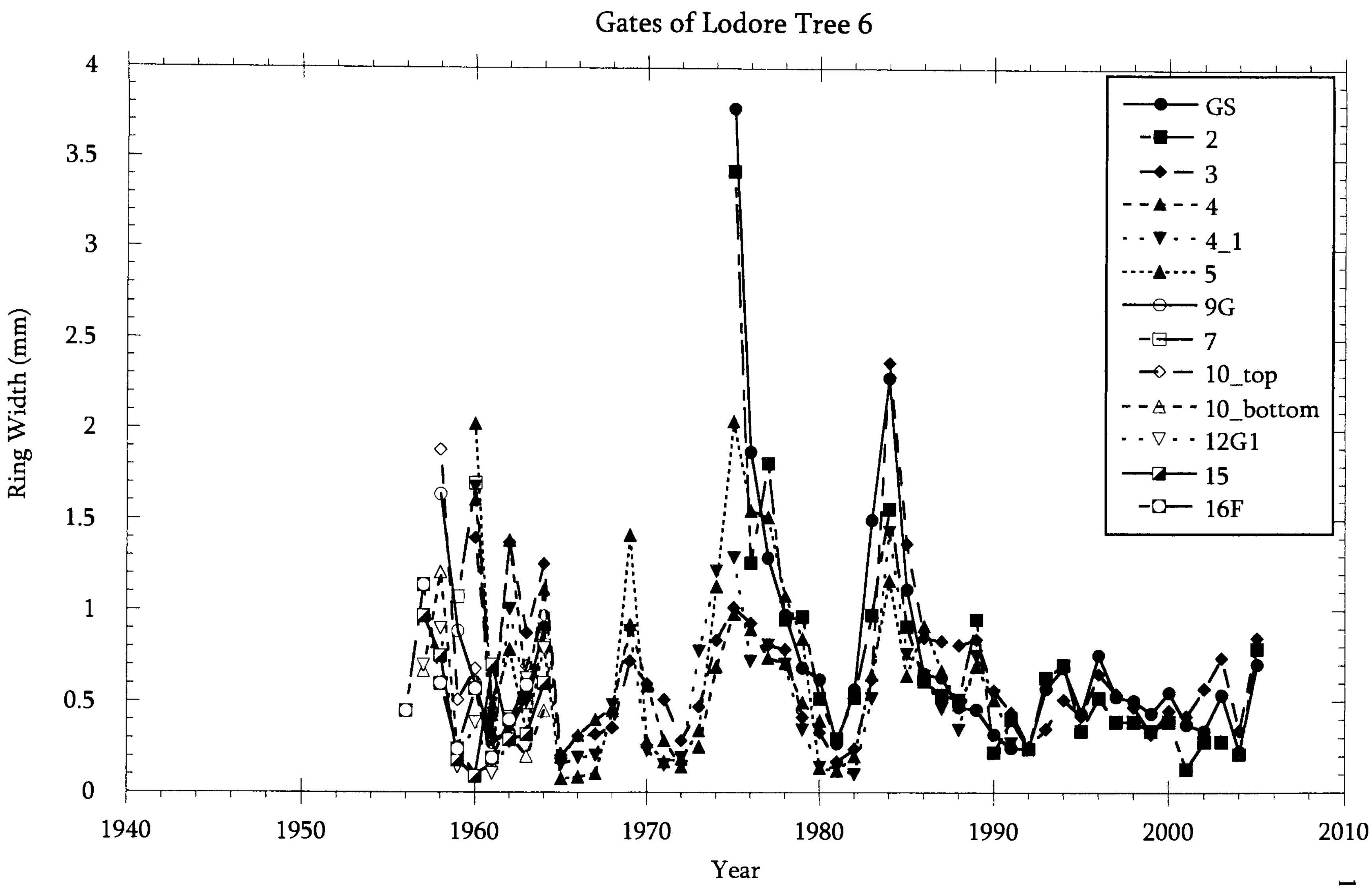
~2.5 cm  GL-5-1-13 (Top Sanded)

~4 cm  GL-5-1-14 (Top + Bottom Sanded)

17 cm  GL-5-1-15

~3 cm  GL-5-1-16E (Top + Bottom Sanded)

7 cm  GL-5-1-17


Gates of Lodore Tree 6
Ring Width (mm)
Year
0
0.5
1
1.5
2
2.5
3
3.5
4
1940
1950
1960
1970
1980
1990
2000
2010
GS
2
3
4
4_1
5
9G
7
10_top
10_bottom
12G1
15
16F

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 4/27/06

Site ID: Gates of Lodore

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: GS
(Sanded Top + Bottom)

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 2

J2X Series Names: GL6GS, GL6GSb

Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Bottom of slab Radius A- 1975-2005

2005 - wideish
2004 - narrow
2003 - wideish
'96-2002 - Similar
'95 - narrower
'93+'94 - wider on Radius A
'90-'92 - very narrow
'85 - wider
'84 - WIDE
'83 - wide
'82 - narrower
'81 - very narrow
'79+'80 - Similar
'78-'75 - gradually wider
'75 - center w/pith

Radius B - 1975 - 2005

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 4/27/06

Site ID: GATES OF LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 2-0 (Bottom Sanded) 2 centers

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 2

J2X Series Names: GL620A, GL620B

Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

1st center Radius A - 1975-2005

(2nd center (older)) Radius B - 1960? - 1974

2005 - wideish
2004 - narrow
2003 - wideish
'96 - 2000 - similar
'95 - narrower
'90-'92 - very narrow
'85 - wider
'84 - WIDE
'81 - very narrow
'79 + '80 - similar
'78-'75 - gradually wider
'75 - center w/pith
'74 - wideish
'69-'73 - similar
'66-'68 - similarly narrow
'65 - very narrow
'64 - WIDE
'63 - narrower
'62 - WIDE
'61 - narrow, possible false ring
'60 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 4/27/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 3

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 2

J2X Series Names: GL63A, GL63B

Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R.F. - Burial after '91 + '80.

M.S. - potential burial by after '62?, '80 + '91

Wood Anatomy Change Notes:

Radius A - 1960 - 2005 Radius B - 1960 - 1980

'61 - false ring

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 4/27/06

Site ID: Gates of Lodore

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 4-0

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 2

J2X Series Names: GL640A, GL640B

Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R.F.-Buried after 1980 + '91.

M.S. - Buried after '80 + '91 + possibly by or after '62.

Wood Anatomy Change Notes:

Radius A - 1960 - 1980 Radius B - 1960 - 1980

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 4/27/06

Site ID: Gates of Lodore

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 4-1

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 2

J2X Series Names: GL641A, GL641B

*Julie, record in very tight yrs. also.

Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R.F. - Burial after '90, '80, '70 possibly earlier

M.S. - Buried after '91

Wood Anatomy Change Notes:

Radius A - 1960 - 1990 Radius B - 1960 - 1991

*can read more later years but other intermittent years are too small + Tight to read now, so will estimate.

'69 - wide

'68 - narrower

'65-'67 - very narrow

'64 - wide

'63 - narrower

'62 - wide

'61 - narrow possible false ring

'60 - center w/pith

'84 + '74 - wide '70-'72 - very tiny! '80-'82 - extremely narrow!!

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F. Reading Date: 9/1/06

Site ID: GATES of LODORE Collection Date: Aug. 2005

Tree/Hole ID: 6 Slab ID: 5

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 2

J2X Series Names: GL65A, GL65B

J.R.-Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R.F. - Burial after 1970, '80, '64

M.S. - burial after '79 & possibly after '62 (growth suppression after '64.)

Wood Anatomy Change Notes:

Radius A - 1960-1990

'86 - wideish
'84 - wide
'83 - narrow
'80-'82 - extremely narrow!
'74-'78 - wide
'79 - narrower

'73 - narrow
'70-'72 - very narrow!!
'69 - wide
'65-'67 - extremely narrow!
'64 - wide
'63 - narrower
'62 - wider

Radius B - 1960-1989

'61 - narrow, possible false ring
'60 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/1/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 7

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 2

J2X Series Names: GL67A, GL67B

J.R.- Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R.- Burial after 1964, '79

M.S.- buried after '79

Wood Anatomy Change Notes:

Radius A - 1959 - 1964

Radius B - 1959 - 1964

'64 - wide

'63 + '62 - similar

'61 - narrow w/possible false ring

'60 - wide

'59 - center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/1/06

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 9G

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 2

J2X Series Names: GL69GA, GL69GB

J.R- Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R.F. - Burial after '64?

M.S. - buried after '59 or '60

Wood Anatomy Change Notes:

Radius A - 1958 - '64

Radius B - 1958 - 1964

'64 - wide

'63 - narrower

'62 - very narrow

'61 - possible false ring - narrow

'60 - wide

'59 - wide

'58 - center, wide, w/ Tiny Pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/1/06

Site ID: Gates of Lodore

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 10
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 3

J2X Series Names: GL610A, GL610B, GL610C

J.R. - Recorded radii A, B, + C into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R.F. - Burial after '64
M.S. - buried by or after '60 + '64

Wood Anatomy Change Notes:

Top Radii A+B - 1958 - 1964.

'64 - wide
'63 - narrower
'62 - very narrow
'61 - very narrow
'60 - wider on one side
'59 - wider
'58 - center wide No visible pith?

Bottom Radius C 1957 - 1964

'64 - wide
'63 - narrower
'59-'62 - extremely narrow
'58 - wide
'57 - wide center w/pith

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/1/06

Site ID: Gates of Lodore

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 12-G1

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 2

J2X Series Names: GL612G1A, GL612G1B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R.F. - Buried after '64 and probably earlier.

M.S. - buried after or by '58 + '64

Wood Anatomy Change Notes:

Radii A+B - 1957 - 1964

'64 - wide

'63 - narrower

'61 + '62 - very narrow

'60 - wider

'59 - very narrow

'58 - wide

'57 - wide, center w/pith.

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/2/06

Site ID: Gates of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 15

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 1

J2X Series Names: GL615A

J.R.F. Recorded radius 'A' into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R.F. - Buried after first two years.

M.S. - burial after by or after '59 or '60.

Wood Anatomy Change Notes:

Center is 1957 w/pith + wide.

'58 - WIDE

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F. Reading Date: 5/2/06

Site ID: Gates of LODORE Collection Date: Aug. 2005

Tree/Hole ID: 6 Slab ID: 16 - F

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: 2

J2X Series Names: GL616FA, GL616FB

J.R. Recorded radii A + B into J

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R.F. - Buried after first two years.

M.S. - buried after or by '57.

Wood Anatomy Change Notes: Radius A - 1956 - '58. Radius B - 1956 - 1963.

center is 1956 w/pith + small.

'57 - wide

'58 - less wide on 'B'.

'59 - very narrow

'60 - wide on 'B'.

'63 - wide

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.F.

Reading Date: 5/2/06

Site ID: Gates of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 23
(Top + Bottom Sanded)
2 centers - maybe 3

Ring Counts/Notes:

J2X filename: GL6J2X.txt

Number of radii measured: ______

J2X Series Names: ______

DO NOT RECORD

Proportion of circumference with secondary growth:

Start Year: ______	Stop Year: ______	Proportion: ______
Start Year: ______	Stop Year: ______	Proportion: ______
Start Year: ______	Stop Year: ______	Proportion: ______

Wood Anatomy Change Notes:

- One center is still '56 - Hard to determine what year the second center is.
- pith? not clear

GATES of LODORE - Ring Reading Notes

Ring Reader: J.R.

Reading Date:

Site ID: GATES of LODORE

Collection Date: Aug. 2005

Tree/Hole ID: 6

Slab ID: 25

Ring Counts/Notes:

J2X filename:

Number of radii measured:

J2X Series Names:

DO NOT RECORD - TOO unclear

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

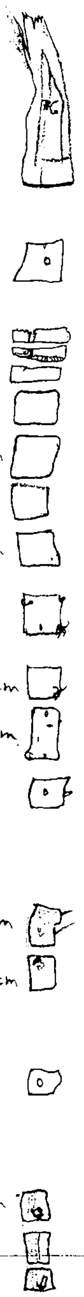
tiny trace of pith.

Did Not reach root.

Gates of Lodore

GL #6

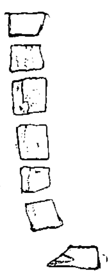
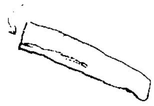
12/2005
J.R.F.
pg. 1 of 2

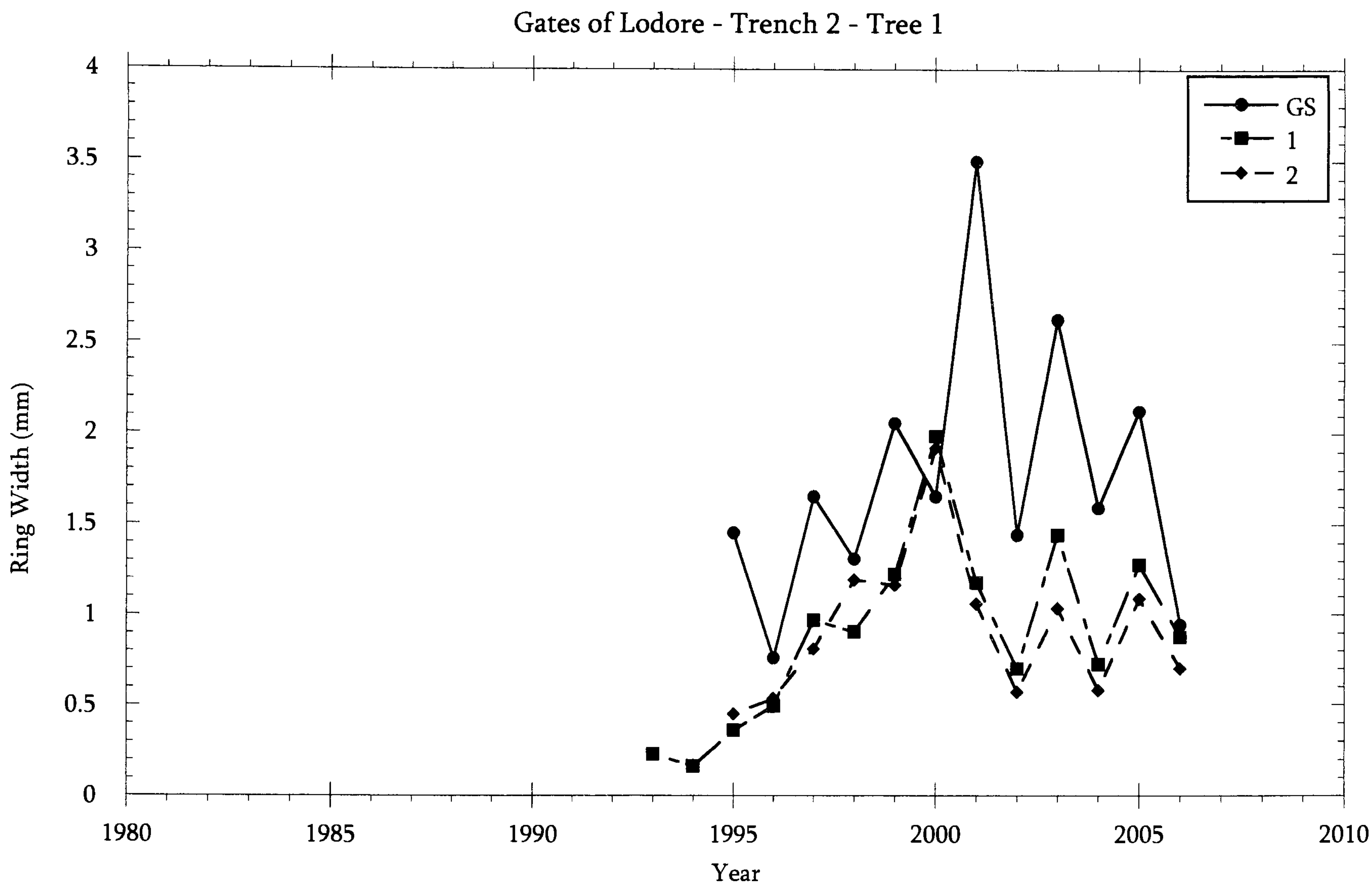


Size	OLD Label	[redacted]	Notes
14cm	GL-6-1	GL-6-1	
4.5cm	GL-6-GS	GL-6-GS (Top + Bottom Sanded)	o nail = GS
1 cm		(bottom sanded) GL-6-2-0	(stem center changes)
~.5-1 cm		(both sides sanded) GL-6-2-1	(stem center changes)
~2.5 cm		GL-6-2-2	(stem center changes)
3 cm	GL-6-2	GL-6-3	(Top Sanded)
4.5cm	GL-6-2	GL-6-4-0	(Top Sanded)
4cm	GL-6-2	GL-6-4-1	(Top Sanded)
3.5cm	GL-6-2	GL-6-5	(Top Sanded)
~5 cm	GL-6-2	GL-6-6	
3.5cm	GL-6-2	GL-6-7	(Top Sanded)
~5.5 cm	GL-6-2	GL-6-8	
3cm	GL-6-G	GL-6-9-G	(Top Sanded) o nail = G
~4cm	GL-6-3	GL-6-10	(Top + Bottom Sanded)
~3.5cm	GL-6-3	GL-6-11	
2.5cm	GL-6-G1	GL-6-12-G1	(Top Sanded) o nail = G1
~3.5 cm	GL-6-4	GL-6-13	(Top + Bottom Sanded)
~4cm	GL-6-4	GL-6-14	
~4.5 cm	GL-6-4	GL-6-15	(Top Sanded)

12/2005
J.R.F.
Pg. 2 of 2

GL #6

		OLD LABEL	NEW LABEL	
3.5cm		GL-6-F	GL-6-16F	(Top Sanded) • nail = F
2 cm			GL-6-17	(Top + Bottom Sanded)
3cm			GL-6-18	
~3.5cm		GL-6-5	GL-6-19	(Top + Bottom Sanded)
3.5cm			GL-6-20	
2.5cm			GL-6-21	(Top + Bottom Sanded)
~3cm			GL-6-22	
2-4cm			GL-6-23	(Top + Bottom Sanded)
~12.5cm			GL-6-24	
2.5-3.5 cm			GL-6-25	



Gates of Lodore - Trench 2 - Tree 1
Ring Width (mm)
Year
GS
1
2
0
0.5
1
1.5
2
2.5
3
3.5
4
1980
1985
1990
1995
2000
2005
2010

Gates of Lodore ~~Trench 2~~ – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 10/18/06

Site ID: GATES of LODORE

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 1

Slab ID: GS

Ring Counts/Notes:

J2X Filename: GL21J2X.txt

Number of radii measured: 2

J2X Series Id: GL21GSA, GL21GSB

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radii A + B – 1995 – 2006

– years streaked + lobed.

– somewhat complacent.

Gates of Lodore Trench 2 - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 10/18/06

Site ID: GATES of LODORE

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 1

Slab ID: 1

Ring Counts/Notes:

J2X Filename: GL21J2X.txt

Number of radii measured: 2

J2X Series Id: GL211A, GL211B

J.R. - Recorded radii A & B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radius A - 1993 - 2006 Radius B - 1993 - 2006

Some Inner rings are unclear, so Center could be 1991 or earlier.

2004 - narrow
'03 - wider
'02 - narrow
2000 - wide
'97-'99 - similar

'96 & '95 - similarly narrow
'94 - very narrow
'93 - wide
next few yrs. compacted
2 innermost yrs. visible.

pith?

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 10/19/06

Site ID: GATES of LODORE

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 1

Slab ID: 2A

Ring Counts/Notes:

J2X Filename: GL21J2X.txt

Number of radii measured: 2

J2X Series Id: GL212AA, GL212AB

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: | Stop Year: | Proportion:

Start Year: | Stop Year: | Proportion:

Start Year: | Stop Year: | Proportion:

Wood Anatomy Change Notes:

Rootly. No pith visible.

Radius A-1995–2006 | Radius B-1996–2006

Some inner rings indiscernible. | '97 – '99 – similar.

2004 – narrow

2002 – narrow

2000 – wide

Center looks like '91 or earlier.

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J. R.

Reading Date: ———

Site ID: GATES of LODORO

Collection Date: Aug. / Sept. 2006

Tree/Hole ID: 1

Slab ID: 4

Ring Counts/Notes:

J2X Filename: GL21J2X.txt

Number of radii measured: ———

J2X Series Id:

DON'T Use

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

All Root No pith

GATES of LODORE
TRENCH 2
TREE #1

Sept. 2006
JIR.
Pg. 1 of 1

~9cm  GL-2-1-0 (has Tag attached)

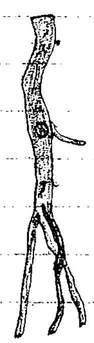
4cm  GL-2-1GS nail = GS

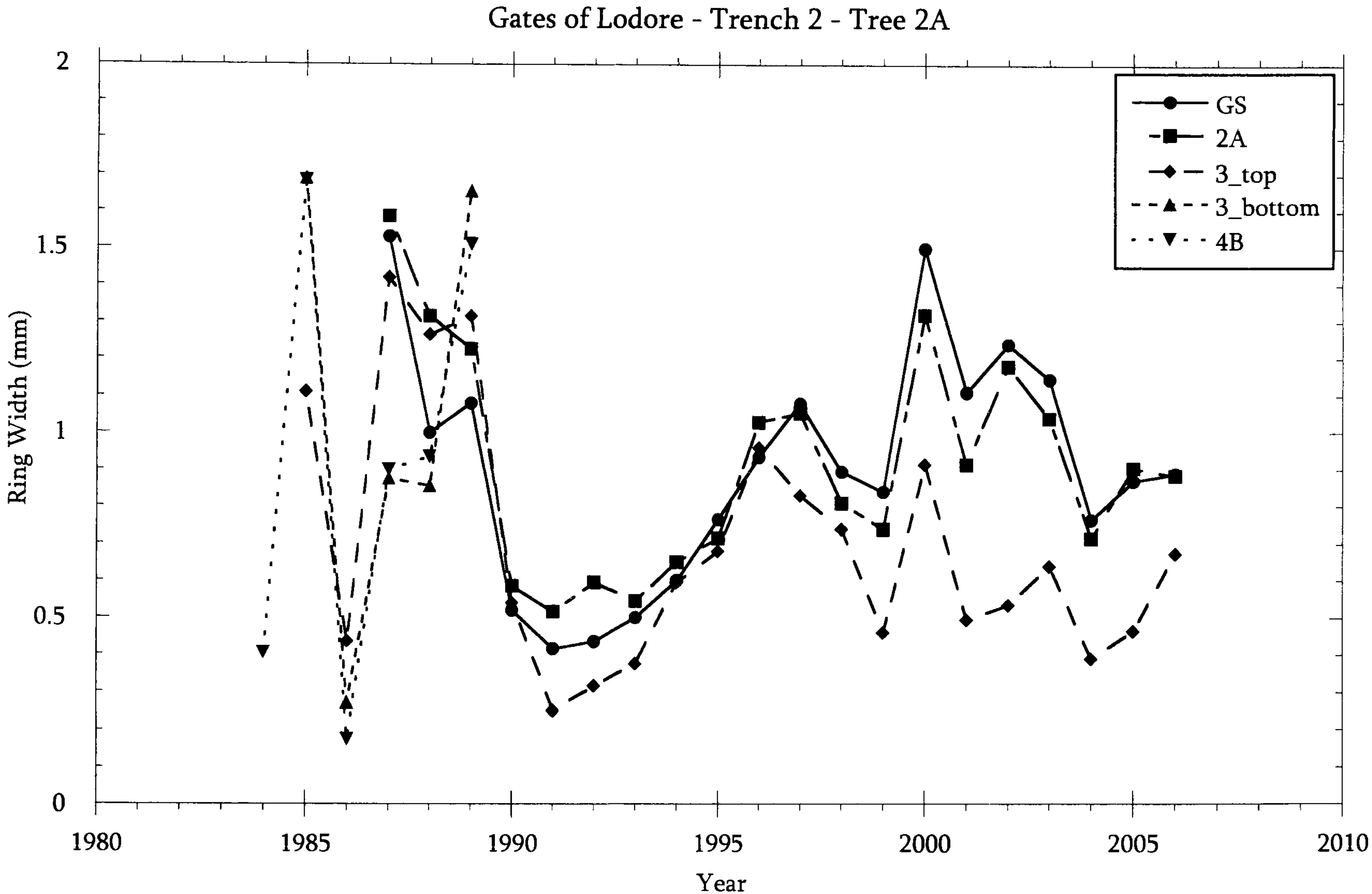
3.5-4cm  GL-2-1-1

3.5cm  GL-2-1-2A nail = A

10cm  GL-2-1-3

4.5cm  GL-2-1-4 - All Root - (Top Sanded)

~33cm  GL-2-1-5


Gates of Lodore - Trench 2 - Tree 2A
Ring Width (mm)
Year
GS
2A
3_top
3_bottom
4B
0
0.5
1
1.5
2
1980
1985
1990
1995
2000
2005
2010

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.A.

Reading Date: Sept. 29, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 2A

Slab ID: GS

Ring Counts/Notes:

J2X Filename: GL22AJ2X.txt

Number of radii measured: 2

J2X Series Id: GL22AGSA, GL22AGSB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radius A (1987-2006)

04'-06' - narrow set
99'-00' - narrow pair
95'-98' - similar wide
90'-93' - similar narrow
87'-89 - similar wide
87' - center w/ pith ⊙

Radius B (1987-2006)

01'-06' - complacent
00' - wide
91'-94' - similar narrow
87' - wide center w/ pith ⊙

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.A.

Reading Date: Sept. 29, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 2A

Slab ID: 2A (Top + Bottom Sanded)

Ring Counts/Notes:

J2X Filename: GL22AJ2X.txt

Number of radii measured: 2

J2X Series Id: GL22A2AA, GL22A2AB

J.K. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radius A (1987-2006)
- 04'-06' - narrow set
- 99' - narrow
- 96'-98' - similar wide
- 91'-94 - similar narrow
- 87'-89' - similar wide
- 87' - wide center w/ pith ⊙

Radius B (1987-2006)
- 00'-06' - similar wide
- 98'-99' - ~~similar~~ narrow pair
- 90'-91' - narrow pair
- 87' - wide center w/ pith ⊙

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.A.

Reading Date: Sept. 29, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 2A

Slab ID: 3 (Top + Bottom Sanded)

Ring Counts/Notes:

J2X Filename: GL22AJ2X.txt

Number of radii measured: 2

J2X Series Id: GL22A3A, GL22A3B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Top Wood Anatomy Change Notes:

Radius A (1985-2006)

'00 - wide
98 - wide
01'-05' - narrow set
99' - narrow
91'-94' - narrow set
89' - wide
87' - wide
86' - narrow
85' - wide center w/ pith ⊙

Radius B (1985-2006)

01'-06' - narrow set
'00 - wide
'98 - wide
99' - narrow
96' - wide
91'-93' - narrow set
87'-89' - similar wide
86' - narrow
85' - wide center w/ pith ⊙

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.A.

Reading Date: Sept. 29, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 2A

Slab ID: 3 (Top + Bottom Sanded)

Ring Counts/Notes:

J2X Filename: GL22AJ2X.txt

Number of radii measured: 2

J2X Series Id: GL22A3C, GL22A3D

J.R. – Recorded radii C + D into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Bottom Wood Anatomy Change Notes:

Radius C (1985 - 1989)

89' - wide
86' - very narrow
85' - wide center w/pith O

Radius D (1985-1989)

89' - wide
86' - very narrow
85' - wide center w/ pith

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J. A.

Reading Date: Sept. 29, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 2A

Slab ID: 4B
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X Filename: GL22AJ2X.txt

Number of radii measured: 2

J2X Series Id: GL22A4BA, GL22A4BB

J.R. – Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

J.R. – Established at bottom of 'B'.

Wood Anatomy Change Notes:

Top

Radius A (1984-1989)
89' – wider
86' – Tiny
85' – wide
84' – narrow w/ small pith ⊙ rotted

Radius B (1984-1989)
89' – wide
87' – wide
86' – narrow
85' – wide
84' – narrow w/ small pith ⊙

* Root Below this Slab

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: JSA

Reading Date: —

Site ID: Gates 2

Collection Date: Aug/Sept 2006

Tree/Hole ID: 2A

Slab ID: ~~5B~~ 6C

Ring Counts/Notes:

~~J2X Filename:~~

~~Number of radii measured:~~

~~J2X Series Id:~~

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

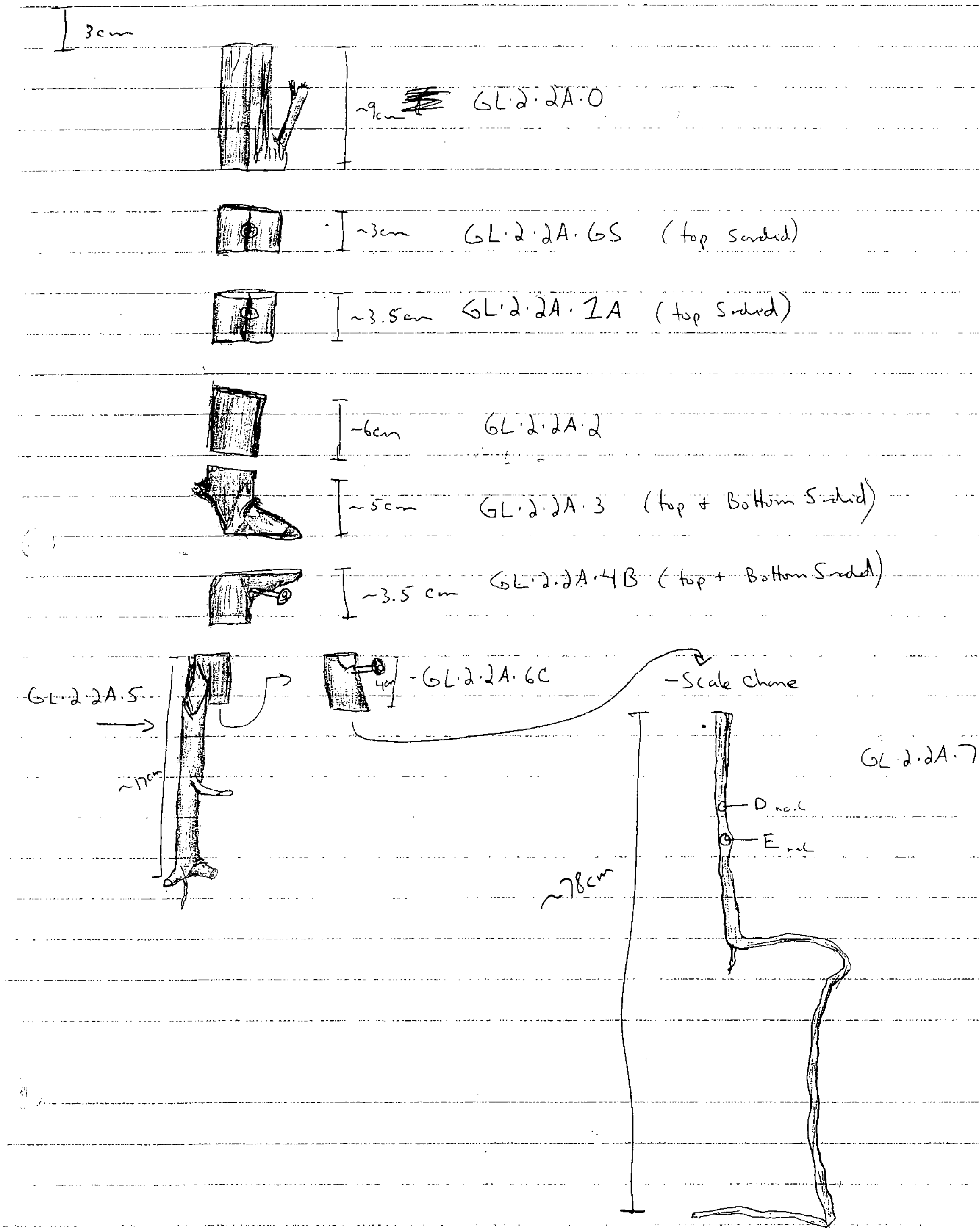
Wood Anatomy Change Notes:

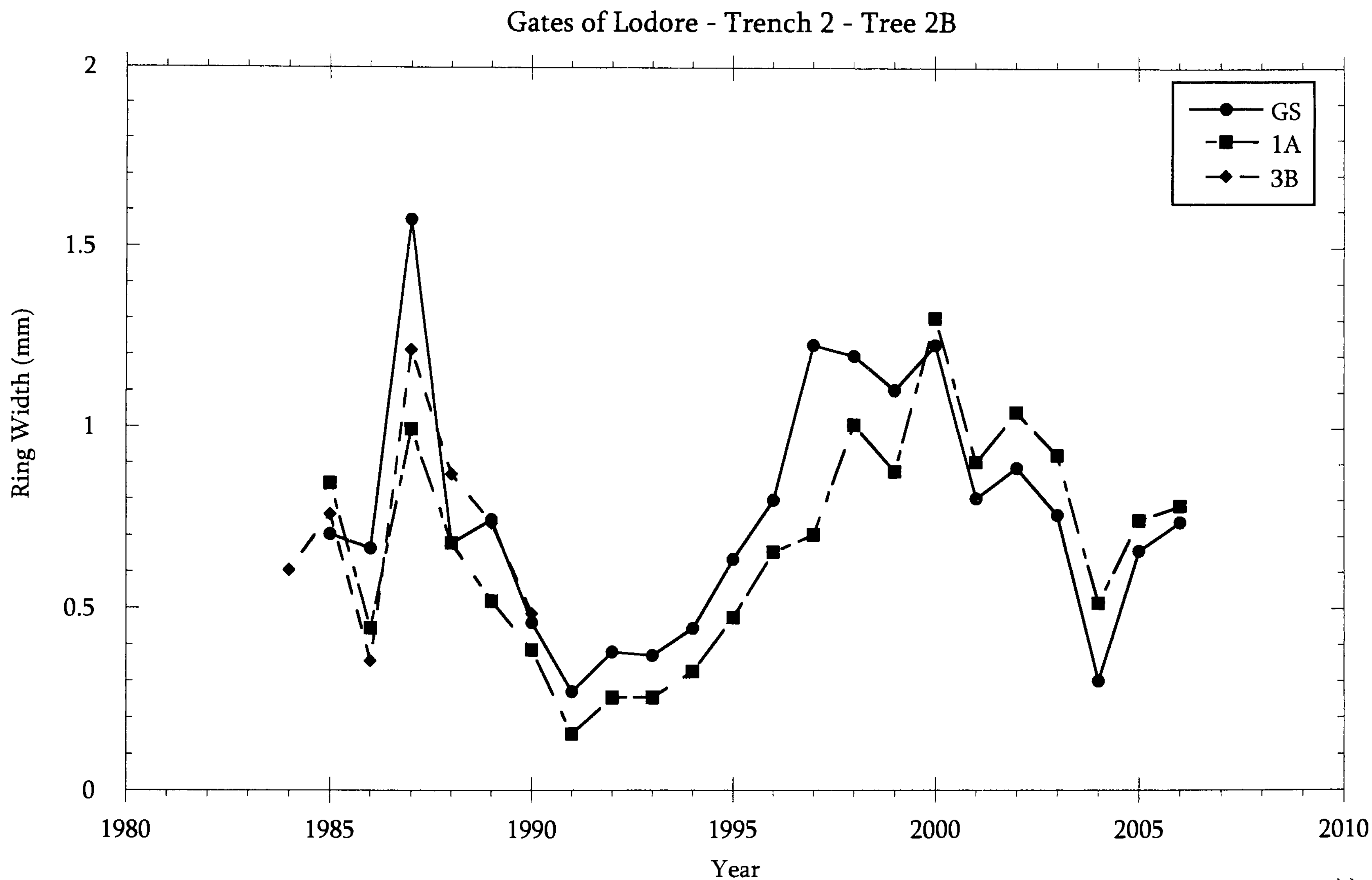
Don't J2x !!!

↳ Root

Gates of lodore T #2a

Collected August 2006 Page 1 of 1





Gates of Lodore - Trench 2 - Tree 2B
Ring Width (mm)
2
1.5
1
0.5
0
1980
1985
1990
1995
2000
2005
2010
Year
GS
1A
3B

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 10/19/06

Site ID: GATES of LODORE

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 2B

Slab ID: GS

Ring Counts/Notes:

J2X Filename: GL22BJ2X.txt

Number of radii measured: 2

J2X Series Id: GL22BGSA, GL22BGSB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radii A+B - 1985-2006

2004 - narrow

2000 - wide

'97-'99 - wide

'96→'91 - progressively narrowing

'88+'89 - similar

'87 - WIDE

'85 - center w/large pith ⊙

Gates of Lodore Trench 2 - Ring Reading Notes

Ring Reader: J.R.

Reading Date: Oct. 19, 2006

Site ID: GATES of LODORE

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 2B

Slab ID: 1A

Ring Counts/Notes:

J2X Filename: GL22BJ2X.txt

Number of radii measured: 2

J2X Series Id: GL22B1AA, GL22B1AB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radii A+B - 1985 - 2006

2004 - narrow

2000 - wide

'99 - narrow on 'B'

1995 - 1991 - progressively narrowing

1990 - narrow

'88 + '89 - Similar

'87 - wide

'85 - center w/pith ⊙

Gates of Lodore Trench 2 - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 10/19/06

Site ID: GATES of LODORE

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 2B

Slab ID: 3B (Top + Bottom Sanded)

Ring Counts/Notes:

J2X Filename: GL22BJ2X.txt

Number of radii measured: 2

J2X Series Id: GL22B3BA, GL22B3BB

J.R.-Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

Top Wood Anatomy Change Notes:

Radius A - 1984-1990

getting rootly.
'90 - narrow
'88 + '89 - similar
'87 - wide
'86 - narrow

Radius B - 1984-1990

'85 - wide
'84 - new center - slight pith?
- estab. at bottom of slab B.

Gates of Lodore Trench 2 - Ring Reading Notes

Ring Reader: J.R.

Reading Date: ——

Site ID: GATES of LODORE

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 2B

Slab ID: 4

Ring Counts/Notes:

~~J2X Filename: GL22BJ2X.txt~~

~~Number of radii measured: ——~~

~~J2X Series Id:~~

NO J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

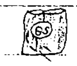
Center is still '84

No pith, all Root.

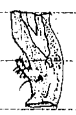
GATES of LODCKE
TRENCH 2
TREE 2B

J. Roth
10/2006
Pg. 1 of 1

12 cm  GL-2-2B-0 Tag attached

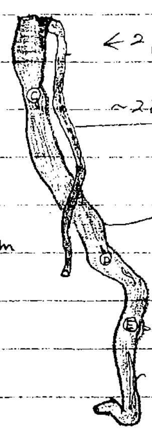
4 cm  GL-2-2B-GS nail = GS

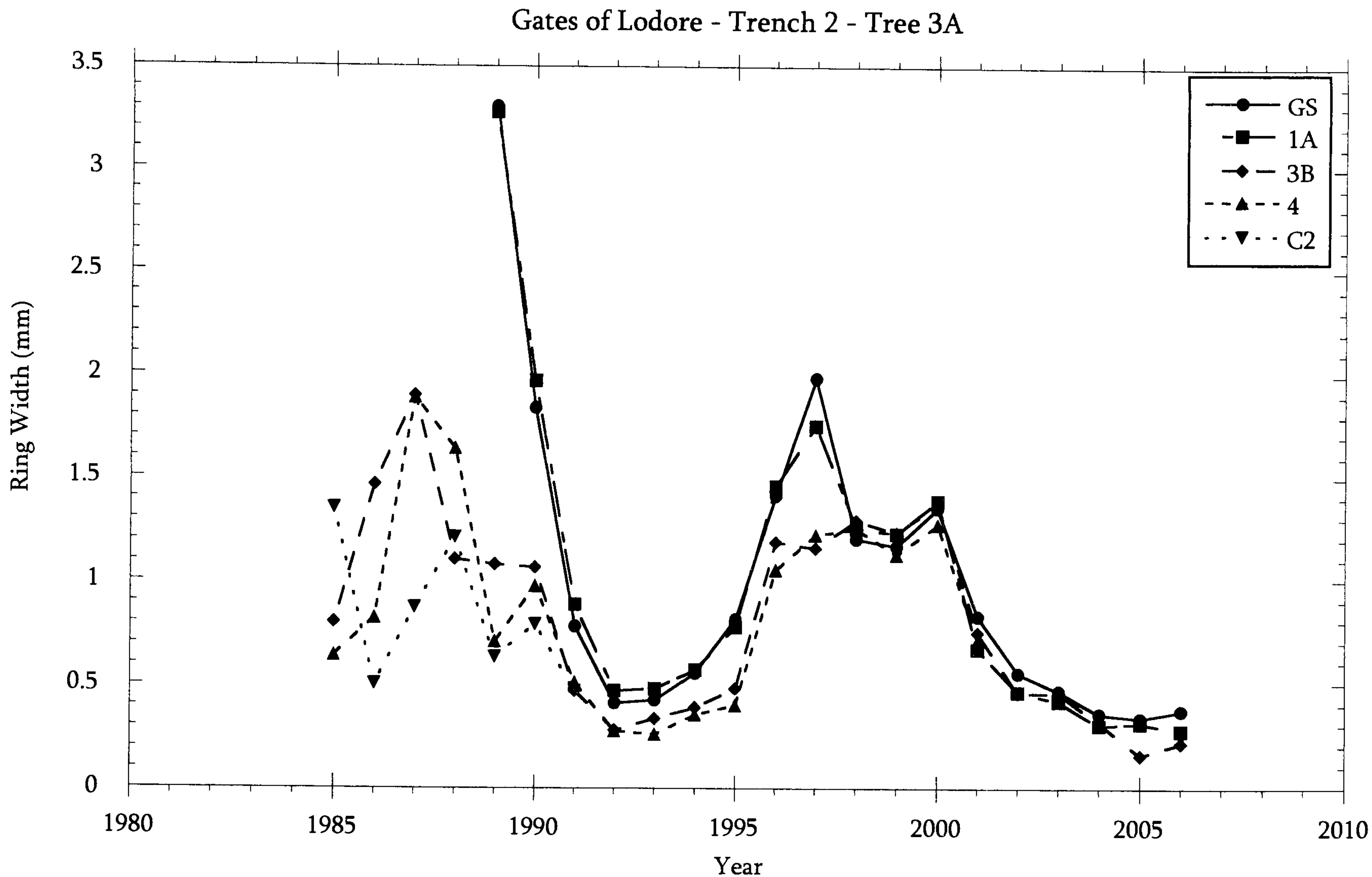
3 cm  GL-2-2B-1A nail = A

9 cm  GL-2-2B-2

4 cm  GL-2-2B-3B nail = B

2.5 cm  GL-2-2B-4 bottom sanded




Gates of Lodore - Trench 2 - Tree 3A
Ring Width (mm)
Year
GS
1A
3B
4
C2
0
0.5
1
1.5
2
2.5
3
3.5
1980
1985
1990
1995
2000
2005
2010

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.R.

Reading Date: Oct. 2, 2006

Site ID: Gates of Lodore

Collection Date: Aug/Sept. 2006

Tree/Hole ID: 3A

Slab ID: GS

Ring Counts/Notes:

J2X Filename: GL23AJ2X.txt

Number of radii measured: 2

J2X Series Id: GL23AGSA, GL23AGSB

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radii A + B – 1989 – 2006

2002 – 2006 – narrow

1998 – 2001 – similarly wide

'96 + '97 – wide

'91 – '95 – similarly narrow

'90 – wide

'89 – large center w/pith ⊙

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.R.

Reading Date: Oct. 2, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 3A

Slab ID: 1A

Ring Counts/Notes:

J2X Filename: GL23AJ2X.txt

Number of radii measured: 2

J2X Series Id: GL23A1AA, GL23A1AB

J.R. – Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Radii A+B – 1989 – 2006

2002 – 2006 – similarly narrow

'98 – 2000 – similarly wide

'96 + '97 – wide

'91 – '95 – similarly narrow

'90 – wide

'89 – wide center w/pith ⊙

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.R.

Reading Date: Oct. 2, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 3A

Slab ID: 3B

Ring Counts/Notes:

J2X Filename: GL23A J2X.txt

Number of radii measured: 2

J2X Series Id: GL23A3BA, GL23A3BB

J.R. – Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. – Compression from 2002 + later yrs.

Wood Anatomy Change Notes:

Radius A – 1985 – 2001

'98 – 2000 – wide

'96 + '97 – similar

'91 – '95 – narrow

'90 – wide

'88 + '89 – variable

Radius B – 1985 – 2006

'86 + '87 – WIDE

'85 – wide center w/pith

Gates of Lodore Trench 2 - Ring Reading Notes

Ring Reader: J.R.

Reading Date: Oct. 2, 2006

Site ID: GATES OF LODORE

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 3A

Slab ID: 4

Ring Counts/Notes:

J2X Filename: GL23AJ2X.txt

Number of radii measured: 2

J2X Series Id: GL23A4A, GL23A4B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radius A - 1985 - 2002

'97 - 2000 - wide

'91 - '95 - very narrow

'90 - wide

'88+'89 - variable

Radius B - 1985 - 2001

'86 + '87 - wide

'85 - center w/small pith

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.R.

Reading Date: Oct. 19, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 3A

Slab ID: C2

Ring Counts/Notes:

J2X Filename: GL23AJ2X.txt

Number of radii measured: 2

J2X Series Id: GL23AC2A, GL23AC2B

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radius A – 1985 – 1988 Radius B – 1985 – 1991

establishment closer to C2 than C1.

'85 – center w/ small pith ⊙

* I think the center is a small 84' w/ pith ⊙ – possible.. but not
– JSA

GATES of LODORE

9/2006
J.K.

TRENCH #2 TREE 3A

pg. 1 of 1

2-3.5 cm  GL·2·3A·0 (~~hat~~ wire + Tag on it)

~2 cm  GL-2-3A-GS nail = GS

3-4 cm  GL-2-3A-1A nail = A

~4 cm  GL-2-3A-2

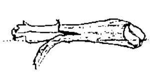
3.5 cm  GL-2-3A-3B nail = B

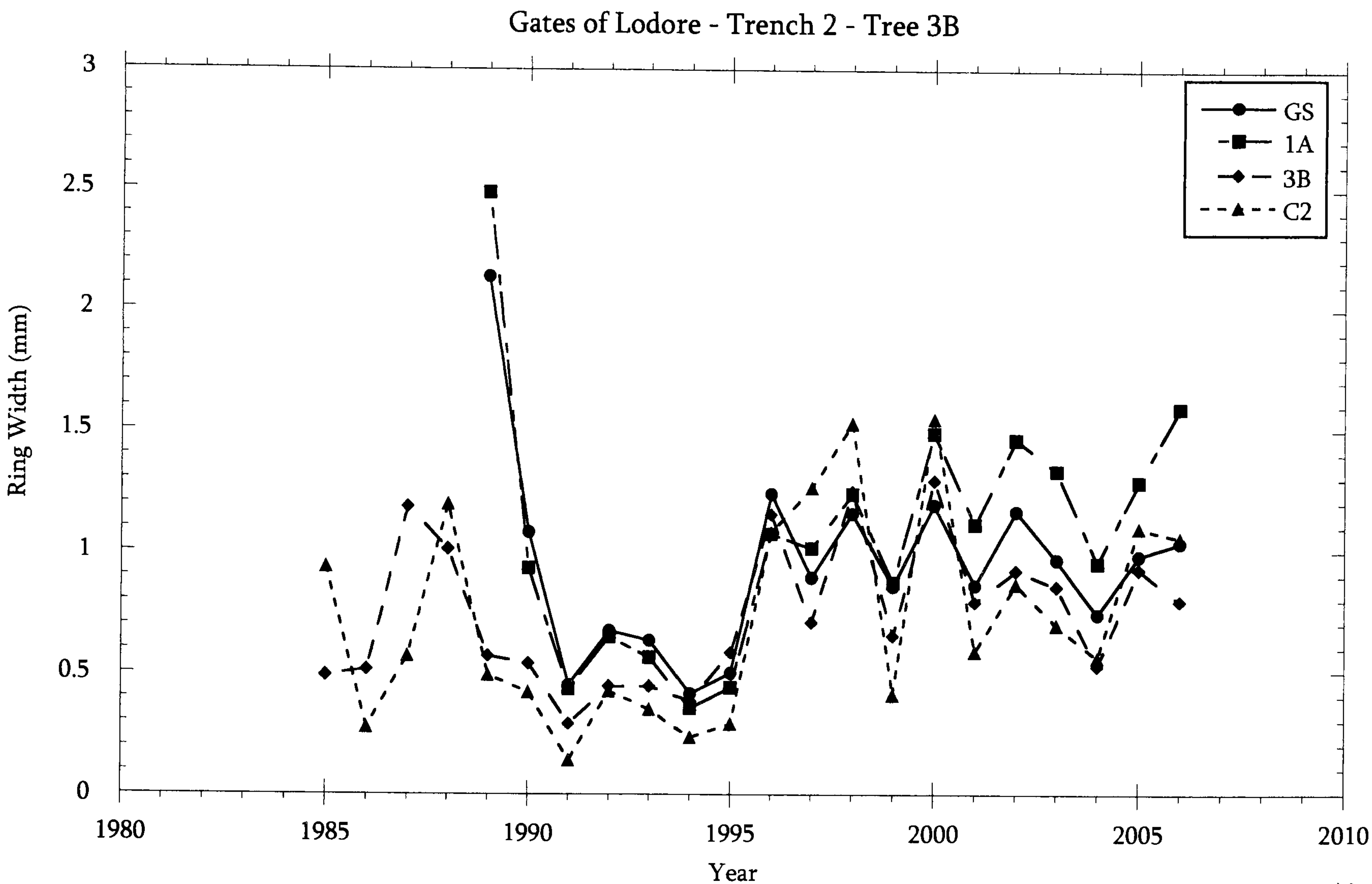
2.5 cm  GL-2-3A-4

3.5 cm  GL-2-3A-C2 nail = C2

~14 cm  GL-2-3A-5

2.5 cm  GL-2-3A-C1 nail = C1

12 cm  GL-2-3A-6


Gates of Lodore - Trench 2 - Tree 3B
Ring Width (mm)
Year
GS
1A
3B
C2
0
0.5
1
1.5
2
2.5
3
1980
1985
1990
1995
2000
2005
2010

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.R.

Reading Date: Oct. 19, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 3B

Slab ID: GS

Ring Counts/Notes:

J2X Filename: GL23BJ2X.txt

Number of radii measured: 2

J2X Series Id: GL23BGSA, GL23BGSB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radii A+B - 1989 - 2006

2000 - wide

'96 - wide

'91 - '95 - narrow

'90 - wide

'89 - wide center w/large pith ⊙

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.R. Reading Date: Oct. 19, 2006

Site ID: Gates of Lodore Collection Date: Aug. / Sept. 2006

Tree/Hole ID: 3B Slab ID: 1A

Ring Counts/Notes:

J2X Filename: GL23BJ2X.txt

Number of radii measured: 2

J2X Series Id: GL23B1AA, GL23B1AB

J.R. - Recorded radii A + B into J2-X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radii A + B - 1989 - 2006

2000 - wide

'96 - wide

'91 - '95 - narrow

'90 - wide

'89 - wide center w/large pith ⊙

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.R.

Reading Date: Oct. 19, 2006

Site ID: GATES of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 3B

Slab ID: 3B

Ring Counts/Notes:

J2X Filename: GL23BJ2X.txt

Number of radii measured: 2

J2X Series Id: GL23B3BA, GL23B3BB

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Radii A + B – 1985 – 2006

2000 – WIDE
'98 – wide
'96 – wide
'92 – '95 – narrow
'91 – very narrow
'89 + '90 – wideish
'87 + '88 – wide
'85 – center w/pith ⊙

Gates of Lodore Trench 2 - Ring Reading Notes

Ring Reader: J.R.

Reading Date: Oct. 19, 2006

Site ID: GATES of LODORE

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 3B

Slab ID: C2

Ring Counts/Notes:

J2X Filename: GL23BJ2X.txt

Number of radii measured: 2

J2X Series Id: GL23BC2A, GL23BC2B

J.R. - recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Center still 1985. Radii A+B - 1985-2006.

'91 - extremely narrow! not marked

Looks to be all Root. - No pith

Establishment at C2.

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: J.R.

Reading Date: ——

Site ID: GATES of LODORE

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 3B

Slab ID: C1

Ring Counts/Notes:

J2X Filename:

Number of radii measured:

J2X Series Id:

NO J2X

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

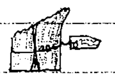
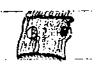
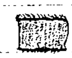
Start Year: Stop Year: Proportion:

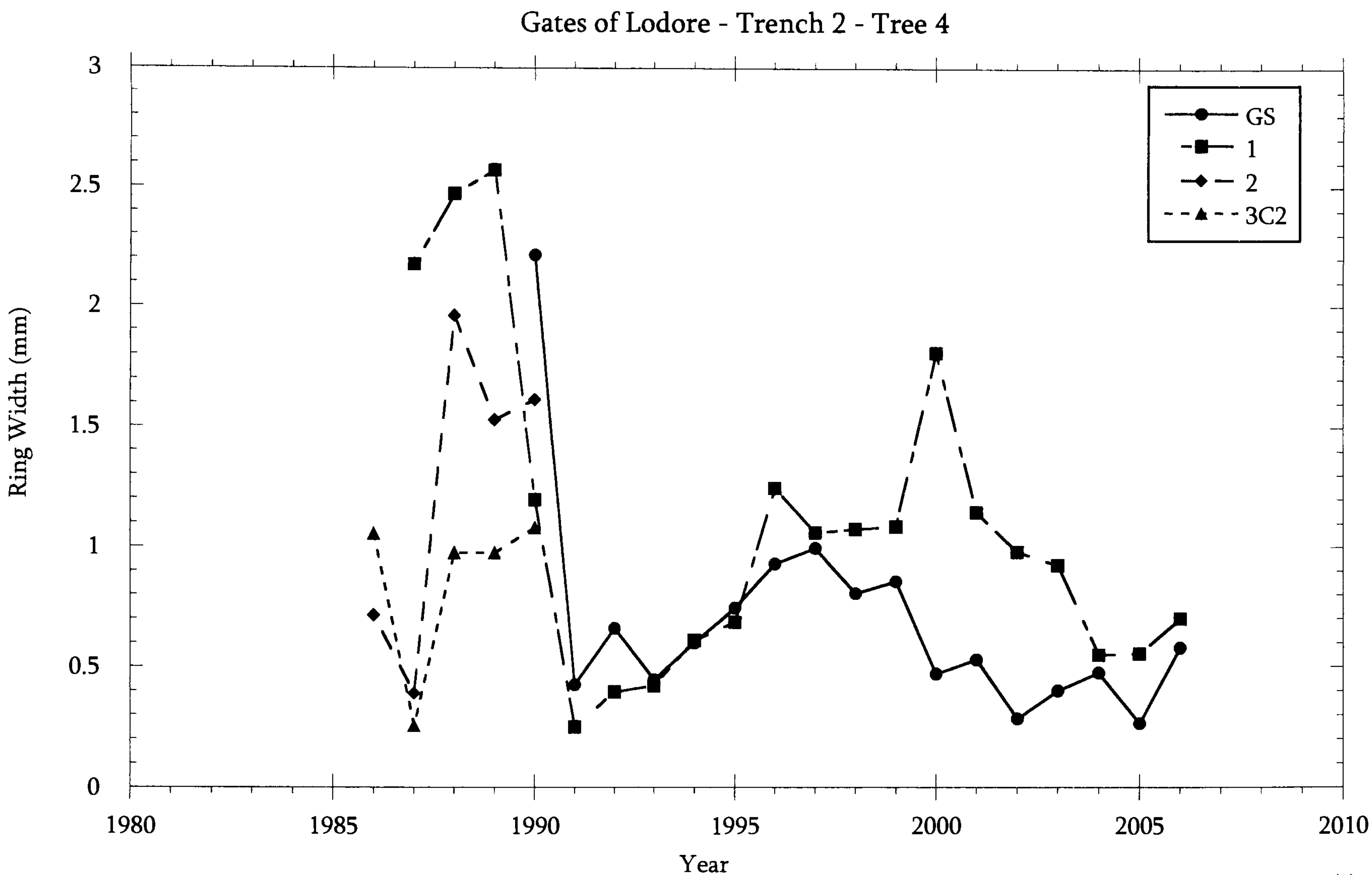
Wood Anatomy Change Notes:

ALL ROOT

GATES of LODORE
~~TRENCH # 2~~
TREE 3B

J. Roth
Oct. 2006
pg. 1 of 1

2.5 - 4.5 cm		GL-2-3B-0	(has tag attached)
2.5 cm		GL-2-3B-GS	nail = GS
3.5 cm		GL-2-3B-1A	nail = A
6 cm		GL-2-3B-2	
3.5 cm		GL-2-3B-3B	nail = 3B
2.5 cm		GL-2-3B-4	
~4 cm		GL-2-3B-C2	nail = C2
12.5 cm		GL-2-3B-5	
4 cm		GL-2-3B-C1	nail = C1
17 cm		GL-2-3B-6	nail = C


Gates of Lodore - Trench 2 - Tree 4
Ring Width (mm)
Year
GS
1
2
3C2
0
0.5
1
1.5
2
2.5
3
1980
1985
1990
1995
2000
2005
2010

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: JSA

Reading Date: Oct. ~~2~~ 18, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 4

Slab ID: GS

Ring Counts/Notes:

J2X Filename: GL24J2X.txt

Number of radii measured: 2

J2X Series Id: GL24GSA, GL24GSB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radius A (1990-2006)
06' - wide
00'-05' - Similar narrow
95'-99' - Similar wider
91'-94' - Similar narrow
90' - wide center w/ pith ⊙

Radius B (1990 - 2006)
05'-06' - very narrow [redacted]
04' - wider
02'-03' - narrow
95'-99' - Similar - wider
91' - narrow
92' - wider
90' - wide center w/ pith ⊙

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: JS4

Reading Date: Oct. ~~2~~ 18, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 4

Slab ID: 1

Ring Counts/Notes:

J2X Filename: GL24J2X.txt

Number of radii measured: 2

J2X Series Id: GL241A, GL241B

J.R – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radius A (87'- 2006')

04'-06' – narrow set
01'-05' – similar wider
00' – wide
96'-99' – similar
96' – wide
91' – narrow
89' – wide
87'-88' – similar wider
87' – center w/ pith ⊙

Radius B (87'- 2006')

96'-06' – complacent
91'-93' – small/narrow set
88' – wider
87' – wide center w/ pith ⊙

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: JSA

Reading Date: Oct. ~~X~~ 18, 2006

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 4

Slab ID: 2

Ring Counts/Notes:

J2X Filename: GL24J2X.txt

Number of radii measured: 2

J2X Series Id: GL242A, GL242B

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radius A (1986-1990)

88'-90' - Similar/wide

87' - narrow

86' - center w/ pith ⊙

Radius B (1986-1990)

88'-90' - wider/similar

87' - narrow

86' - center w/ pith ⊙

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: JSA

Reading Date: Oct. ~~2~~ 18, 2006

Site ID: GATES of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 4

Slab ID: 3C2

Ring Counts/Notes:

J2X Filename: GL24J2X.txt

Number of radii measured: 2

J2X Series Id: GL243C2A, GL243C2B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Radius A (1986 - 1990)

88'-90' - Similar / wide

87' - narrow

86' - center w/ tiny or no pith

Radius B (1986 - 1990)

88'-90' - Similar

87' - narrow

86' - center w/ tiny or no pith.

Gates of Lodore Trench 2 – Ring Reading Notes

Ring Reader: JSA

Reading Date: —

Site ID: Gates of Lodore

Collection Date: Aug./Sept. 2006

Tree/Hole ID: 4

Slab ID: 4

Ring Counts/Notes:

J2X Filename:

Number of radii measured:

J2X Series Id:

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

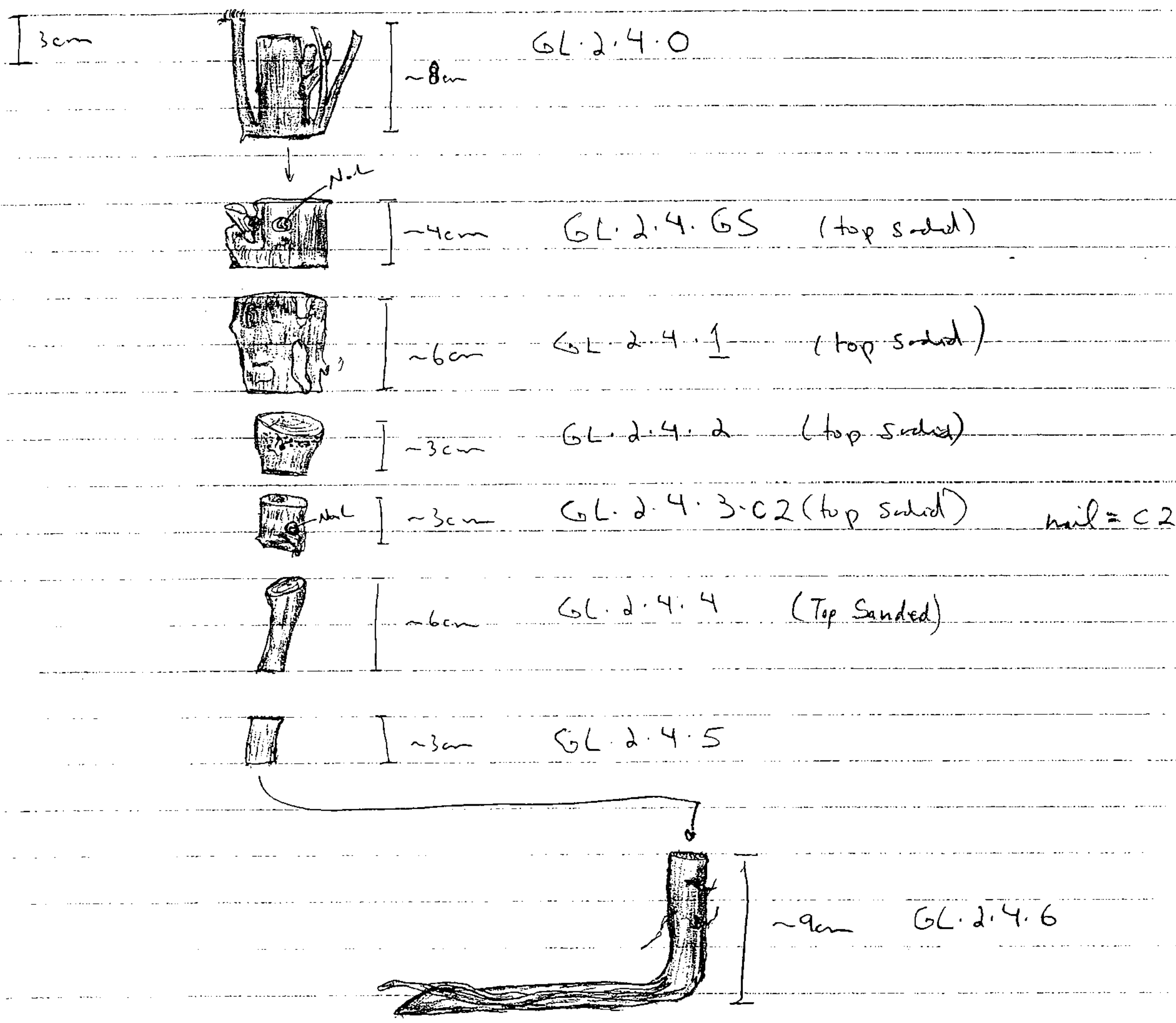
Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

→ All Root No J2X'ing

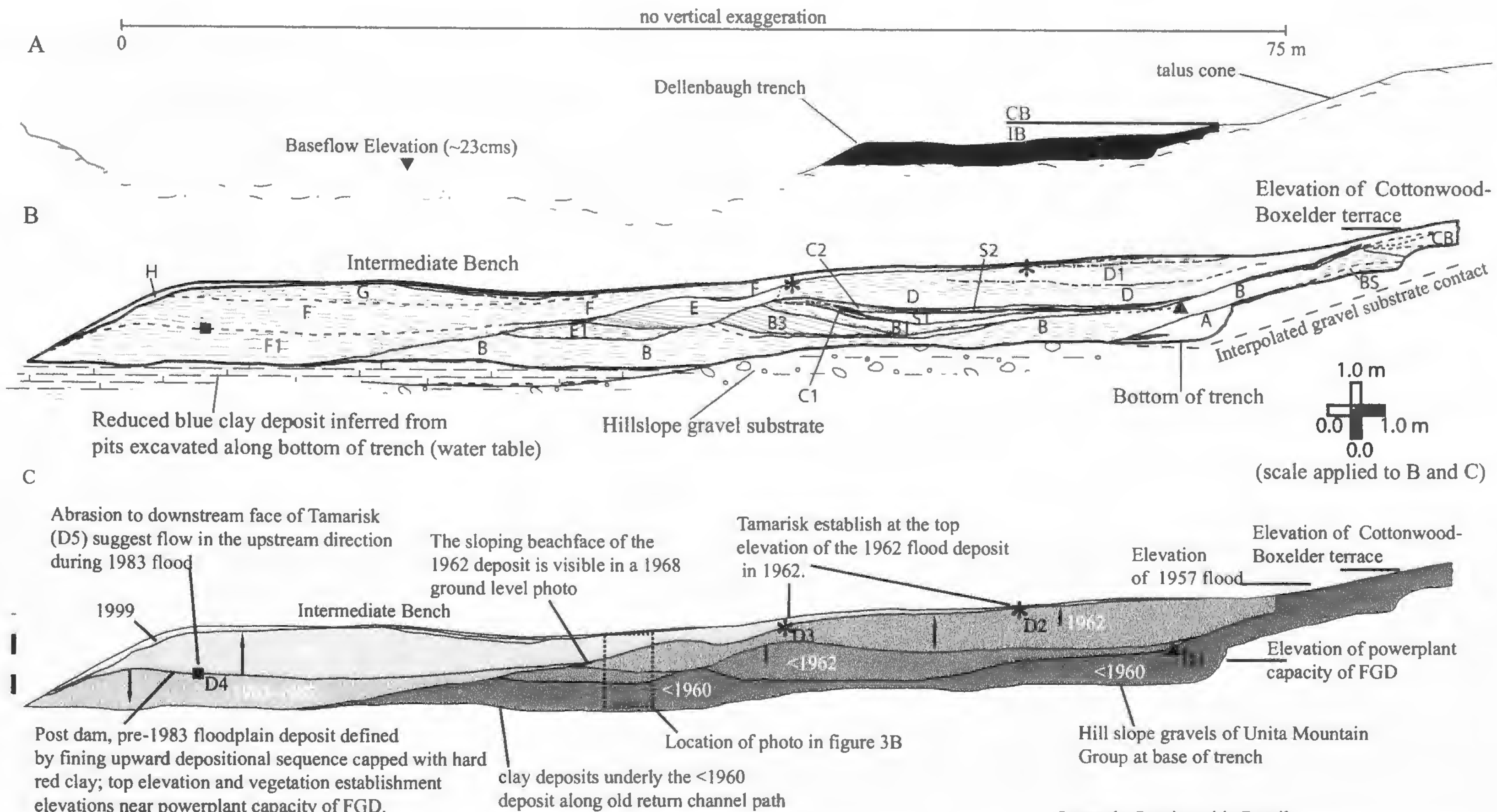
Gates of lodore Trench 2 Tree #4

Collected in August / Sept 2006



APPENDIX A2

SUPPLEMENTAL STRATIGRAPHIC AND DENDROGEOMORPHIC DATA FOR THE DELLENBAUGH TRENCH



Stratigraphic details of the Dellenbaugh trench excavation; all views facing in the downstream direction. (A) total channel/valley bottom cross sectional profile along trecnh (B) stratigraphic details of floodplain deposits including sedimentary structures, unit contacts, and the location and establishment elevation of the trees used in the dedrogeomorphic analysis (C) dendrogeomorphic interpretation of the age of each stratigraphic deposit and the direction of grain coarsening.

Legend - Stratigraphic Details

- —— abrupt/erosional unit boundary
- ----- gradational / diffuse unit boundary
- orientation of bedding
- ▲ old Tamarisk est. elevation
- * est. elevation of Tamarisk
- ■ approximate est. elev. of Tamarisk
- / direction of grain coarsening
- X# discrete unit
- BS basal sands
- ▪ ▬ estimated offshore location of eddy fence

Descriptions of stratigraphic units within the Dellenbaugh Excavation

Unit	Description
A	Generally fining upward brown unit with a gradational top and basal contact which sometimes contacts coarse hillslope gravel; grades from fine sand to silt and clay near top*
B	Gray-brown unit with an abrupt top and unknown lower boundary (below base of trench); thinly laminated fine sand and sand with sub-horizontal ripple structures and some rust staining *
B1	Fining upward brown/buff unit with an abrupt base composed of fine sand with on and offshore climbing ripples and thinly laminated ripple structures grading into silt and clay*
B2	Unit composed almost entirely of gray, hard clay with a sharp base and top*
B3	Generally coarsening upward buff unit with sharp upper and lower boundaries composed almost entirely of well sorted fine sand and sand, with thinly laminated dune foreset structures showing onshore flow vector; D_{50} = 15 mm; GSD = 1.48
C1	Buff colored unit with an abrupt upper boundary and gradational lower boundary; composed entirely of well-sorted fine sand with thinly laminated low-angle climbing ripples showing offshore flow vector; D_{50} = 16 mm; GSD = 1.49
C2	Buff colored unit similar to C1 with an abrupt lower base and a generally gradational upper boundary; composed entirely of well-sorted fine sand with thinly laminated low-angled climbing ripples showing offshore flow vector; intermittent as beaded seams in the onshore direction; pinches into CB-terrace; D_{50} = 15 mm; GSD = 1.5
D	Coarsening upward brown-gray unit with a generally abrupt base composed of silt and clay into fine sand with some rust staining with a gradational upper boundary; some thinly laminated ripple structures in upper part of unit; D_{50} = 7.5 mm; GSD = 1.76
D1	Coarseing upward brown-gray-buff unit which has an abrupt base and gradational top contact and grades laterally into unit D; composed of clay base grading into very fine sand with some thinly laminated climing ripples; D_{50} = 6 mm; GSD = 1.74
D2	Unit with gradational lower and upper boundaries; composed of well sorted fine sand with thinly laminated low-angle climbing ripples; D50 = 8 mm; GSD = 1.65
E	Coarsening upward brown unit from very fine sand to fine, well sorted fine sand; abrupt base and upper boundary; thinly laminated ripple structures; nearly vertical onshore boundary with D at onshore boundary.
E1	Unit composed entirely of well-sorted buff very fine and fine sands with thinly laminated climbing ripples with both on and offshore flow vectors; abrupt base and top; D_{50} = 15 mm; GSD = 1.57
F	Generally coarsening upward brown/buff/reddish unit with a silty-clay base grading into a well-sorted fine sand; internal structure consists of onshore-offshore directional climbing ripples which progess onshore into low-angle, thinly laminated climbing ripples which are genearlly orientated parallel to the basal contact; higher angle climbing ripples have charcoal in some of the foreset beds. D_{50} = 9 mm; GSD = 1.53
F1	Fining upward unit with an abrupt brown base composed of fine sand and clay grading into a hard red-brown clay gradational top; D_{50} = 3.5 mm; GSD = 2.27
G	Unit composed of very fine and fine buff sand with a gradational basal contact and a top contact that is both gradational and abrupt; internal structure is composed of thinly laminated onshore climbing ripples; D_{50} = 13 mm; GSD = 1.52
H	Generally coarsening upward brown/buff unit with an abrupt very fine sand and clay base grading into fine sand' thinly laminated horizontal bedding with some duff near top; D_{50} = 5 mm; GSD = 2.06
H1	Thinly horizontally bedded brown unit with an abrupt base and top and composed of very fine sand, silt, and clay; D_{50} = 4.9 mm; GSD = 2.06
S1	Unit composed entirely of red hillslope fine sands, massive in structure*; abrupt upper and lower contacts.
S2	Unit composed entirely of red hillslope fines sands with some granule size particles, massive in structure; intermittent, beaded seams in onshore direction, abrupt base and top contacts*.
CB	Unit composed of generally brown very fine sands with gradational upper and lower boundaries; red hillslope sands near base and thinly laminated ripple structures near top*
BS	Well sorted buff fine and very fine sands; D_{50} = 15 mm; GSD = 1.6

* not sampled for grain size
GSD - geometric standard deviation

STAGE DISCHARGE RELATION FOR DELLENBAUGH TRENCH

Water Surface Data at Dellenbaugh from Mixed Sources

Date	Q (cfs)	Q (CMS)	Elevation	Adjusted	2nd Adjusment
10/6/1989[1]	1320	37.37824	94.70	4993.271	4993.331
8/21/1989[1]	1270	35.9624	94.72	4993.291	4993.351
11/3/2001[1]	1350	38.22775	94.76	4993.331	4993.391
6/14/1995[1]	10900	308.6537	96.72	4995.291	4995.351
Estimated[2]	800	22.65348	94.25	4992.825	4992.884
Estimated[2]	4600	130.2575	95.87	4994.437	4994.497

[1] From original Grams XS at Dellenbaugh

[2] Adjusted WSE using common discharges between XS10 and Grams XS at Dellenbaugh

Stage Relationship for Trench Figure XS

Date	Q (cfs)	Q (CMS)	Elevation	Adjusted	2nd Adjusment
Regress	13700	387.9408	96.81	4995.3796	4995.439
Regress	15100	427.5844	96.89	4995.4635	4995.523
Regress	8400	237.8615	96.39	4994.9591	4995.019
Regress	11200	317.1487	96.64	4995.206	4995.266
Regress	19600	555.0103	97.12	4995.6887	4995.748
Regress	2000	56.6337	95.16	4993.7358	4993.796
Regress	5000	141.5843	95.94	4994.515	4994.575
Regress	11600	328.4755	96.67	4995.2363	4995.296

Field measurements made by JSA

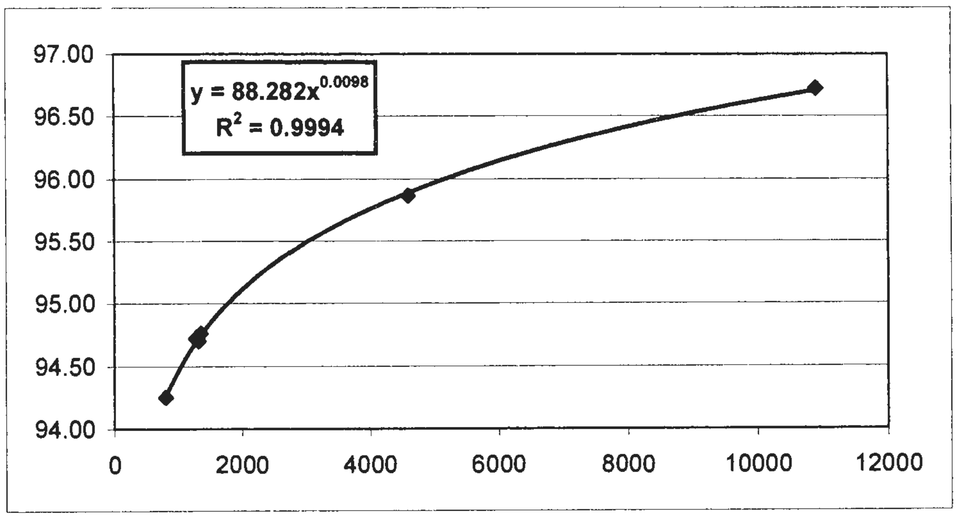
Date	Elevation	Q (cfs)	Description
11/4/2005	4993.422	1390	WSE near Dellenbaugh Trench
11/4/2005	4993.363	1390	WSE near Grams original Dellenbaugh XS

From XS 10

Q (cfs)	Elevation
800	97.251
1390	97.757
4600	98.863
8400	99.424

This stage relation was created using a combination of stage data. The original source for stage data was the stage data taken by Paul Grams near the Dellenbaugh photo location and his original trench in the foreground of that photo. The stage data were taken relative to a rebar that had been installed on site. I re-surveyed that rebar, the water surface elevation near Paul's trench, and the water surface at my trench to combine the data and adjust it slightly to my trench's elevation grid. I filled in two WSE from the XS10 stage relation (shown in box above)...I needed these data for the intermediate values, especially the 4600 cfs (powerplant value). XS 10 is in the same backwater (between riffles) as the Dellenbaugh bar and should therefore have a similar stage relation.

Jason S. Alexander



Tamarisk Tree Nomenclature Key For Dellenbaugh Ring Reading Notes

Chapter 2 –Name	Growth Rate Plots and Ring Reading Notes Name
D1	Tree 1
D2	Tree 3
D3	Tree 4
D4	Tree 5

Dellenbaugh Tree Interpretations: from Ring Reading Notes and Stage Discharge Relations- reviewed by Mike L. Scott and Julie Roth.

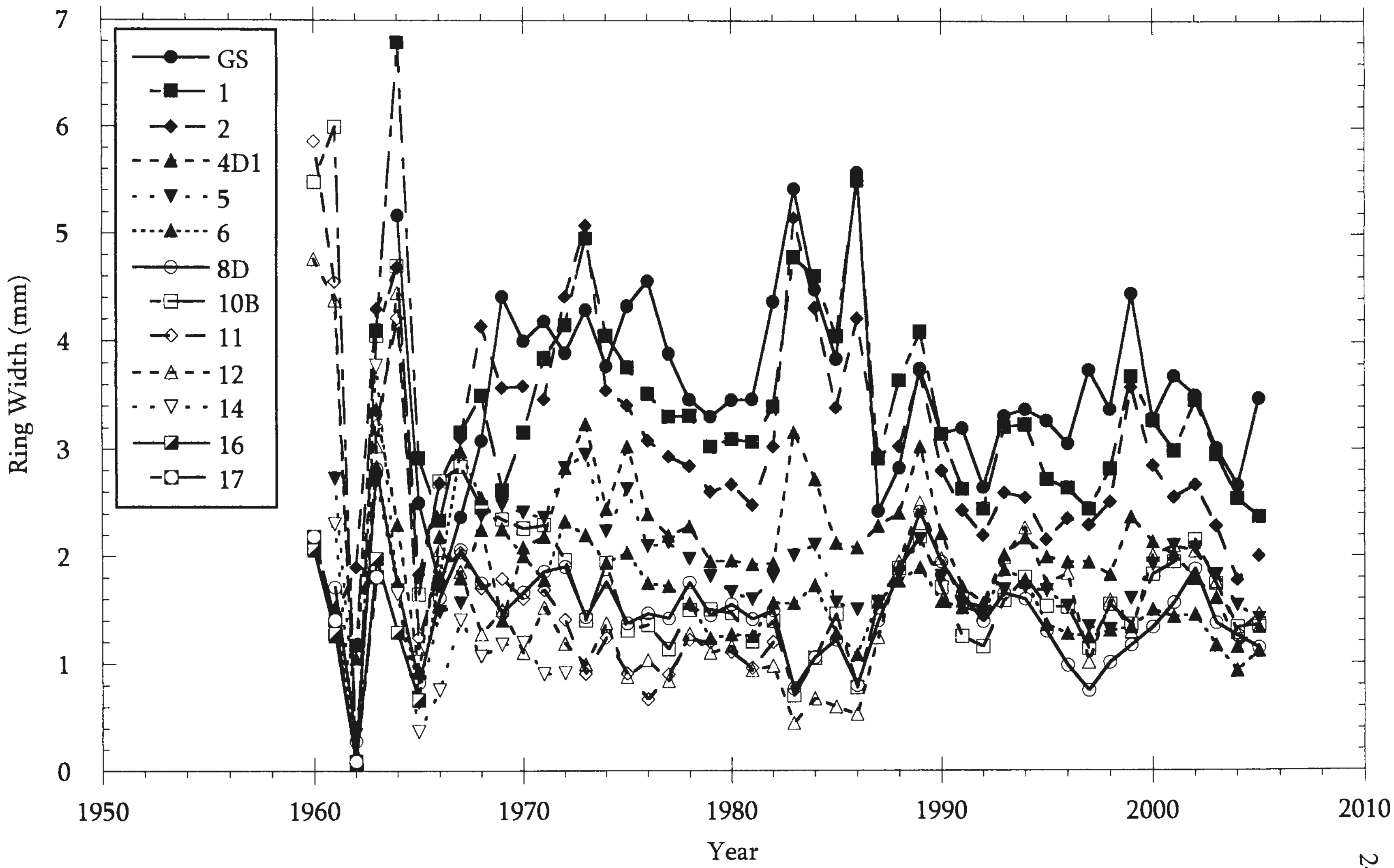
DBB_TREE1 (Established 1960)
Although no details are given below slab 11, all contacts below "D1" show burial after 1962 and some burial after 1982, suggesting that all of the units from "B" to "D2" are likely deposits from the 1962 flood. The burial after 1982 could be a function of the deep horizontal accretion in the 1983 flood. Everything below the slab 11 elevation will be assigned "<1960".

DBB TREE3 (Established 1962)
No nails were driven into contacts on this tree. Establishment elevation is less than 17cm from the surface, given the possibility of some erosion and that there is a solid contact that leads to the large accretion prism offshore, this is likely the elevation of the top of the 1962 deposit. This tree confirms the top elevation of the 1962 deposit described above.

DBB TREE4 (Established ~1963)
While the last shown age is 1963, this tree likely established in 1962 after the flood receded, otherwise it established by seeds landing on this bare surface in 1963…nevertheless, the establishment elevation near the top of the "E/D" interface establishes the 1962 near this point, once again confirming the sloping face of the 1962 flood deposit. This tree also shows burial after 1983 with suppression at 1983, suggesting the "F" deposit is 1983.

DBB TREE5 (Established ~1973)
We did not reach the establishment elevation on this tree. We also only marked the "G" contact with a nail. That being said, it is pretty obvious what part of the tree was out of the ground by the extreme damage to the tree in the 1983 flood, noticeable from the flood scarring and burial signal from the GS down to near the "F1" contact. The establishment elevation is likely at or near the "F1" contact. I counted approximately 40cm from the "G" contact to the end of the tree, not counting the lost thickness from cutting and sanding. This puts the establishment close to the elevation of the "F" surface, not a stretch considering that the surface looks like the "Post-dam, pre-1983" floodplain. This is how this will interpreted.

Dellenbaugh Tree 1



Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. + J.A.

Reading Date: 8/9/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 5

Slab ID: GS-1

Ring Counts/Notes:

J2X filename: DB5J2X.txt

Number of radii measured: 2

J2X Series Names: DB5GS1A, DB5GS1B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

MLS stem injury '83, possibly '83

Wood Anatomy Change Notes:

Radius A (1974 - 2005)

2001-2004 - narrow set!
99 - narrow
98 - wider
95 - narrow
87 - wide
85 - wide
80-83 - Very narrow Band with Damage
77 - wider
74 - wider
⊙ 74 - center with pith

Radius B (1974 - 2005)

2003-2005 - narrow set
99 - narrow
98 - wide
95 - narrow
87 - wide
85 - wide
80-83 Very narrow set
77 - wide
⊙ 74 - wide; center w/ pith

Dellenbaugh – Ring Reading Notes

Ring Reader: J.A. + J.R.

Reading Date: 8/9/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 5

Slab ID: 1

Ring Counts/Notes:

J2X filename: DB5J2X.txt

Number of radii measured: 2

J2X Series Names: DB51A, DB51B

J.R. – Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

MLS – Injury to stem '83, possibly '84

Wood Anatomy Change Notes:

Radius A (1974-2005)

2004-2005 – narrow pair
99' – narrow
98' – wide
95 – narrow
94 – wide
87 – wide
85 – wide
80-83' – Very Narrow Set w/ Damage @ 83'
77 – wider
74 – wide
⊙ 74 – Center w/ pith

Radius B (1974-2005)

95' – narrow
94' – wide
92 – narrow
87' – wide
85' – wide
80-83' – narrow set
77' – wide
⊙ 74' – wide; Center w/ pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. + J.A. Reading Date: 8/10/06

Site ID: Dellenbaugh Collection Date: Nov. 2005

Tree/Hole ID: 5 Slab ID: 3

Ring Counts/Notes:

J2X filename: DB5J2X.txt

Number of radii measured: 2

J2X Series Names: DB53A, DB53B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

MLS - burial by/after '83; Stem damage b/a '83

*Eight years not marked, so don't miss them when J2Xing.

Wood Anatomy Change Notes:

Radius A (1974-1994)
94' - wide
91-93 - narrow set
87' - wide
85 - wide
1980-83 - very narrow set w/damage @ 83'
77 - wider
73 - narrow
⊙ 74 - [illegible]

Radius B (1974-2005)
2004-2005 - narrow pair
99' - narrow
97' - narrow
95 - narrow
91' - narrow
87' - wide
85' - wide
79-83 - narrow set
77' - wider
75 - narrow
⊙ 74' - wide; center with Pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.A. + J.R.

Reading Date: 8/10/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 5

Slab ID: 4

Ring Counts/Notes:

J2X filename: DB5J2X.txt

Number of radii measured: 2

J2X Series Names: DB54A, DB54B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

MLS - burial and stem damage b/a '83.

* - ditto

Wood Anatomy Change Notes:

Radius A (1974- 1994)

94' - wide
91' - narrower
87' - wide
85' - wide
1979-83 - narrow set
with Damage in 83'
77' - wider
75 - narrow
74 - wide center w/ Pith

Radius B (1974- 1994)

94' - wider
92' - wide
91' - narrow
89' - wider
86' - narrow
85' - wide
78' - 83 - narrow set
77' - wider
74 - center w/ Pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. + J.A.

Reading Date: 8/10/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 5

Slab ID: 5G

Ring Counts/Notes:

J2X filename: DB5J2X.txt

Number of radii measured: 2

J2X Series Names: DB55GA, DB55GB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

MLS - Stem burial 6/9 '83. Damage in '83.

* Tight years not pencil marked - so Don't miss them in J2X.

Wood Anatomy Change Notes:

Radius A (1974 - 1987)

87' - wide
86' - narrower
85 - wide
1979-83 - narrow set
77' - wider
75' - narrower
○ 74' - wider; center w/ P.th

Radius B (1974 - 1994)

94' - wider
91' - Very Narrow
89' - wide
86' - narrow
85' - wide
79-83' - narrow set
○ 74' - wider; center w/ P.th

Dellenbaugh – Ring Reading Notes

Ring Reader: J.R. + J.A.

Reading Date: 8/10/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 5

Slab ID: 7

Ring Counts/Notes:

J2X filename: DB5J2X.txt

Number of radii measured: 2

J2X Series Names: DB57A, DB57B

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

MCS – small ~73 ⊙; Stem burial + injury b/a ~83

* Again, tight years not marked – Don't miss them.

Wood Anatomy Change Notes:

Radius A (1973 - 1987)

87' – wide
86' – narrower
85' – wide
1980-83' – narrow set
77' – wider
75' – very narrow
74' – wide
⊙73 – Small center w/pith

Radius B (1973 - 1989)

85' – wider
79-82' – narrow set
74 – wider
⊙ 73 – Small center w/pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.A. + J.R.

Reading Date: 8/10/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 5

Slab ID: 9

Ring Counts/Notes:

J2X filename: DB5J2X.TXT

Number of radii measured: 2

J2X Series Names: DB59A, DB59B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

MCS - yes ~730; stem burial + injury b/4 '83.

Wood Anatomy Change Notes:

Radius A (1973-1989)

85' - wider

79-83' - narrow set

77' - wider

74 - wider

⊙ 73' - narrow - center w/ pith

Radius B (1973-1988)

87' - wide

86' - narrow (extremely narrow w/ small loss?)

85' - wider

82' - wider ← 84+85 - really narrow

79-83' - narrow set

75-76 - narrow pair

74 - wider

⊙ 73' - narrow; center w/ pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.A. + J.R.

Reading Date: 8/10/06

Site ID: Dellenbaugh

Collection Date: November 2005

Tree/Hole ID: 5

Slab ID: 11

Ring Counts/Notes:

J2X filename: DB5J2X.TXT

Number of radii measured: 2

J2X Series Names: DB511A, DB511B

J.R. - Recorded radii into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

MLS - Stem burial + injury b/a '83.

Wood Anatomy Change Notes:

Radius A (1973-1982)

79'-81 (Narrow set)
77' - wide
75' - narrow
74 - wide
⊙ 73 - center with P.h

Radius B (1973-1982)

80-82' - narrow set
77'+76' - wide set
74 - wide
⊙ 73' - center w/ P.h

Dellenbaugh - Ring Reading Notes

Ring Reader: J.A. + J.R.

Reading Date: 8/10/06

Site ID: Dellenbaugh

Collection Date: November 2005

Tree/Hole ID: 5

Slab ID: 13

Ring Counts/Notes:

J2X filename: DB4J2X.TXT

Number of radii measured: 2

J2X Series Names: DB513A, DB513B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

MLS - Stem burial b/c '83.

Wood Anatomy Change Notes:

Radius A (1973-1982)

79'-81' - narrow set
77' - wide
75' - narrow
74' - wide
① 73' - center w/pith

Radius B (1973-1982)

80-82' - narrow set
77' + 76' - wide set
74' - wide
① 73' - center with Pith.

Dellenbaugh – Ring Reading Notes

Ring Reader: J.A. + J.R.

Reading Date: August 10, 2006

Site ID: Dellenbaugh

Collection Date: November 2005

Tree/Hole ID: 5

Slab ID: 14

Ring Counts/Notes:

J2X filename: DB4 J2X.TXT

Number of radii measured: 2

J2X Series Names: DB514A, DB514B

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

MKS – Stem burial b/4 ~83

* No tick marks due to size of slab

Wood Anatomy Change Notes:

Radius A (1973-1982)

79-81' – narrow set

77' – wide

75' – narrow

⊙73' – wide; center with pith

Radius B (1973-1979)

79' – Narrow

77' + 76' – wide pair

⊙73' – wider; center w/ pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.A + J.R.

Reading Date:

Site ID: Dellenbaugh

Collection Date: November 2005

Tree/Hole ID: 5

Slab ID: 17

Ring Counts/Notes:

J2X filename: DR4J2X.TXT

Number of radii measured: ——

J2X Series Names:

DO NOT J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

MLS - ok!

* No tick Marks due to size of slab

Wood Anatomy Change Notes:

Radius A (1973 - 1975)

74' - wide

0-73' - center w/pith

Radius B (1973 - 1975)

0-73' - center with Pith

DID NOT Reach Root.

J. A.
8/2006

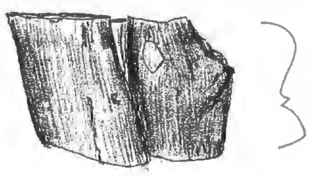
Dellenbaugh Tree 5 (Cont'd)

1.5cm

~5.5cm

(top-Sanded)

DB.5.4



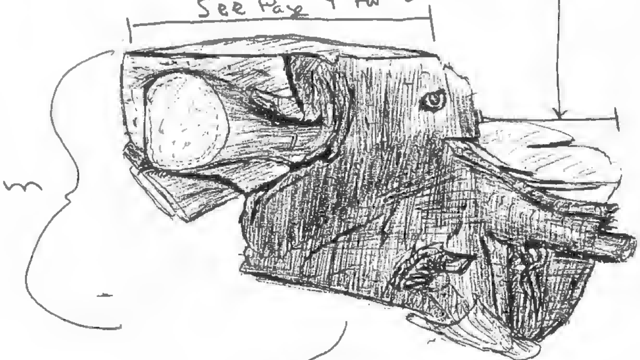
4.5cm (top Sanded)

DB.5.5G

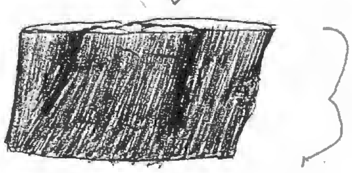
this goes here!

See Page 4 For D.B.5.G

8cm



DB.5.6



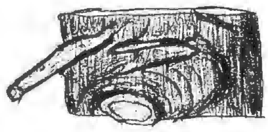
3.5cm

D.B.5.7
(top-Sanded)

J. A.
8/2006
Pg 3 of 4

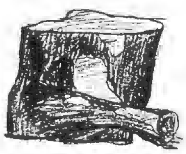
- 1.5cm

Dellenbaugh
Tree 5



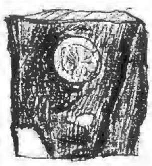
3cm

DB.5.8



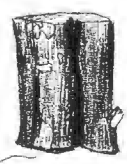
4cm (top sanded)

DB.5.9



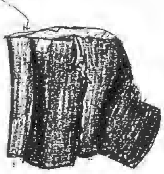
3.5cm (oops on scale)

DB.5.10



4.0cm (top sanded)

DB.5.11



4.0cm

DB.5.12

3.5cm (top sanded)

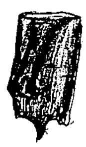
DB.5.13

Dellenbaugh
Tree 5

J. A.
8/2006
Pg 4 of 4
I - 1.5cm

} ~3.0 cm (top sanded)

DB.5.14



} ~3.0 cm (top sanded)

DB.5.15

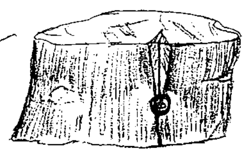
} ~2.5cm (top sanded)

DB.5.16

} ~2.5cm (top sanded)

DB.5.17

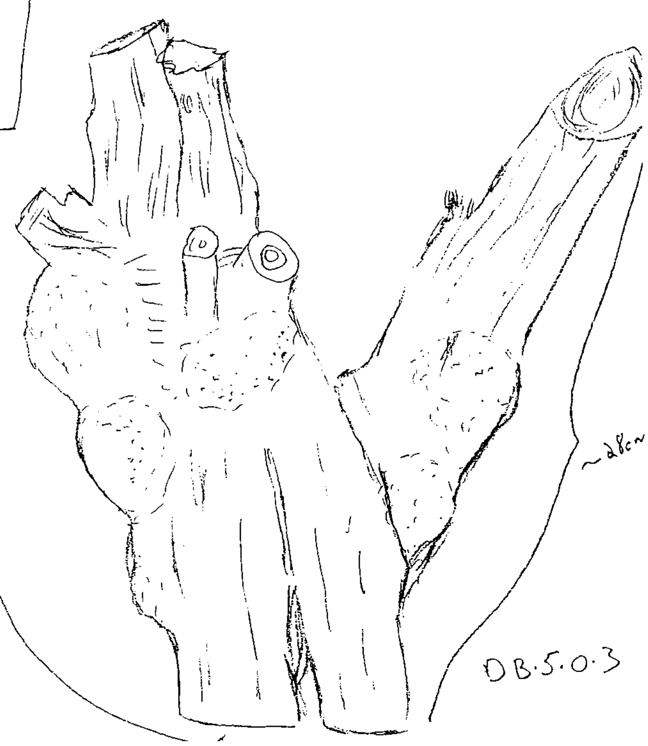
3.7cm }



← 6 (nail)

DB.5.G

This goes to DB.5.6



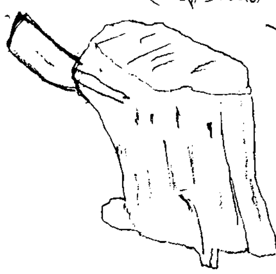
DB.5.0.3

DELLENBAUGH TREE 5

J.A.
8/2006
Pg. 1 of 4

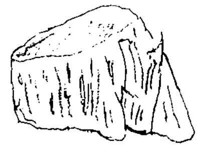
I - 1.5cm

(top sanded)



5.0-7.5cm

DB5-0-2

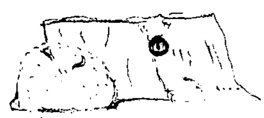


4-7.5cm

DB 5-0-1

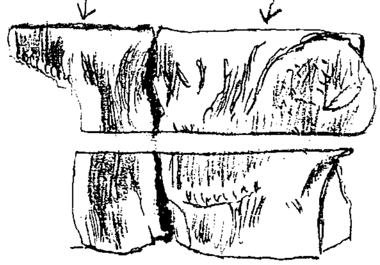
3cm

DB5-GS-1 (Top Sanded)



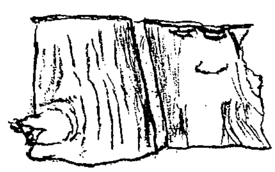
4cm (nail = GS)

DB-5-GS (Top Sanded)



3.5cm DB-5-1

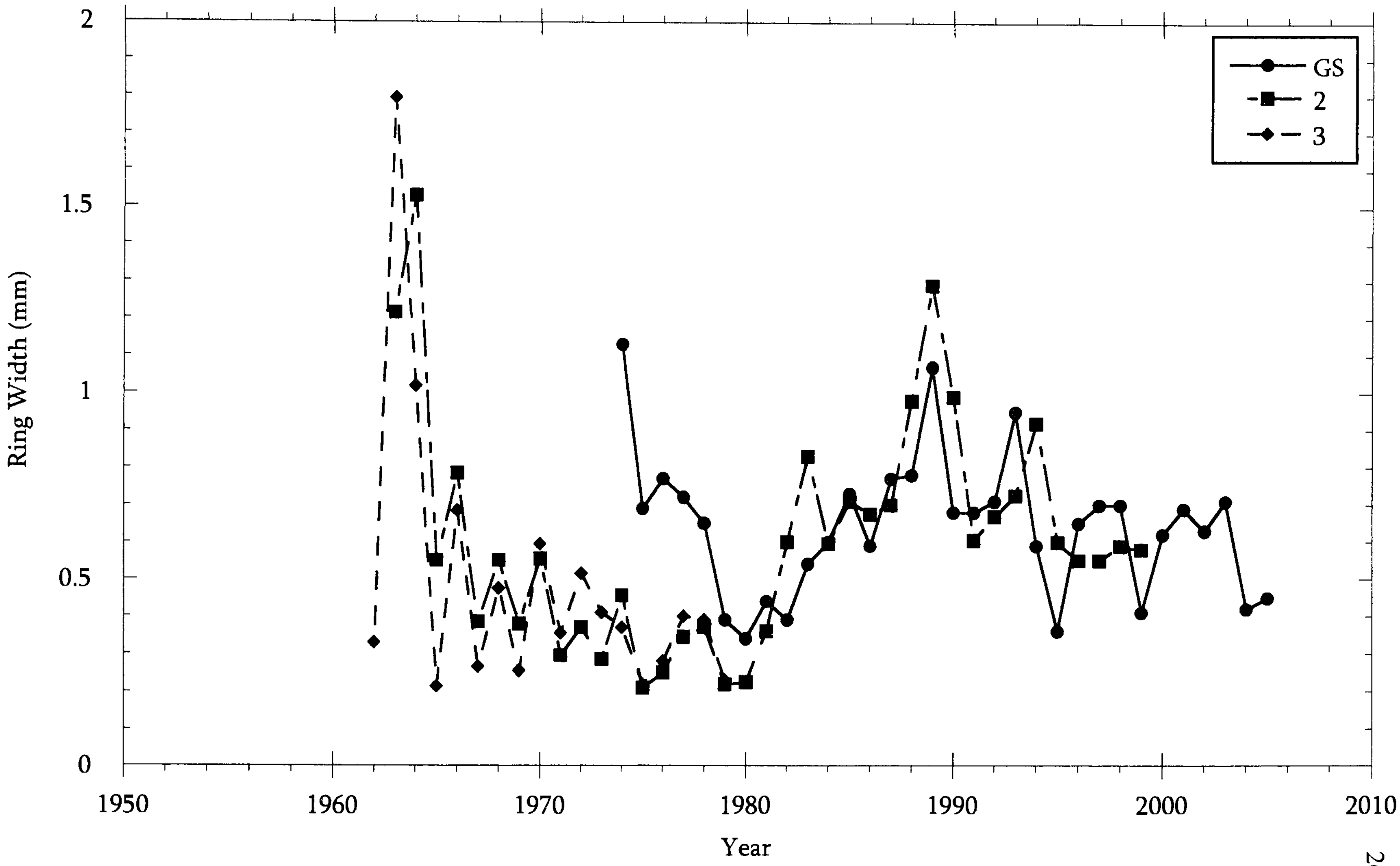
4cm DB-5-2



4.5cm

DB-5-3

Dellenbaugh Tree 3



Dellenbaugh - Ring Reading Notes

Ring Reader: JSA

Reading Date: 7/31/05

Site ID: DELLENBAUGH

Collection Date: NOV. 2005

Tree/Hole ID: 1

Slab ID: GS

Ring Counts/Notes:

J2X filename: DB1J2X.TXT

Number of radii measured: 2

J2X Series Names: DB1GSA, DB1GSB

→ Entered into J2X on 7/31/05 - JSA

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radius A 2005 - 1964

2000 - 2003 - similar
2004 - narrow
1999 - wider
93-98 - similar
90-91 - narrow + similar
89 - wider
87 - narrow
86 - wide
79-81 - similar / Dark
76 - wider
69-73 - wide + similar
65-68 - narrower + similar
64 - wide

Radius B 2005 - 1964

2003 - 2004 - narrower pair
1999 - wide
94-96 - similar
89 - wide
86 - really wide
85 - really wide
79-81 - similar / Dark
75-76 - wider
69 - wider
66 - narrow
64 - wide

Dellenbaugh – Ring Reading Notes

Ring Reader: JSA

Reading Date: 8/1/06

Site ID: Dellenbaugh

Collection Date: Nov 2005

Tree/Hole ID: 1

Slab ID: 1

Ring Counts/Notes:

J2X filename: DB1J2X.TXT

Number of radii measured: 2

J2X Series Names: DB11A, DB11B

Entered into J2X on 8/1/06 by JSA

Proportion of circumference with secondary growth:

Start Year: ___ Stop Year: ___ Proportion: ___

Start Year: ___ Stop Year: ___ Proportion: ___

Start Year: ___ Stop Year: ___ Proportion: ___

Wood Anatomy Change Notes:

Radius A 2005 - 1962

99' - wider
94.93 - wider
92 - narrower
89 - wide
86 - really wide
83 - wider
75-77 - similar
72-74 - wide/similar
66 - narrow
64 - wide
63 - wide
⊙ 62 - center w/pith

Radius B - 2005 - 1962

99 - wider
93-94 - wider/similar
86 - wider
83-85 - similar
75 - wider
69 - narrower
64 - wide
63 - wide
⊙ 62 - center w/pith

Dellenbaugh – Ring Reading Notes

Ring Reader: J.A. + J.R

Reading Date: 8/1/06

Site ID: Dellenbaugh

Collection Date: November 2005

Tree/Hole ID: 1

Slab ID: 2

Ring Counts/Notes:

J2X filename: DB1J2X.TXT

Number of radii measured: 2

J2X Series Names: DB12A, DB12B

Entered into J2X on 8/1/06 by JSA

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radius A 2005 – 1961

- 99 - wider
- 93-97 - similar
- 89 - wider
- 87 - narrow
- 86 - wide
- 83 - wide
- 73 - wide
- 69 - Narrow
- 65-66 - Narrow Pair
- 64 + 63 - wide
- ⊙ 61' Center w/ Pith

Radius B 2005-1961

- 99 - wider
- 89 - wider
- 86 - wider
- 83 - wide
- 81-82 - Narrow or/similar
- 72-73 - Wide Pair
- 1965 - Narrow
- 64 - wide
- 63 - wider
- 62 - Narrower
- 61-62 - Narrow Pair
- ⊙ 1961 Center w/ pith

Dellenbaugh – Ring Reading Notes

Ring Reader: J.A. & J.R.

Reading Date: 8/ 1/06

Site ID: Dellenbaugh

Collection Date: November 2005

Tree/Hole ID: 1

Slab ID: 4 · 01
(Sanded Top & Bottom)

Ring Counts/Notes:

J2X filename: DB1J2X.TXT

Number of radii measured: 2

J2X Series Names: DB1401A, DB1401B

Entered into J2X on 7/31/06 by JSA

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

J.R. - Burial after '62, general buriedness throughout slab.

Top

Wood Anatomy Change Notes:

Radius A: (2005-1968)

2000-2002 - Similar
99' - wider
93-98 - Similar
83-84 - wide Pair
1975 - wider
73' - wider

Radius B: (2005-1961)

1999-2000 - wider Pair
90-98' - Similar
89 - wide
83 - wide
85-88 - Similar
73' - wider
69 - narrow
65' - narrow
63 - wider
62 - narrower than '63.
⊙ - 61 center w/ Pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.A. + J.R.

Reading Date: 8/1/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 1

Slab ID: 5-1
(Top + Bottom SANDED)

Ring Counts/Notes:

J2X filename: DB1J2X.txt

Number of radii measured: 2

J2X Series Names: DB151A, DB151B

Entered into J2X by JSA on 8/2/06

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Buried after '61, '82.

Top

Wood Anatomy Change Notes:

Radius A (1961 - 2005)
89-88 - wider
87 - narrow
83-84 - Wide pair
75 - wider
72-73 - wide pair
74-76 - narrow group
63 - Wide
62 - Very narrow
⊙ 61 - center w/ pith - Wide

Radius B (1961 - 2005)
1989 - wider
1986 - narrower
65 - Very narrow
63 - wide
✱ 62 - Very narrow
⊙ 61 - center with pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. + J.A. Reading Date: 8/2/06

Site ID: Dellenbaugh Collection Date: Nov. 2005

Tree/Hole ID: 1 Slab ID: 6

Ring Counts/Notes:

J2X filename: DB1J2X.txt

Number of radii measured: 2

J2X Series Names: DB16A DB16B

Entered into J2X by JSA on 8/2/06

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

J.R. - Burial after '82, '61.
JSA - Burial after 61

Wood Anatomy Change Notes:

Radius A (1961-2005)
83-84 - wide Pair
1975 - wide
72-73 - wide Pair
65 - Narrow
63 - wide
62 - almost non-existent
⊙61 - Center w/ Pith

Radius B (1961-2005)
93-94 - Wide Pair
1986 - narrower
67+68 - wider
65 - narrow
63 - wider
✱ 62 - almost non-existent (ANE)
⊙ 61 - Center with Pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. & J.A.

Reading Date: 8/2/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 1

Slab ID: 8D

Ring Counts/Notes:

J2X filename: DB1J2X.TXT

Number of radii measured: 2

J2X Series Names: DB 18DA, DB18DB

Entered into J2X by JSA on 8/2/06

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial after '61, '82, '96
JSA - Burial after '61, '82,

Wood Anatomy Change Notes:

Radius A: (1961 - 2005)

1997 - Small
89 - wider
86 - narrow
83 - narrow.
71 + 72 - wider
67 - wider
65 - narrow
63 - wide
* 62 - Really Narrow (Almost Non-Existent)
⊙61 - Center w/ Pith

Radius B (1961 - 2005)

97 - narrower
89 - wider
86 - narrow
'83 - narrow
'71 + 72 - wider
67 - wider
65 - narrow
63 - wide
* 62 - Really Narrow (ANE) [almost non-existent]
⊙61' - Center w/ Pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. + J.A.

Reading Date: 8/2/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 1

Slab ID: 10 - B1

Ring Counts/Notes:

J2X filename: DB1J2X.txt

Number of radii measured: 2

J2X Series Names: DB110B1A , DB110B1B

Entered into J2X by JSA on 8/2/06

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

J.R. - Buried after '82, '61
JSA - Buried after '61, '82

Wood Anatomy Change Notes:

Radius A - 1960-2005

02'4 - similar
'91 + '92 - similarly narrow
'83, '84, '86 - similarly narrow
'77 - narrow
'65 - narrower
'64 - wide
'62 - "ANE"
'61 - wide
'60 - center w/pith - false rings

Radius B - 1960 - 2005

'93 + '94 - wide
'89 - wide
'83 + '86 - narrow
'70's - complacent
'65 - narrow
'62 - "ANE"
'61 - wide
'60 - center w/pith - false rings

Dellenbaugh - Ring Reading Notes

Ring Reader: J.A. + J.R.

Reading Date: 8/2/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 1

Slab ID: 11

Ring Counts/Notes:

J2X filename: DB1J2X.txt

Number of radii measured: 2

J2X Series Names: DB111A , DB111B

F

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial after '60, '82

Wood Anatomy Change Notes:

Radius A - 1960 - 1971

'82 - '80 - similar

'66 - '72 - similarly wide

'65 - narrow

'64 - WIDE

'63 - wood Δ's between '63 + '64

'62 - "ANE"

Radius B - 1960 - 1982

'61 - wide

'60 - wide center w/pith + false rings.

Dellenbaugh - Ring Reading Notes

Ring Reader: JSA, J.L.

Reading Date: August 2, 2006

Site ID: Dellenbaugh

Collection Date: Nov, 2005

Tree/Hole ID: 1

Slab ID: 12
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: DB1 J2X. txt

Number of radii measured: 2

J2X Series Names: DB112A, DB112A

Entered into J2X on August 2, 2006 by JSA

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial after '60, '82
JSA - Burial after ~~61, 63~~ 60, 82

Wood Anatomy Change Notes:

Top Radius A - 1960 - 2005 Radius B - 1960 - 1982

Dellenbaugh – Ring Reading Notes

Ring Reader: J.R. + J.A.

Reading Date: August 2, 2006

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 1

Slab ID: 14

Ring Counts/Notes:

J2X filename: DB1 J2X.txt

Number of radii measured: 2

J2X Series Names: DB114A , DB114B

Entered into J2x by JSA on August 2, 2006

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

J.R. – Burial after 19

JSA – Burial after 61, 63'

Wood Anatomy Change Notes:

Radii A + B – 1961 – 1972

'65 – narrow

'63 – WIDE

'62 – 'ANE'

'60 – center w/no visible pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. + J.A.

Reading Date: August 2, 2006

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 1

Slab ID: 16

Ring Counts/Notes:

J2X filename: DB1J2X.txt

Number of radii measured: 2

J2X Series Names: DB116A, DB116B

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Full lootiness shows after '63(?)

Wood Anatomy Change Notes:

Radii A + B - 1960 - 1965

'65 - narrow
'64 - wider
'63 - WIDE
'62 - 'ANE'
'61 - wide
'60 - center, no visible pith

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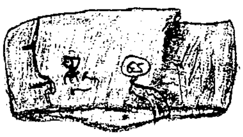
7/2006
pg. 1 of 3

DELLENBAUGH TREE 1

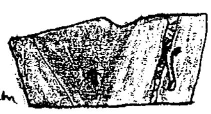
Note * Additional stems not drawn.

~10cm

DB-1-GS nail = GS

~5cm
~5cm

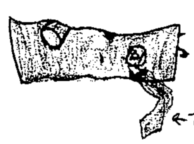
--- → cut

DB-1-1 (Top Sanded)
DB-1-1-1 (Top Sanded)

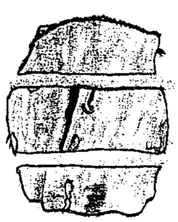
7-8.5cm

DB-1-2 (Top Sanded) (+ Bottom)

7.5-8cm

DB-1-3 2 pieces

7cm


DB-1-4-D1 (Top + Bottom Sanded) nail = D1

~6cm
~6.5cm
~5cm

DB-1-5
DB-1-5-1 (Top + Bottom SANDED)
DB-1-5-2

cont. →

DELLENBAUGH TREE 1

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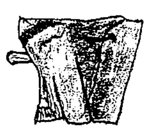
7/2006

* Additional Stems not drawn.

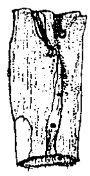
5-6.5 cm		DB-1-6	(Top SANDED)
5-6 cm		DB-1-7	
3.5-6.5 cm		DB-1-8D	nail = D
~5 cm / ~2 cm	 — (cut here	DB-1-9 → / DB-1-9-1	(Top + SANDED BOTTOM) (Top has many centers)
5-6 cm		DB-1-10-B1	nail = B1
5-6 cm		DB-1-11	(Top Sanded)
5-7 cm		DB-1-12	(Top + Bottom Sanded)
11 cm		DB-1-13	
4 cm		DB-1-14	(Top + Bottom Sanded)

cont. →

DELLENBAUGH
TREE 1

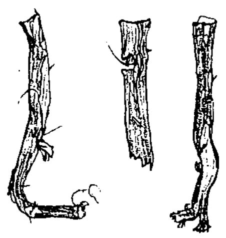
J. Roth
7/2006
Pg. 3 of 3

5cm

~16.5cm  DB-1-15

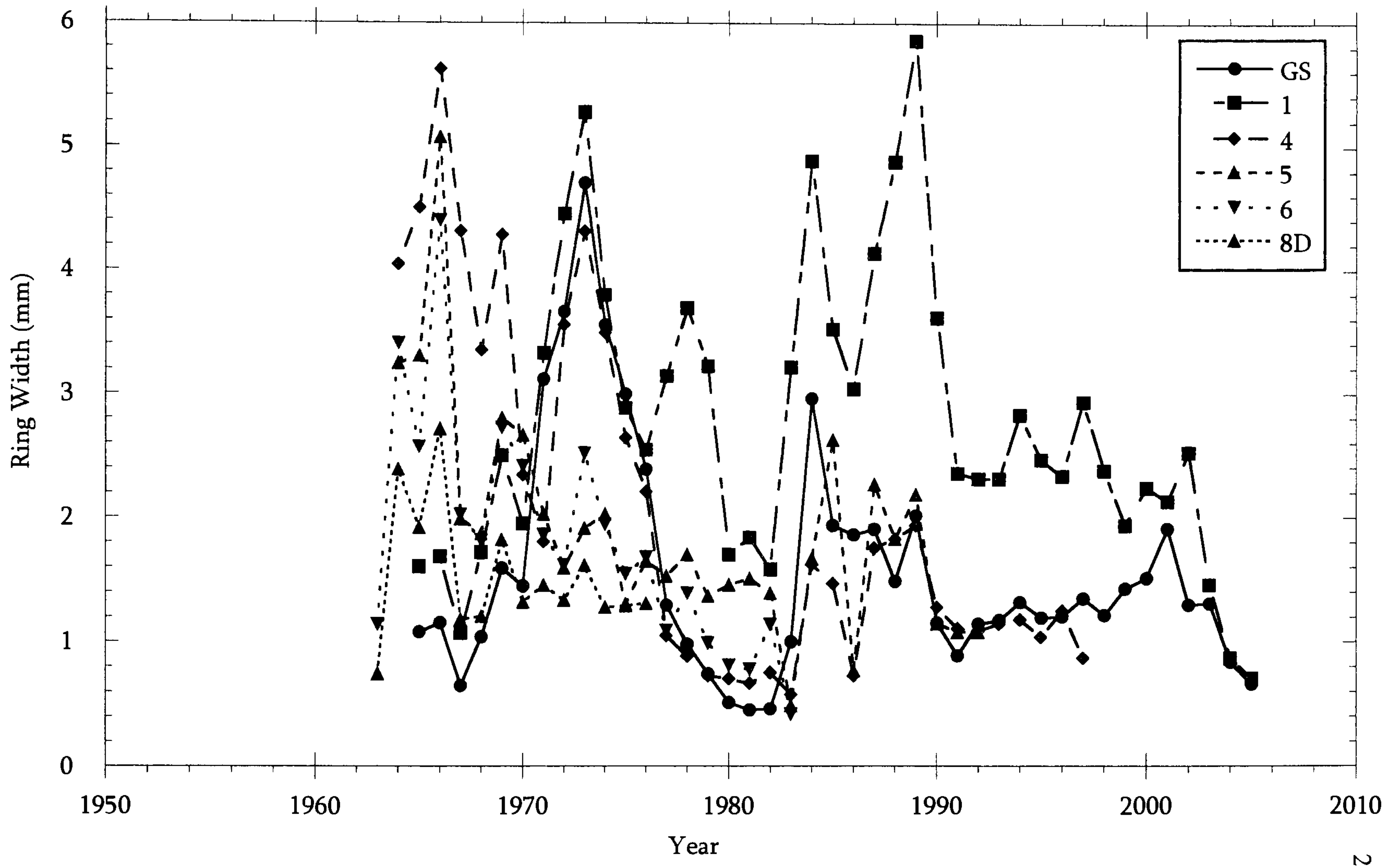
~3cm  DB-1-16 (Top SANDED)

~2cm  DB-1-17 (Top + Bottom Sanded) (Bott. has 3 stem centers)



Three NOT Labeled Root legs all attach to above stem.

Dellenbaugh Tree 4



Dellenbaugh - Ring Reading Notes

Ring Reader: J.R.

Reading Date: August 11, 2006

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 3

Slab ID: 2-GS

Ring Counts/Notes:

J2X filename: DB3J2X.txt

Number of radii measured: 1

J2X Series Names: DB32GSA, DB32GSB

* Entered in J2X by JSA in August 11, 2006

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radius A - 1974 - 2005

2000's - complacent

90's - complacent

'79 - '83 - narrow

'75 - 78 - similar

74 - center

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R.

Reading Date: August 11, 2006

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 3

Slab ID: 2-2

Ring Counts/Notes:

J2X filename: DB3J2X.txt

Number of radii measured: 2

J2X Series Names: DB322A, DB322B

* Entered into J2X by JSA on August 11, 2006

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - burial after '99.

Wood Anatomy Change Notes:

Radius A - 1963 - 2005

'98 - wide
'97 - narrow
'93 - wide
'92 - narrow
'89 - wide
'86 - narrow
'79 + '81 - narrow
'75 - very narrow
'72 - wider '69 - false ring
'67 - narrow
'66 - wide
'65 - narrow
'64 - WIDE
'63 - center w/pith.

Radius B - 1963 - 1999

'93 - wide
'92 - narrow
'89 - wide
'86 - narrow
'83 + '84 - narrow
'82 - wide
'79 + '80 - narrow
74 - wider
'71 - '73 - very narrow
'70 - wider
'69 - narrow - false ring
'66 - wide
'65 - narrower
'64 - wide
'63 - center w/pith.

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R.

Reading Date: August 11, 2006

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 3

Slab ID: 2-3 (Top + Bottom Sanded)

Ring Counts/Notes:

J2X filename: DB3J2X.txt

Number of radii measured: 2

J2X Series Names: DB323A, DB323B

* Entered into J2X by JSA on August 11, 2006

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Top
Radius A - 1962 - 19~~78~~79

Radius B - 1962 - 1972

'72 - wide
'71 - narrow
'69 - narrow
'68 - wide
'67 - narrow
'66 - wide
'65 - narrow
'63 + '64 - wide
'62 - new little year
looks mostly all rooty tooty!

Dellenbaugh Bar

Tree #3
Stem 2

J. A.
August 2006
pg. 1 of 1

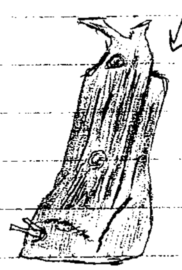
2cm

20.5 cm

DB.3.2.0

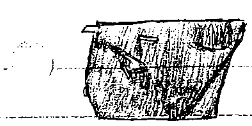
3 cm (sanded on top)

DB.3.2.65



10cm

DB.3.2.1



3.5 cm (sanded on top)

DB.3.2.2

3.5cm

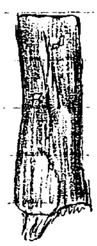
DB.3.2.3

3.5cm

DB.3.2.4

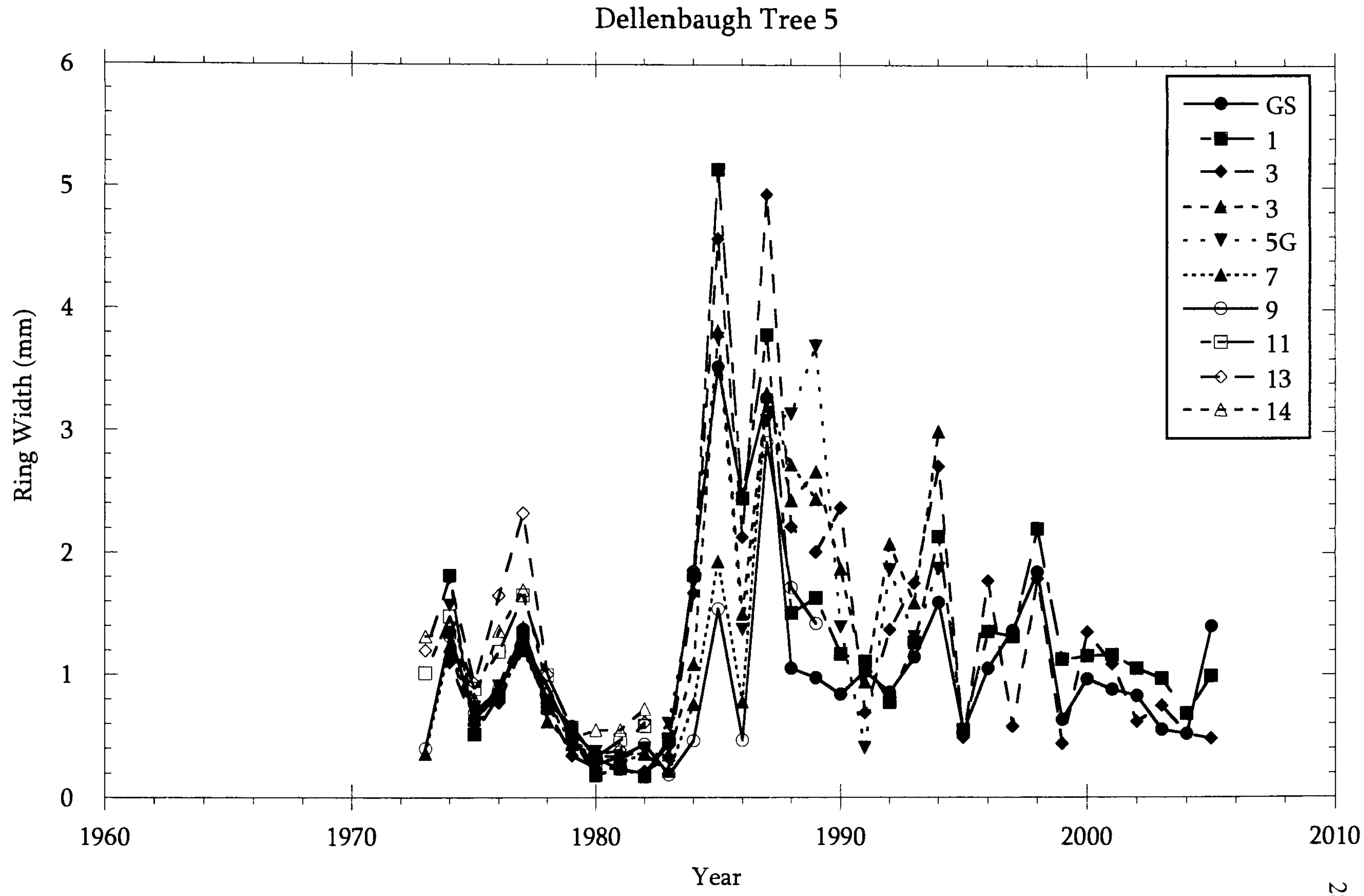
2.8cm

DB.3.2.5



8.0cm

DB.3.2.6


Dellenbaugh Tree 5
Ring Width (mm)
Year
0
1
2
3
4
5
6
1960
1970
1980
1990
2000
2010
GS
1
3
3
5G
7
9
11
13
14

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. + J.A.

Reading Date: 8/11/06

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 4

Slab ID: 1

Ring Counts/Notes:

J2X filename: DB4J2X.txt

Number of radii measured: 2

J2X Series Names: DB41A , DB41B

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes: Slab is stretched.

Radius A - 1965-2005

2005- Small (outer years wavey)
'90's - complacent
'89 - wide
'82 - narrow
'77-'79 - wide
'67 - narrower
'65 - center w/pith

Radius B - 1965-2005
(outer years wavey)

2005 - small
'90's - complacent
'89 - wide
'71 - '74 - similarly wide
'65 - center w/pith.

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. + J.A.

Reading Date: August 11, 2006

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 4

Slab ID: GS

Ring Counts/Notes:

J2X filename: DB4J2X.txt

Number of radii measured: 2

J2X Series Names: DB4GSA, DB4GSB

* Entered into J2X by JSA on Aug 11, 2006

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radii A + B - 1965 - 2005

Radius A

2005 - small
'90's - complacent
'89 - wide
'84 - wide
'80 - '83 - similarly small
'71 - '76 - wide
'69 + '70 - similar
'67 - narrow '65 - center w/pith.

Radius B

wood "burly" on this side.
'99 - has false ring
'89 - wide
'84 - wide
'83 - narrower
'80 - '82 - similarly narrow
'71 - '76 - wide
'69 + '70 - similar
'67 - narrow

'65 - center w/pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. + J.A

Reading Date: August 11, 2006

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 4

Slab ID: 4

Ring Counts/Notes:

J2X filename: DB4J2X.txt

Number of radii measured: 2

J2X Series Names: DB44A, DB44B

* Entered into J2x by JSA on August 11, 2006

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

- Burned after 97' - JSA

* Center area removed by arthropod - center not visible

Wood Anatomy Change Notes:

Radius A (1964* - 1993)

87' - wider
86' - narrow
84' - wider
83' - narrow
77-83' - narrow set
73' - wide
66' - wide
⊙ 63 - Likely center*

Radius B (1964* - 1997)

90-97' - progressively smaller from 90' on out
89' - wide
86' - narrow
79'-83' - narrow set
72'-74' - wide set
69' - wide
66' - wide

⊙ 63' - Likely Center

Dellenbaugh – Ring Reading Notes

Ring Reader: J.R. + J.A.

Reading Date: August 11, 2006

Site ID: Dellenbaugh

Collection Date: Nov, 2005

Tree/Hole ID: 4

Slab ID: 5

Ring Counts/Notes:

J2X filename: DB4J2X.txt

Number of radii measured: 2

J2X Series Names: DB45A, DB45B

* Entered into J2X by JSA on August 11, 2006

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

– Burial after 82' – JSA

* Center eaten/removed by pesky Arthropod

Wood Anatomy Change Notes:

Radius A (1964* – 1976)

75-76' – narrow pair
73-74' – wide pair
71' – narrow
67-68' – narrow pair
66' – wide
⊙ 63' – presumed center w/ pith

Radius B (1964* – 1992)

89' – wide
86' – narrow
85' – wide
83' – narrow
77'-82 – similar widths
76' – wider
69-71' – wide set
66' – wide

⊙ 63' – center w/ pith

Dellenbaugh - Ring Reading Notes

Ring Reader: J.A. + J.R.

Reading Date: August 11, 2006

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 4

Slab ID: 6 Top (2 centers) Top + Bottom sanded

Ring Counts/Notes:

J2X filename: DB4J2X.txt

Number of radii measured: 2

J2X Series Names: DB46A, DB46B

* Entered into J2x by JSA on August 11, 2006

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

- Burial after 82' - JSA

Wood Anatomy Change Notes:

Radius A (1963 - 1976)

1973 - wide
71' - narrow
68' - narrow
66' - wide
64' - wide
○ 63' - narrow; center w/ Pith

Radius B (1963 - 1983)

77-83' - narrow set
72' - narrow
69' - wide
66' - wide
○ 63' - narrow; center w/ pith

* establishment in 63' @ this level

Dellenbaugh - Ring Reading Notes

Ring Reader: J.R. + J.A

Reading Date: August 11, 2006

Site ID: Dellenbaugh

Collection Date: Nov. 2005

Tree/Hole ID: 4

Slab ID: 8D

Ring Counts/Notes:

J2X filename: DB4J2X.txt

Number of radii measured: 2

J2X Series Names: DB48DA, DB48DB

* Entered into J2X by JSA on August 11, 2006

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

*Burial after 82' - JSA

Wood Anatomy Change Notes:

Radius A (1963 - 1976)

73' - wide
70-71' - narrow pair
69' - wider
66' - wide
○ 63' - narrow - center
Likely Root

Radius B (1963 - 1976)

67' - narrow
66' - wide
64' - wide
○ 63' - narrow; center

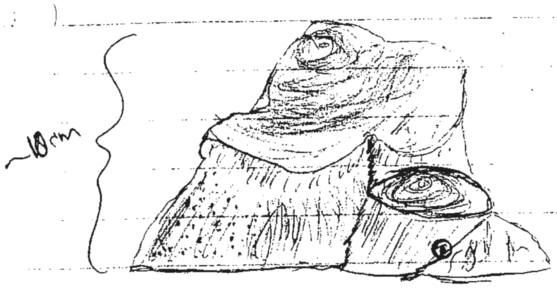
J. A. - August 2006

Page 1 of 4

Dellenbaugh

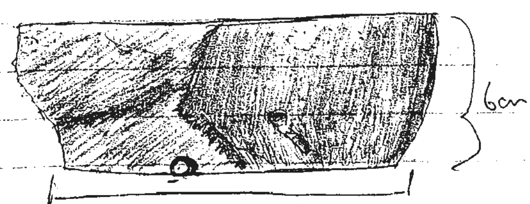
Tree 4

2cm



DB-4-65

(Sanded on top)



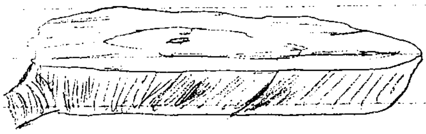
DB.4.1 (Sanded on top + Bottom)

DB.4.2

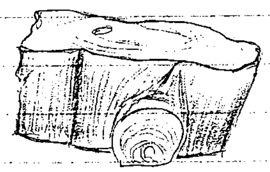
Dellenbaugh
Tree 4

J. A.
August 2006
Page 2 of 4

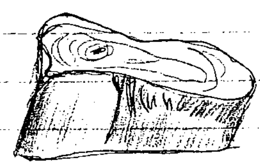
I · 2cm



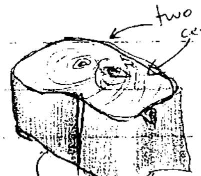
} ~2.0cm DB4.3



} ~4.0cm DB.4.4 (top-sanded)

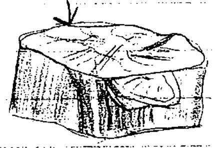


} 4.0cm DB.4.5 (top-sanded)

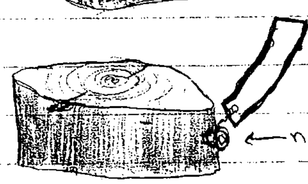


} 4.1cm DB.4.6 (sanded top + bottom)

→ this is the intersecting slab for the two root extensions (DB.4.7 + DB.4.7.1)



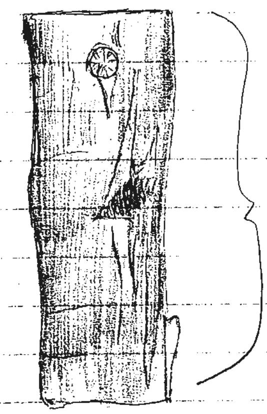
} ~4.0cm DB.4.7] See Page For other side of root



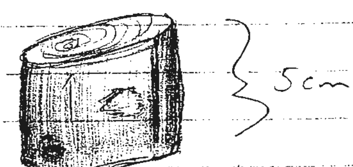
← nail "D" } 4.5cm DB.4.8.D
(sanded on top)

Dellenbaugh
Tree 4

J. A.
August 2006
Page 3 of 4

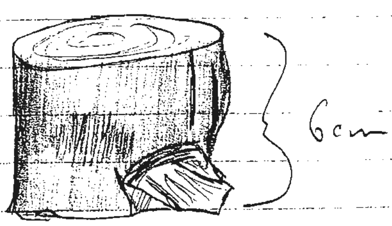


DB.4.9

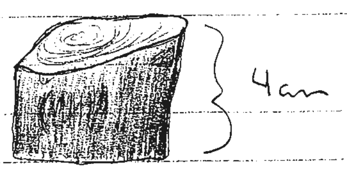


(top-sanded)

DB.4.10

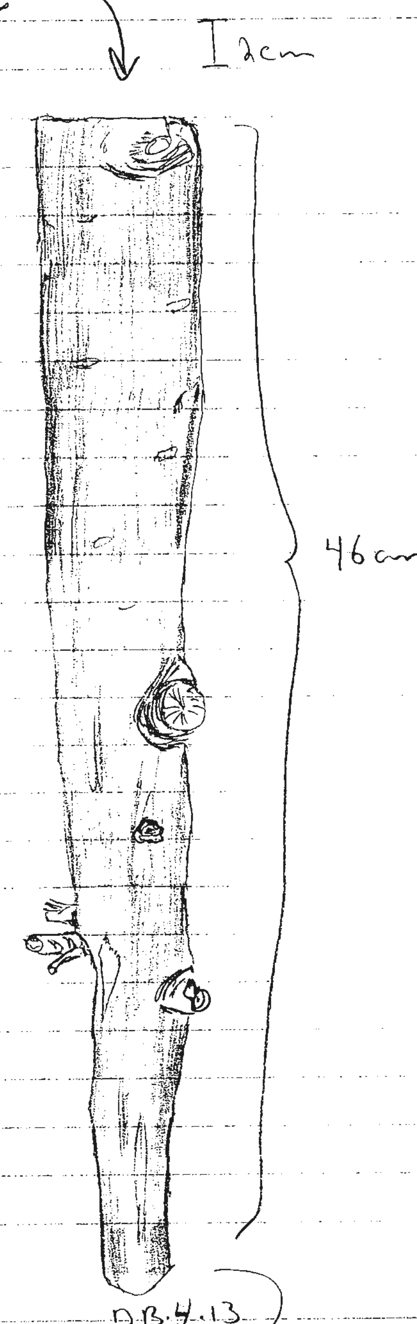


DB.4.11

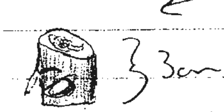


DB.4.12

(top-sanded)



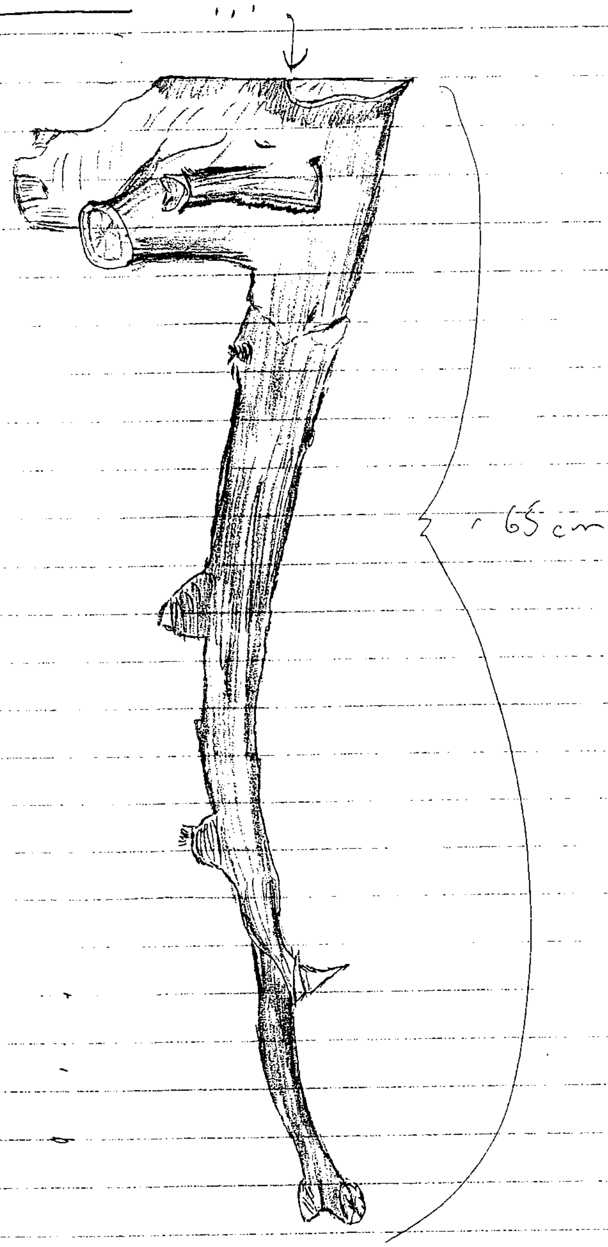
DB.4.13



DB.5.13 (top-sanded)

Dellenbaugh
Tree 4

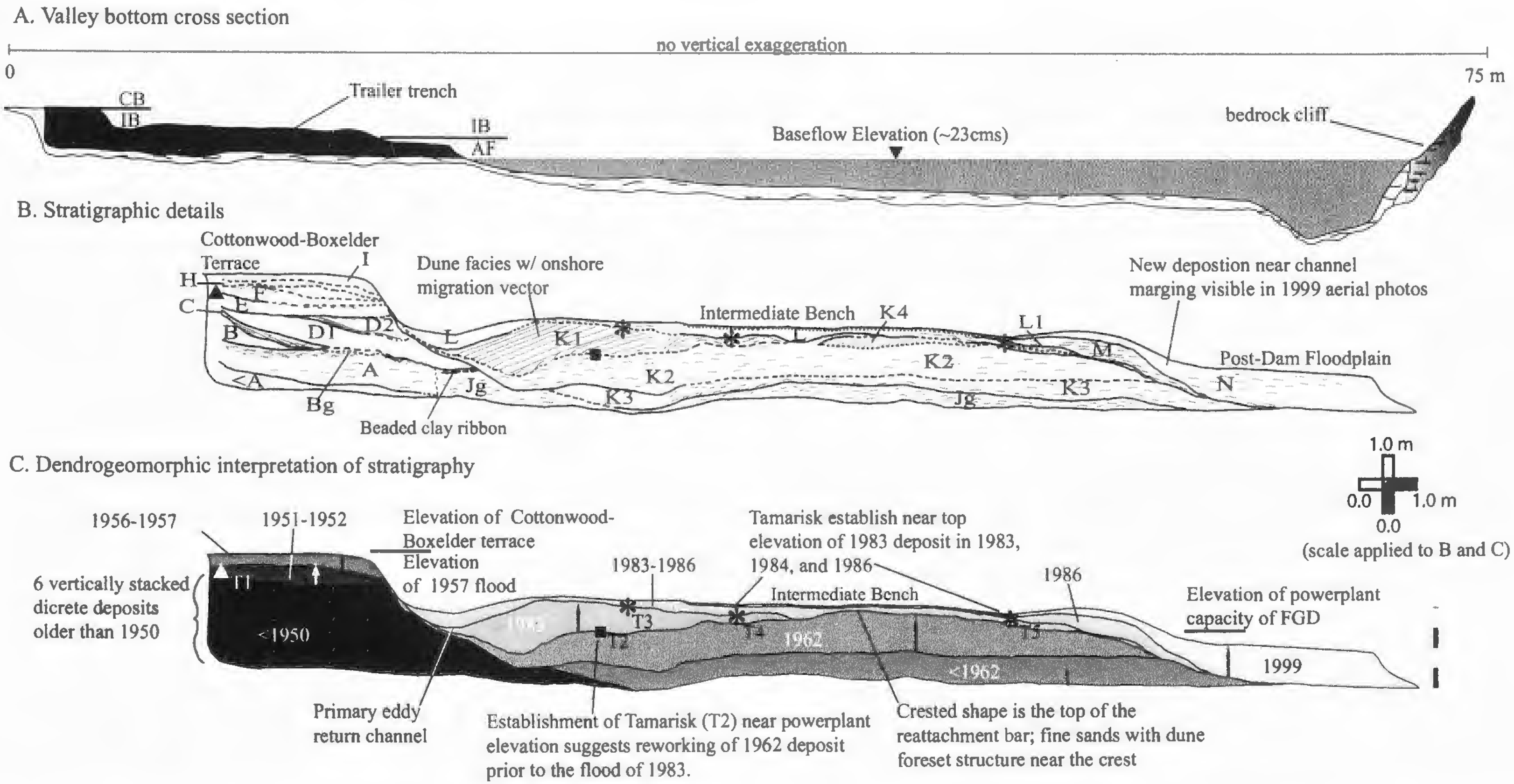
J.A. - August 2006
Page 4 of 4



DB.4.7.1
↑
Stem 2 *see pg. 2

APPENDIX A3

SUPPLEMENTAL STRATIGRAPHIC AND DENDROGEOMORPHIC DATA FOR THE TRAILER TRENCH



Stratigraphic details of the Trailer trench excavation; all views facing in the downstream direction. (A) total channel/valley bottom cross sectional profile along trecnh (B) stratigraphic details of floodplain deposits including sedimentary structures, unit contacts, and the location and establishment elevation of the trees used in the dedrogeomorphic analysis (C) dendrogeomorphic interpretation of the age of each stratigraphic deposit and the direction of grain coarsening.

Legend - Stratigraphic Details

——	abrupt/erosional unit boundary
- - - - -	gradational / diffuse unit boundary
·····	orientation of bedding
▲	old Tamarisk est. elevation
*	est. elevation of Tamarisk
■	approximate est. elev. of Tamarisk
↗	direction of grain coarsening
X#	discrete unit
BS	basal sands
▪ ▬	estimated offshore location of eddy fence

Descriptions of stratigraphic units within the Trailer Excavation

Unit	Description	Unit	Description
<A	Gray unit composed of almost entirely of very fine sand with bioturbated ripple structures; D_{50} = 7 mm; GSD = 1.48	I	Brown/buff unit a gradational lower boundary; consists of massive fine sand with bioturbated ripple structure; unti generally coarsens offshore; D_{50} = 3.7 mm; GSD = 1.7
Ag	Brown/gray unit which generaly coarsens upward from clay to fine or very fine sand with an abrupt lower boundary and an abrupt/gradational upper boundary; contains discontinous clay seams; upper part of unit contains trough ripple stratifications; offshore boundary is gradational with Jg; D_{50} = 6 mm; GSD = 1.66	J	Gray unit with an intermittently abrupt upper boundary and an unknown lower boundary (below water table); generally coarsening upward unit of very fine sand to fine sand; contains beaded (intermittent) clay band; bioturbated, thinly laminated climbing ripple structure; D_{50} = 14 mm; GSD = 1.46
Bg	Brown/gray intermittent unit with an abrupt lower boundary and gradational upper boundary; coarsens from clay bottom to silty clay and bands of fine sand with climbing ripple structure; D_{50} = 4.5 mm; GSD = 2.07	K1	Buff colored unit composed of well-sorted fine sand with dune-forset structure throughout with onshore migration vector; lower boundary is transitional (base of dune forset incorrnporates finer sands of K2); upper boundary is gradational; D_{50} = 16 mm; GSD = 1.39
C	Brown/gray unit with abupt lower and upper boundaries; composed of very fine sand with low-angle climbing ripples near the base; D_{50} = 7.5 mm; GSD = 1.81	K2	Brown unit with a lower boundary which transitions from abrupt to gradational from onshore to offshore and a gradational upper boundary; coarsening upward sequence with reddish clay at the base grading into fine sand near top; thinly laminated ripple structure; D50 = 11 mm; GSD = 1.64
D1	Brown/gray unit with an abrupt lower boundary composed of silty clay grading into very fine sand with ripple structures; upper boundary transitions from abrupt to gradational from onshore to offshore; D_{50} = 3.6 mm; GSD = 1.81.	K3	Gray clay unit with some silt; abrupt lower boundary and gradational upper boundary*
D2	Brown/gray unit with a lower boundary which transitions from abrupt to gradational from onshore to offshore; lower boundary is composed of a thin seam of fine sand with low-angle climbing ripples grading into massive silty-clay; upper boundary is composed of very fine sand and silt with ripple structure; upper boundary transitions from abrupt to gradational onshore to offshore; D_{50} = 3.3 mm; GSD = 1.8	K4	Buff colored unit compoed of well sorted fine sand and sand with dune foreset structures with onshore migration vector; upper boundary transitions from abrupt to gradational onshore to offshore; D_{50} = 15 mm; GSD = 1.54
E	Brown/gray unit with an abrupt lower boundary and upper boundary which transitions from abrupt to gradational from onshore to offshore; unit generally coarsens upward from silty clay to very fine sand and fine sand with climbing ripples near top; D_{50} = 3.8 mm; GSD = 1.8	L	Buff colored unit composed of very well-sorted very fine and fine sand with thinly laminated climbing ripple structure; gradational lower and abrupt upper boundary; D_{50} = 22 mm; GSD =1.36
F	Brown/gray unit lower and upper bondaries which transition from abrupt to gradational from onshore to offshore; unit coarsens upward from silty clay to fine sand with climbing ripple structure; D50 = 8.5 mm; GSD = 1.57	M	Brown/buff colored unit composed of a genearlly coarsening upward sequence of silty/fine sand grading into well sorted fine sand; lower part of unit has rust staining; thinly laminated ripple structure; abrupt lower and upper bondaries; D_{50} = 8 mm; GSD = 1.68
G	Description not available	N	Red/brown colored unit composed of a coarsening upward sequence from red clay lower boundary to fine sand near top; lower boundary is abrupt; thinly laminated ripple structures; D50 = 5 mm; GSD = 2.3
H	Brown/buff unit with a lower boundary which transitions from abrupt to gradational from onshore to offshore and a gradational upper boundary; unit generally coarsens upward from silty clay to very fine sand; unit generally coarsens offhore*		

* not sampled for grain size
GSD - geometric standard deviation

STAGE DISCHARGE RELATION FOR TRAILER TRENCH

Water Surface Elevation Data from Grams XS13....then adjusted to Trailer

Date	Discharge	W.S.E_1	W.S.E_2	Avg WSE	Adjusted WSE
06/27/90	818	95.232	95.242	95.24	97.00
06/02/91	1436	95.689226	95.673461	95.68	97.44
08/19/91	1219	95.467	95.46	95.46	97.23
05/08/92	4387	96.607	96.605	96.61	98.37
06/17/92	4287	96.581015	96.556786	96.57	98.33
06/05/93	4540	96.566477	96.521564	96.54	98.31
06/18/93	8290	97.392402	97.368497	97.38	99.14
	1530.00			**95.70**	**97.46**

Stage Relationship for Trench Figure XS

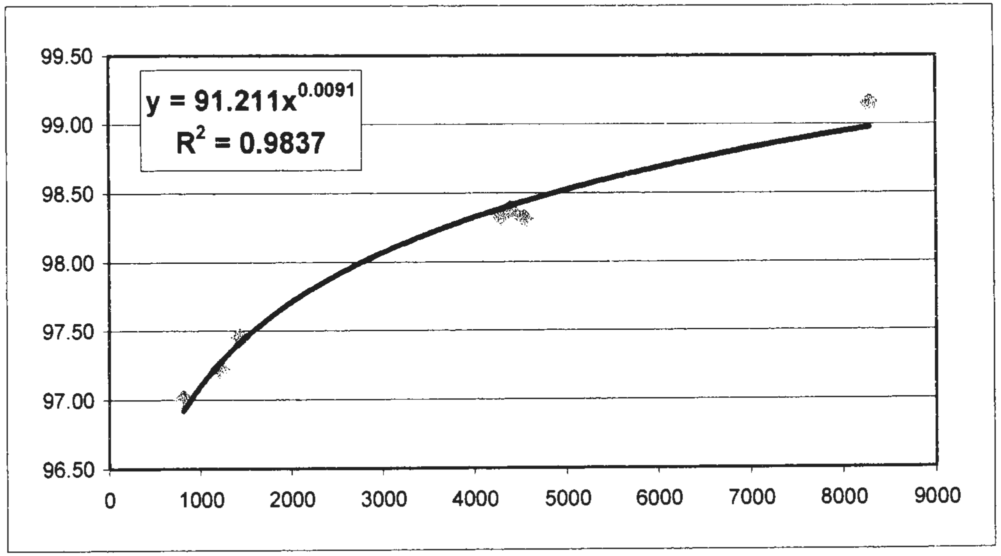
Q (cfs)	Elevation (m)
2000	97.74
4600	98.49
5000	98.56
5000	98.56
5300	98.61
8000	98.98
8400	99.03
11,200	99.29
11600	99.32
13,700	99.47
15,100	99.56
17200	99.68
19,600	99.79

Field measurements made by JSA

Date	Elevation	Q (cfs)	Description
5/10/2006	97.46	1530	WSE near Trailer Trench

This stage relation relies on the stage-discharge data at the Paul Grams XS13 upstream, and within the same backwater. The stage was adjusted to the Trailer site using the difference between the WSE of common discharges. The XS13 common stage was computed using the stage relation. The June 26, 1997 stage data from XS13 was not used because it seemed to be wildly off from the others (outlier).

Jason S. Alexander



Trailer Tree Interpretations: from Ring Reading Notes and Stage Discharge Relations- reviewed by Mike L. Scott and Julie Roth.

TT-TREE1 (Established ~1950)
The presence of pith on the top of the "F" contact, but not at the bottom puts the establishment elevation at the "F" contact. Quite a few years are gained between "F" and "H", and the tree is confirmed root below "F". Possible injury to stem in 1957 near slab "H". Thus, all units below "F" are labeled "<1950". While there are only 4 floods following 1950 that could have emplaced the sediments shown, and there are exactly four units above "F", I do not have tree data to substantiate the deposition in a particular year. The only flood that could have emplaced the top of the terrace, even under the assumption of +/- 10cm stage, is the 1957 flood. Thus I will group the units near the top as "1956/1957" and the "F" and "G" units as "1951/1952".

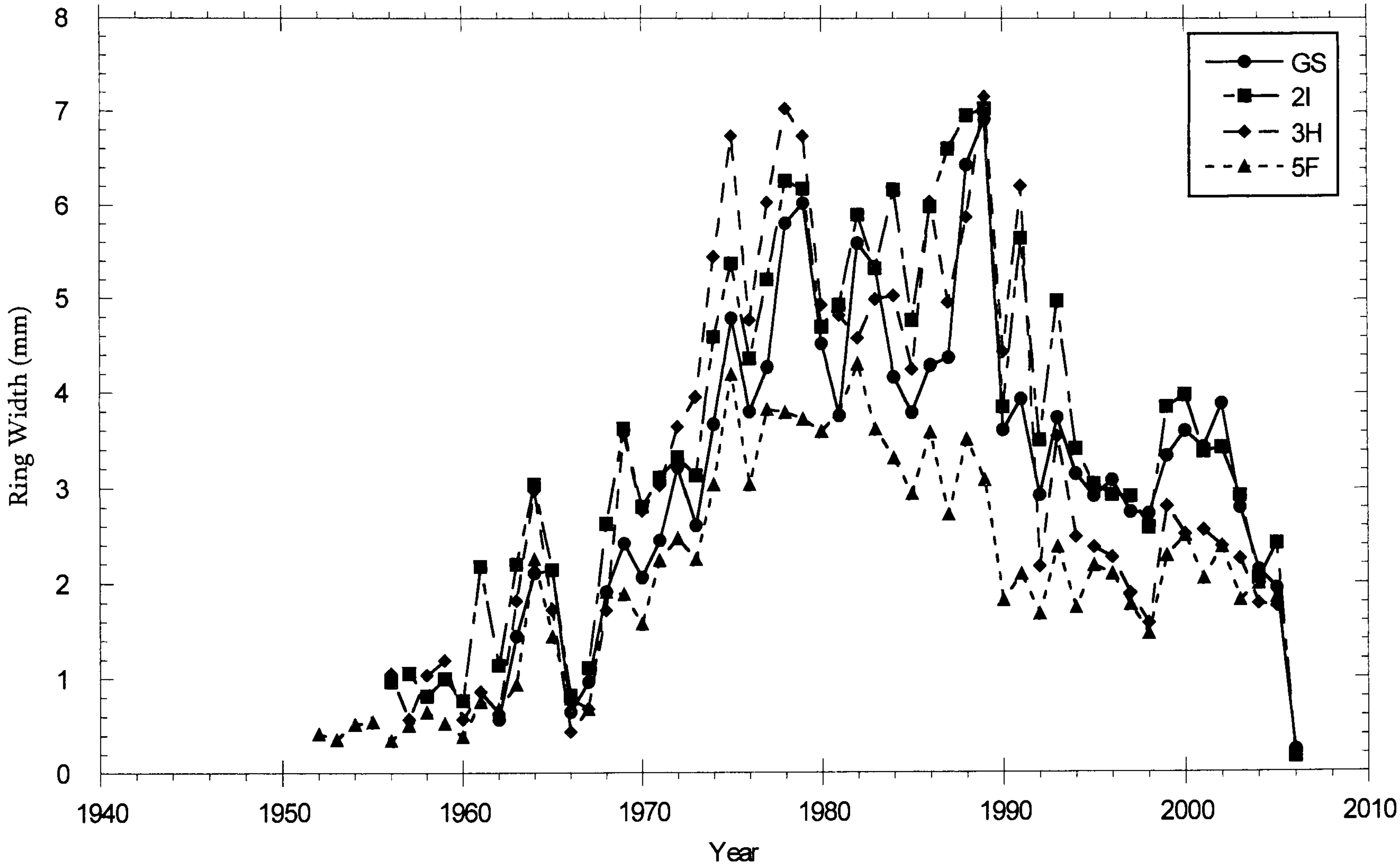
TT- TREE2 (Established <1980)
This tree shows burial in the ring widths in 1983 and in the anatomy in 1990 and 1999. Since a burial in 1990 is not probable, but a change in flow management is, likely burial happened in 1983 and potentially in 1999. This would make the large dune structures of "K1" the product of 1983 and the "L" unit either 1984 (which is also narrow) or 1999. We will have to use other trees around to confirm or deny this question. Although we did not get to the establishment elevation, the bottom of the tree is near the elevation of powerplant capacity and likely this tree established sometime in 1970 on a surface of re-worked 1962 deposition....although we will never have a definitive answer to this question, it is a very probably assumption considering the vertical location of establishment.

TT-TREE3 (Established ~1985)
The pith in this tree disappears below the bottom of slab 2, before the "L" contact. Julie questions the presence of pith on the top of slab 2. Thus establishment is around the slab 2 elevation. Although this tree shows establishment in 1985, likely we missed the establishment date of 1984, since no flows in 1985 could have reached this elevation. Otherwise, this established on the 1984 surface, IN 1985. Thus, I would say that "L" is likely the top of 1983 and the top of "L" is likely the top of 1984...with some burial by the thin drape in 1999....OR...above "L" is the 1999 flood, as suggested in TREE2, and the 1984 deposit was scoured away.

TT-TREE4 (Established 1983)
Establishment elevation of this tree is near the "L" contact in 1983, although this is not completely clear due to rot of the pith at this slab. If we take this interpretation in the light of the TREES 3 and 4, then establishment in 1983 near the "L" contact is a likely scenario. Ring width suppression is also noted in 1997 in slab "GS" and in 1999 from slab "GS" down. No "burial" comments are recorded, but I assume that this tree would likely show burial after 99'. This is how I will record the "N" unit until further notice.

TT-TREE5 (Established ~1984)
Although the years after 1999 are relatively narrow in this tree, no burial years are called out. 1986 is narrow beginning below slab "M" indicating potential burial. 1999 and after are narrow beginning below "M". Thus likely burial years are 1986, 1997, 1999; these are also the only years after 1984 that could have reached up to this elevation. Likely there was some deposition in 1986, resulting in the "L1" sequence and this tree established near the top of "L". Likely the burial after 1997 and 1999 are the "M" and "N" lenses, which I will deem the "late 90's" units. UPDATE: large sandy deposit shown in 1999 post-flood photos is the "N" unit…thus N will deemed 1999.

Trailer Tree 1



Trailer Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 9-13-06

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: GS

Ring Counts/Notes:

J2X Filename: TR1J2X.TXT

Number of radii measured: 2

J2X Series Id: TR1GSA, TR1GSB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

Wood Anatomy Change Notes:

Radius A - 1962 - 2005

~ center rot + other damage ~

2001 + 2002 - wide

'92 - narrower

'90 - narrow

'88 + '89 - wide

'85 - narrower a lot of early wood

'81 - slightly narrower

Radius B - 1965 - 2006

'70's - complacent on 'B'.

'69, '71 + '73 - narrow on 'A'.

'68 - wide on 'B'

'66 - narrow

'65 - wider

'64 - wide

'62 - narrow

Not recording '61 cuz of rot.

Trailer Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 9-13-06

Site ID: TRAILER

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: 2 I

Ring Counts/Notes:

J2X Filename: TR1J2X.txt

Number of radii measured: 2

J2X Series Id: TR12IA, TR12IB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - some wood rotted

Wood Anatomy Change Notes:

Radius A - 1956 - 2006

2006 - narrow single band of cells.
'93 - wide
'92 - narrow
'90 - narrow
'88 + '89 - wide
'85 - narrower
'70's - complacement
'68 - wide
'66 + '67 - narrow
'63-'65 - Similar
'62 - narrow
'61 - wider
'60 - narrow
'59 - narrow
'56 - wide center w/pith ⊙

Radius B - 1965 - 2006

Trailer Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 9-13-06

Site ID: TRAILER

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: 3 H

Ring Counts/Notes:

J2X Filename: TR1J2X.txt

Number of radii measured: 2

J2X Series Id: TR13HA, TR13HB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. -

Wood Anatomy Change Notes:

Radius A - 1956 - 2005

00's - complacent
'93 - wide
'92 - narrow
'91 - WIDE
'90 - narrower
'88 + '89 - wide
'85 - narrower on 'A'.
'70's - mostly complacent
'68 - wide
'66 + '67 - narrow damage yrs.
'64 - wide
'63 - narrower
'62 - narrow
'60 - very narrow
'58 - wider
+59

Radius B - 1956 - 2005

'57 - very narrow
'56 - center w/pith ⊙

Trailer Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 9-13-06

Site ID: TRAILER

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: 5F

Ring Counts/Notes:

J2X Filename: TR1J2X.txt

Number of radii measured: 2

J2X Series Id: TR15FA, TR15FB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:
[cracked center] sickly wood ?
Radius A - 1965 - 2005 -

Radius B - 1952 - 2005

Looks pretty rooty.

* center looks like 1951 or '50, but only recorded the clearly visible yrs. from 1952 on.

Trailer Trench – Ring Reading Notes

Ring Reader: J.R.

Reading Date: ——

Site ID: TRAILER

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: 7E

Ring Counts/Notes:

J2X Filename: TR1J2X.txt

Number of radii measured: 2

J2X Series Id: ——

Don't J2X.

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

Wood Anatomy Change Notes:

Looks mostly rooty!

Trailer Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: —

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: 8 D

Ring Counts/Notes:

J2X Filename: TR1J2X.txt

Number of radii measured: —

J2X Series Id: —

Don't J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

All root

Trailer Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: —

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: 9C

Ring Counts/Notes:

J2X Filename: TR1J2X.txt

Number of radii measured: —

J2X Series Id: —

Don't J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

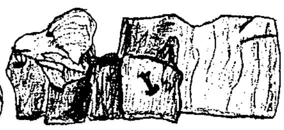
Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

All Root

J.R.
8/2006
Pg. 1 of 2

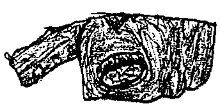
TRAILER TREE I

(7-10cm)  TR-1-0 (3 pieces seperated)

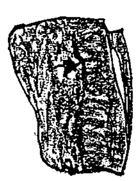
(6-8cm)  TR-1-GS nail = GS

(6-7 cm)  TR-1-2I nail = I

(7-8cm)  TR-1-3H nail = H

(8-9 cm)  TR-1-4

(4-6cm)  TR-1-5F nail = F (on opposite side)

(13-15cm)  TR-1-6

(~5cm)  TR-1-7E nail = E

Cont. →

TRAILER TREE I

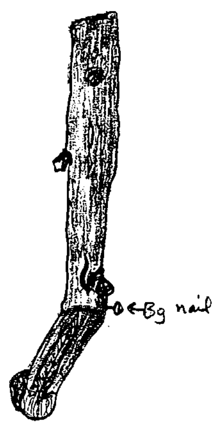
J.R.
8/2006

3.5-4 cm  TR-1-8D nail = D

(~4cm)  TR-1-9C nail = C

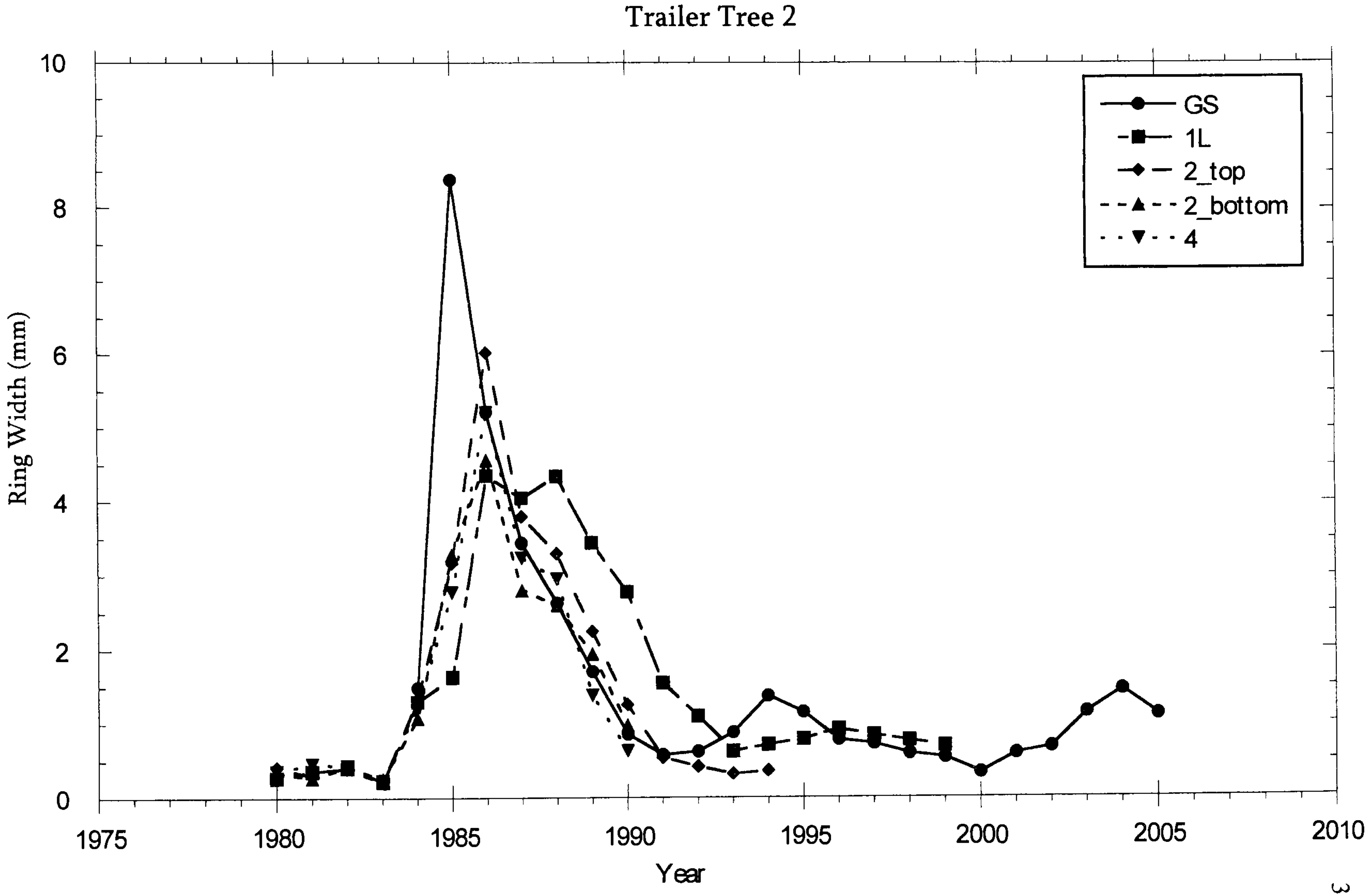
(~4cm)  TR-1-10

(5cm)  TR-1-11

(~45cm) 

TR-1-12 nail = Bg

(~39cm)  TR-1-13 nail = Ag



Trailer Tree 2
Ring Width (mm)
Year
GS
1L
2_top
2_bottom
4
0
2
4
6
8
10
1975
1980
1985
1990
1995
2000
2005
2010

Trailer
[redacted] Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: Sept. 28, 2006

Site ID: TRAILER

Collection Date: May 2006

Tree/Hole ID: 2

Slab ID: GS

Ring Counts/Notes:

J2X Filename: TR2J2X.txt

Number of radii measured: 2

J2X Series Id: TR2GSA, TR2GSB

J.R. - recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radius A - 1984 - 2005

2000 - narrow
'99 - narrow
'94 + '95 - similar
'90 - '92 - very narrow on 'A'
'87 + '88 - similarly wide
'86 - wide

Radius B - 1984 - 2005

'85 - WIDE
'84 - center w/pith ⊙

Trailer
[redacted] Trench – Ring Reading Notes

Ring Reader: J.R.

Reading Date: Sept. 28, 2006

Site ID: TRAILER

Collection Date: May 2006

Tree/Hole ID: 2

Slab ID: 1-L

Top has 2 centers.

Ring Counts/Notes:

J2X Filename: TR2J2X.txt

Number of radii measured: 2

J2X Series Id: TR21LA, TR21LB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - buried after '99.

Wood Anatomy Change Notes:

Radius A - 1980 - 1999

'93-'95 - Smallish
'90 - wide
'86-'89 - WIDE
'85 - narrower

Radius B - 1980 - 1999

'84 - slightly narrower than '85
'83 - very narrow + faint
'81 + '82 - similarly narrow
'80 - small center w/large pith ⊙

Trailer

[redacted] Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: Sept. 28, 2006

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 2

Slab ID: 2 (TOP)

Ring Counts/Notes:

J2X Filename: TR2J2X.txt

Number of radii measured: 2

J2X Series Id: TR22A, TR22B

J.R. - recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Burial after 1990.

Wood Anatomy Change Notes:

Radius A - 1980-1994

'91-'94 - very narrow

'85-'88 - wide

'84 - narrower

'83 - very vessely + narrow

'82-'80 - similarly narrow

Radius B - 1980 - 1991

'80 - is center w/large pith ⦿

Trailer Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: Sept. 28, 2006

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 2

Slab ID: 2 (Bottom) (3 centers)

Ring Counts/Notes:

J2X Filename: TR2J2X.txt

Number of radii measured: 2

J2X Series Id: TR22C, TR22D

J.R. - recorded radii C+D into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - buried after 1990.

Wood Anatomy Change Notes:

Radii C+D - 1980 - 1990

1990 - narrow

'87+'88 - similarly wide

'86 - WIDE

'85 - wide

'84 - narrower

'83 - very narrow

'80 - '82 - similarly narrow

'80 - center w/ Large pith.

Trailer
[redacted] Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: Sept. 28, 2006

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 2

Slab ID: 4

Ring Counts/Notes:

J2X Filename: TRJ2X.txt

Number of radii measured: 2

J2X Series Id: TR24A, TR24B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Buried after 1990.

Wood Anatomy Change Notes:

Radius A - 1980 - 1990

`90 - narrow

`87 + `88 - similarly wide

`86 - WIDE

`85 - wide

Radius B - 1980 - 1990

`84 - narrower

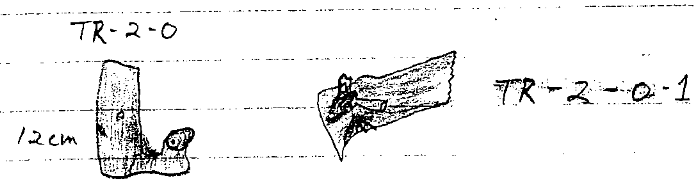
`83 - Very narrow + vessely

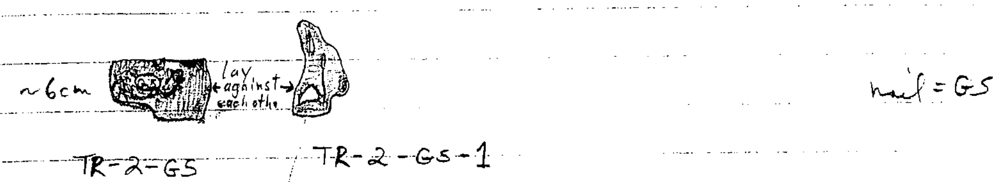
`80 - `82 - similarly narrow

`80 - center w/Large pith ⊙

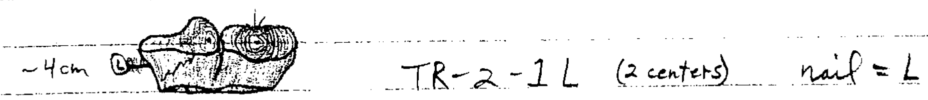
TRAILER TREE 2

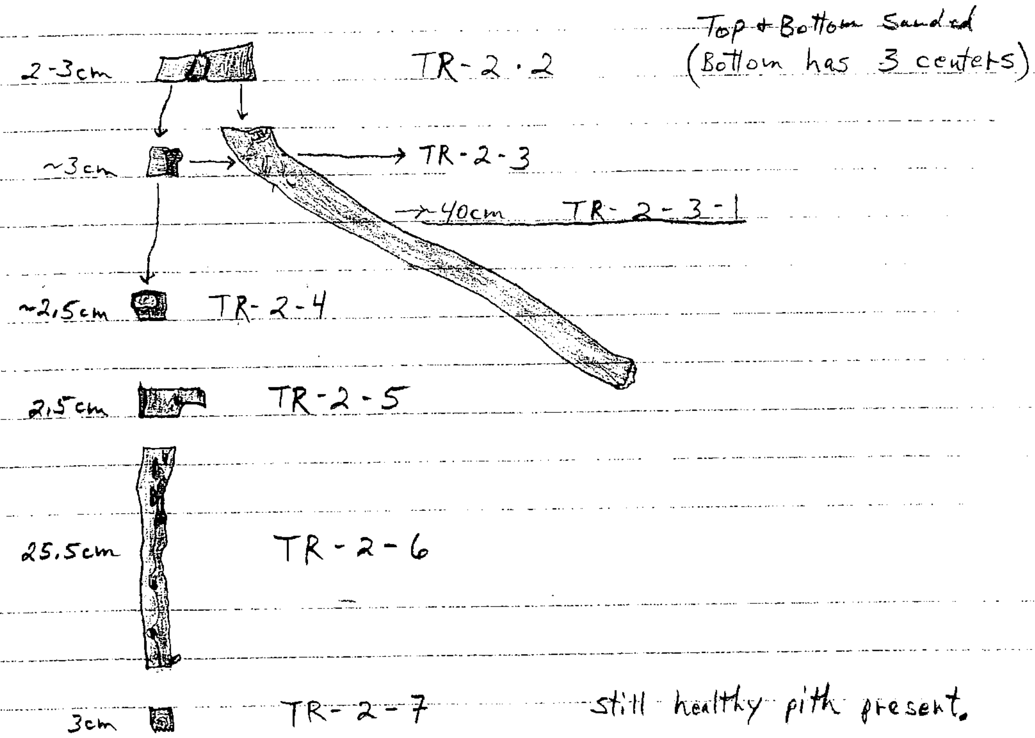
J.R.
9/2006
pg. 1 of 1

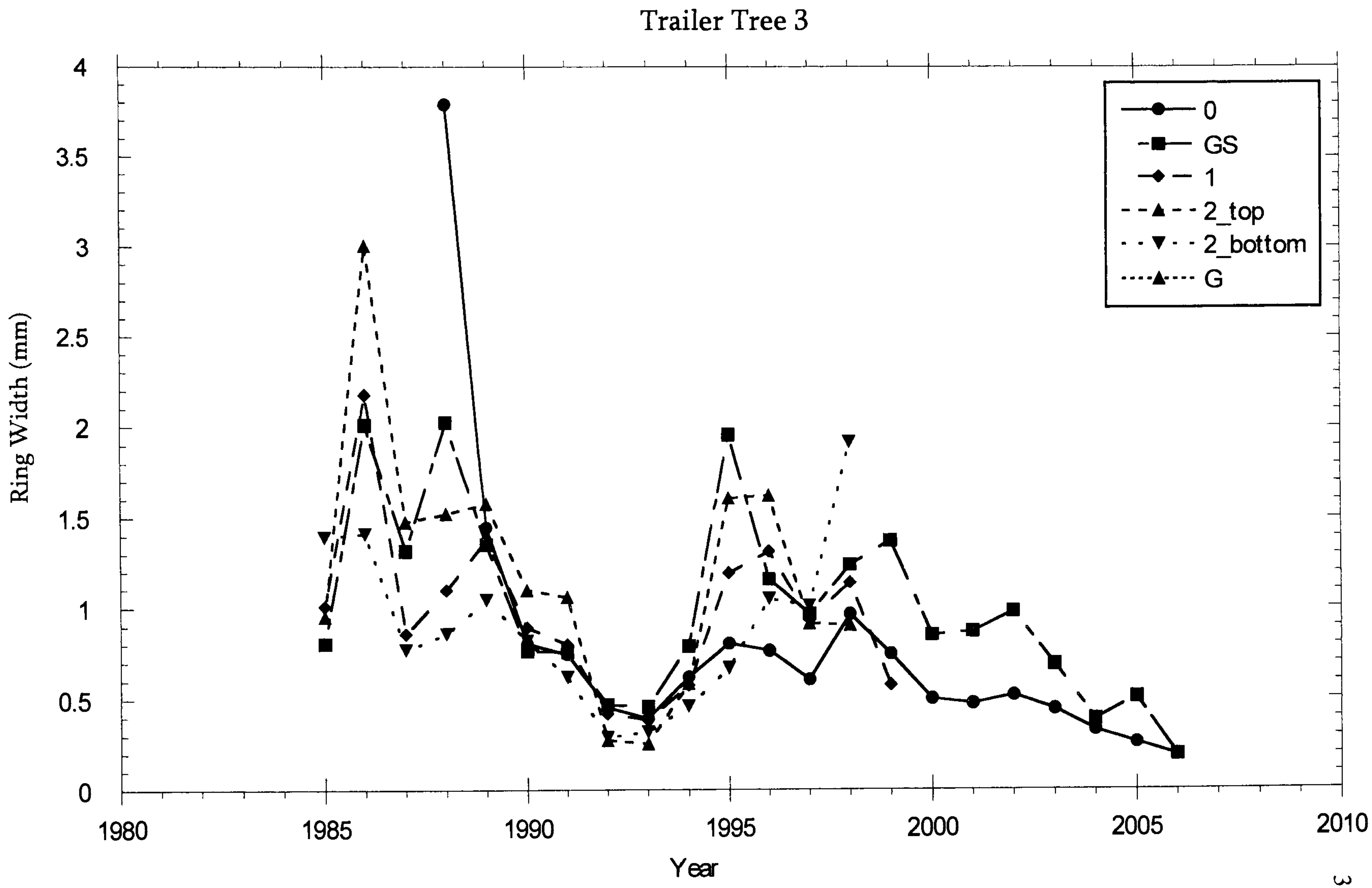




- next piece comes off of back side of TR-2-GS (severe angle), and TR-2-GS-1 also attaches here.






Trailer Tree 3
Ring Width (mm)
Year
0
GS
1
2_top
2_bottom
G
0
0.5
1
1.5
2
2.5
3
3.5
4
1980
1985
1990
1995
2000
2005
2010

Trailer Trench – Ring Reading Notes

Ring Reader: JSA

Reading Date: Sept 14, 2006

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 3

Slab ID: Ø

Ring Counts/Notes:

J2X Filename: TR3J2X.txt

Number of radii measured: 2

J2X Series Id: TR30A, TR30B

J.R. – Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Radius A (1988 - 2006)

01' - 06' - small set (06 - tiny)

98' - wider

92-93' - narrow

89' - wide

88' - wide; center w/pith ⊙

Radius B (1988 - 2003)

99' - 2001 - narrow

97' - wider

93' - narrow

Trailer Trench - Ring Reading Notes

Ring Reader: JSA /

Reading Date: September 14, 2006

Site ID: Trailer Trench

Collection Date: May 2006

Tree/Hole ID: 3

Slab ID: GS

Ring Counts/Notes:

J2X Filename: TR3J2X.txt

Number of radii measured: 2

J2X Series Id: TR3GSA, TR3GSB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Radius 'B' shows some compression in outer '00 yrs.

Wood Anatomy Change Notes:

Radius A (1985-2006)

06' - tiny
04-05' - small pair
98-99' - wider pair
92-93' - narrow pair
88' - wider
86' - wide
85' - narrow ; center w/ pith ⊙

Radius B (1985-2000)

99 - wider
95 - wide
92-93' - narrow pair
88' - wide
85' - narrow

Trailer Trench - Ring Reading Notes

Ring Reader: JSA/ Reading Date: Sept 14, 2006

Site ID: Trailer Collection Date: May 2006

Tree/Hole ID: 3 Slab ID: 1

Ring Counts/Notes:

J2X Filename: TR3J2X.txt

Number of radii measured: 2

J2X Series Id: TR31A, TR31B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial after 1999.

Wood Anatomy Change Notes:

Radius A (1985 - 1999)	Radius B (1985 - 1999)
95' wide	96' - wider
92-93' - narrow pair	92'-93' - narrow pair
88' - wider	89' - wider
86' - wide	86' - wide
85' - center w/ pith ⊙	85' - center w/ pith ⊙

J.R. - I don't know about pith, cuz there's a big pencil TSK, TSK, TSK, blob covering it! Makes it difficult to line up the edge of pith.

Trailer Trench - Ring Reading Notes

Ring Reader: JSA /

Reading Date: Sept 14, 2006

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 3

Slab ID: 2 (top)

Ring Counts/Notes:

J2X Filename: TR3J2X.txt

Number of radii measured: 2

J2X Series Id: TR32A, TR32B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Radius A (1985-1998)
- 96' + 95' - wider
- 92' + 93 - narrow pair
- 89' - wider
- 86' - wide
- 85' - center w/ pith ⊙

J.R. - pith?, Really?,

Radius B (1985-1998)
- 96' + 95' - wide pair
- 92' + 93' - very narrow
- 87-89 - wide side
- 86' - wide
- 85' - center w/ pith ⊙

Trailer Trench - Ring Reading Notes

Ring Reader: JSA / Reading Date: Sept. 14, 2006

Site ID: Tr.W Collection Date: May 2006

Tree/Hole ID: 3 Slab ID: 2 (Bottom)

Ring Counts/Notes:

J2X Filename: TR3J2X.txt

Number of radii measured: 2

J2X Series Id: TR32C; TR32D

J.R. - Recorded radii C + D into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radius C (1985 - 1998)

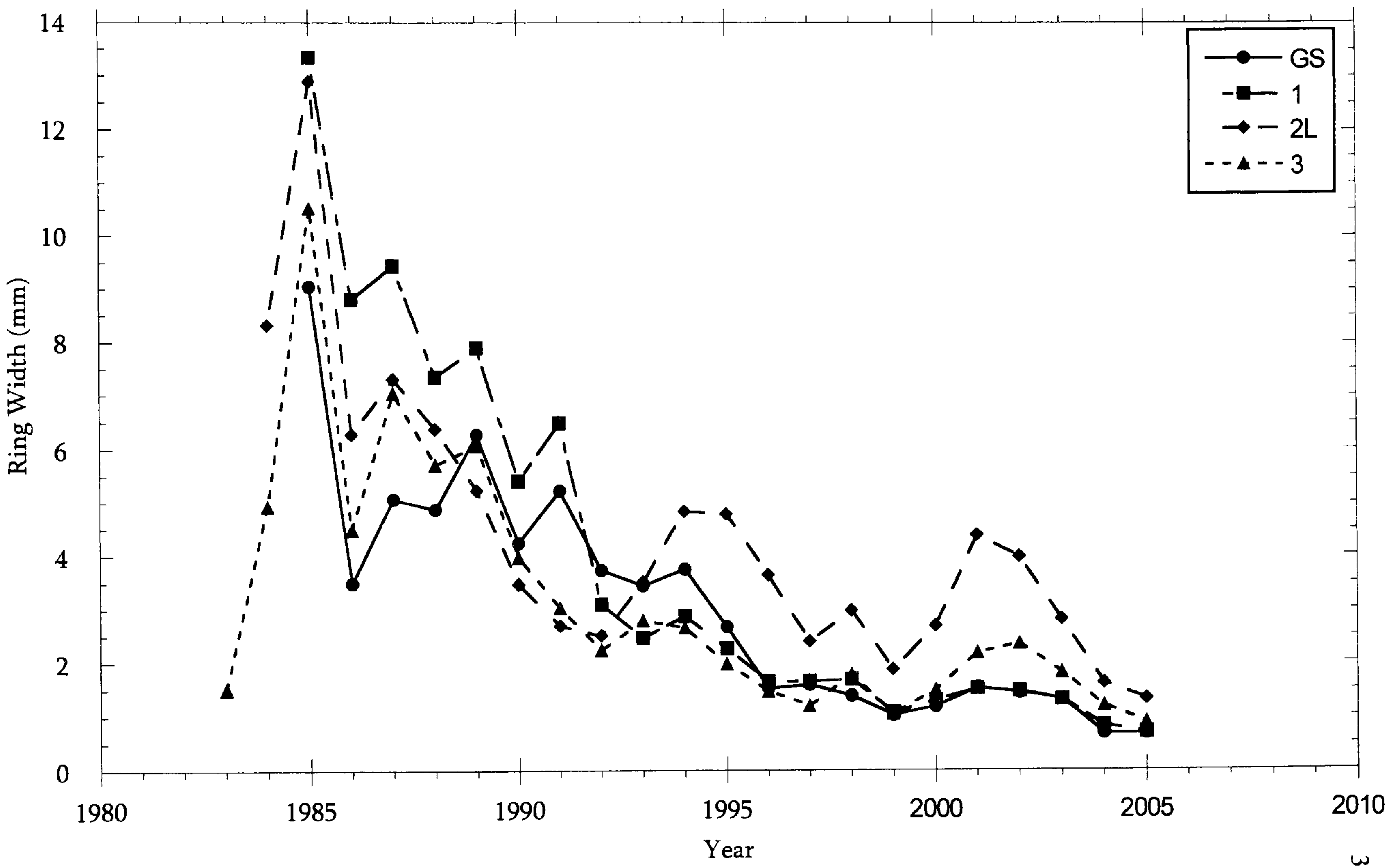
98' - wide
92'-93' - narrow pair
88-90 - wider set
86-87' - narrow set
85' - center (no Pith)
↑ root!

Radius D (1985 - 1991)

89' - wider
86' - wide
85' - center (no Pith)
↑ root

* contact L (next slab) all Root.

Trailer Tree 4



Trailer Trench – Ring Reading Notes

Ring Reader: JSA

Reading Date: Sept

Site ID: TRAILER

Collection Date: May 2006

Tree/Hole ID: 4

Slab ID: GS4

Ring Counts/Notes:

J2X Filename: __________

Number of radii measured: 2

J2X Series Id: __________

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Radius A (1986-2006)

97'-06' – Narrow set
91-95 – Complacent +
88-90 – Wide set
87 – wide springwood w/ False ring
86' – wide; center of pith ⊙

Radius B (1986-1994)

90-92' – complacent
88-89' – wide set
87' – False ring
86' – wide; center of pith ⊙

Trailer Trench - Ring Reading Notes

Ring Reader: JSA

Reading Date: Sept 27, 2006

Site ID: Tsulw

Collection Date: May, 2006

Tree/Hole ID: 4

Slab ID: GS6

* The "6" refers to stem No.

Ring Counts/Notes:

J2X Filename: TR4J2X.txt

Number of radii measured: 2

J2X Series Id: TR4GS6A, TR4GS6B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

Wood Anatomy Change Notes:

Radius A (1985-2005)

98-05' - narrow years
→ 92-94' - complacent
87-89' - complacent
85' - wide; center w/pith ⊙

Radius B (1985-2005)

04-05' - narrow set
99'-05' - narrow
93'-95' - complacent
91' - wide
89' - wide
85' - wide; center w/pith ⊙

Trailer Trench - Ring Reading Notes

Ring Reader: JSA

Reading Date: Sept. 27, 2006

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 4

Slab ID: 1

* This slab is part of slab #1 which is a composite box consisting of multiple stems

Ring Counts/Notes:

J2X Filename: TR4J2X.txt

Number of radii measured: 2

J2X Series Id: TR41A, TR41B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radius A (1985-2005)

04'-05' - narrow
96-03' - Complacent
92-94' - Complacent
91' - wide
89' - wide
85-87 - wide set
85' - wide; center w/pith ⊙

Radius B (1985-2005)

04'-05' - narrow
99'-03' - complacent
93' - narrower
86-89 - complacent + wide

Trailer Trench - Ring Reading Notes

Ring Reader: JSA

Reading Date: 9/27/2006

Site ID: TRAILER

Collection Date: May 2006

Tree/Hole ID: 4

Slab ID: 2 L

Ring Counts/Notes:

J2X Filename: TR4J2X.txt

Number of radii measured: 2

J2X Series Id: TR42LA, TR42LB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radius A (1984-2004)

04-05' - narrower
99' - narrower
97' - narrower
94' - wide
86'-89' - compliant wide
85' - wide
83' - narrow
(center not visible due to rot)
so pith is questionable

Radius B (1984-2005)

04'-05' - narrower
99' - narrower
96' - wide
86'-89' - compliant; wider
85' - wide
83' - narrower - center
(Pith not visible due to rot)

Trailer Trench - Ring Reading Notes

Ring Reader: JSA

Reading Date: 9/27/2006

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 4

Slab ID: 3

Ring Counts/Notes:

J2X Filename: TR4 J2X.txt

Number of radii measured: 2

J2X Series Id: TR43A, TR43B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radius A (1983-2005)

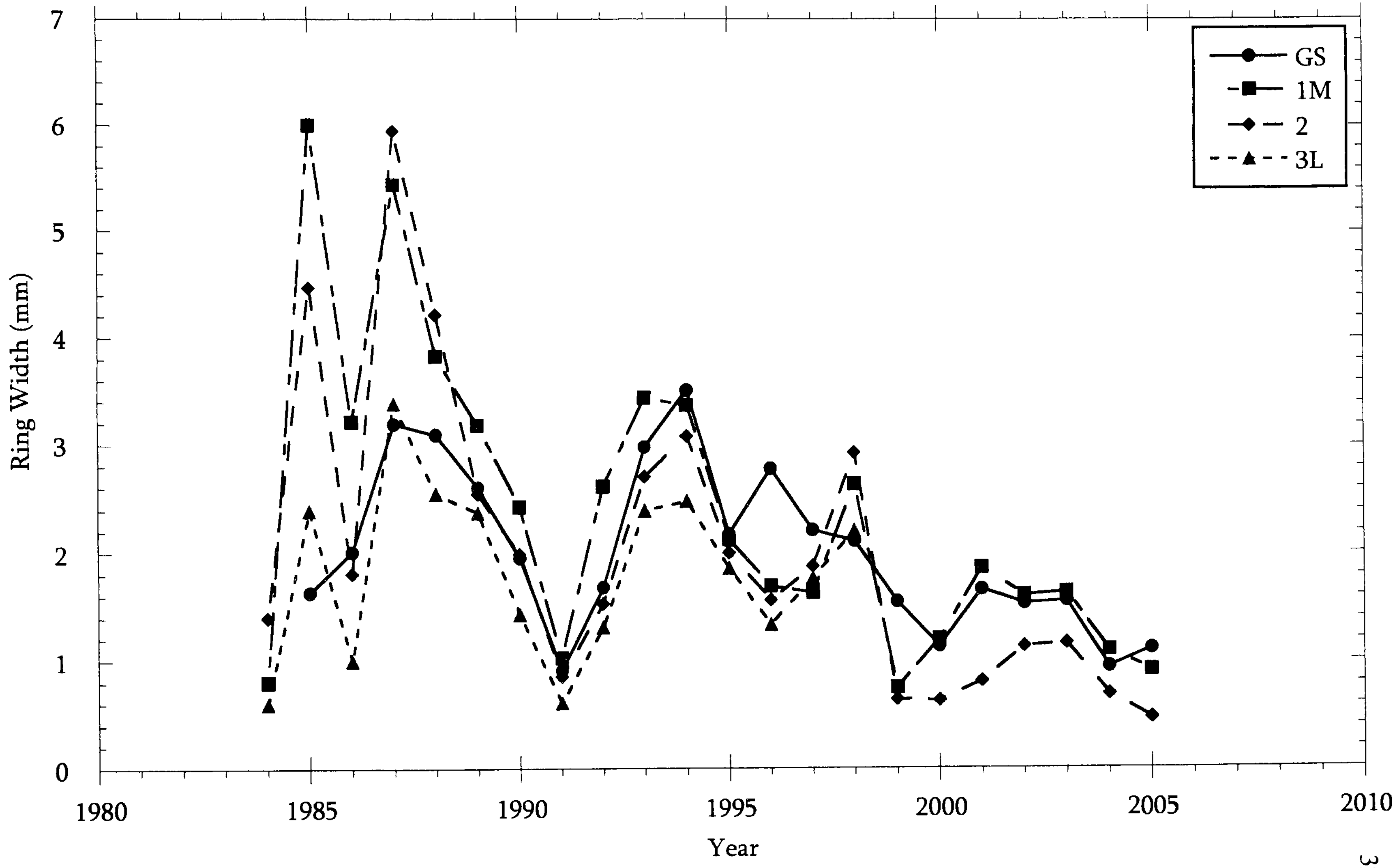
04'-05' - narrowest
99' - narrow
92-97' - complacent
87-89' - complacent; wide
86' - narrow
85' - wide
83' - narrow - Root!

Root!

Radius B (1983-2005)

04'-05' - narrower
99' - narrow
93' - wide
87'-89' - complacent
86' - narrower
85' - wide
83' - narrower - Root!

Trailer Tree 5



Trailer Trench - Ring Reading Notes

Ring Reader: J R.

Reading Date: 9-13-2006

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 5

Slab ID: G S

Ring Counts/Notes:

J2X Filename: TR5J2X.txt

Number of radii measured: 2

J2X Series Id: TR5GSA, TR5GSB

J.R. - Recorded radii A + B J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radius A - 1985 - 2005

2006 - not visible but for a few cells

2000's - narrowish

'98 - bit of false ring

'91 - narrow

'85 - '89 - wide

'85 - center w/pith ⊙

Radius B - 1985 - 2005

'04 - narrow

99 - narrow

95 - narrower

'91 - narrow

'89 - wider

'87 - narrow

'85 - center w/pith

Trailer Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 9-13-06

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 5

Slab ID: 1M (2 centers)

Ring Counts/Notes:

J2X Filename: TR5J2X.txt

Number of radii measured: 2

J2X Series Id: TR51MA, TR51MB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radii A+B - 1984 - 2005 JSA

1999+2000 - narrow on 'A'
'98 - wide w/bit of false ring
'91 - narrow
'85 - '89 - WIDE
'84 - new small center w/pith ⊙

} - Agree

Trailer Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 9-13-2006

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 5

Slab ID: 2

Ring Counts/Notes:

J2X Filename: TK5J2X.txt

Number of radii measured: 2

J2X Series Id: TR52A, TR52B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Wood Anatomy Change Notes:

Radii A + B - 1984 - 2005

2006 - not visible
1999-'05 - all narrow
'98 - wide
'91 - narrow
'86 - narrow
'85 - wide

'84 - small center w/pith?
↳ Not sure that is pith! JSA.

Trailer Trench – Ring Reading Notes

Ring Reader: J.R.

Reading Date: 9-13-2006

Site ID: Trailer

Collection Date: May 2006

Tree/Hole ID: 5

Slab ID: 3L

Ring Counts/Notes:

J2X Filename: TR5J2X.txt

Number of radii measured: 2

J2X Series Id: TR53LA, TR53LB

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. – buried after '96 on 'A' + '98 on 'B'.

Wood Anatomy Change Notes:

Radius A – 1984 – 1996

Radius B – 1984 – 1998

'91 – narrow

'86 – narrow

'84 – center w/ tiny pith?

TRAILER TREES 5

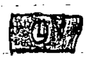
J. Roth
9/2006
Pg. 1 of 1

(~9 cm)  TR-5-0

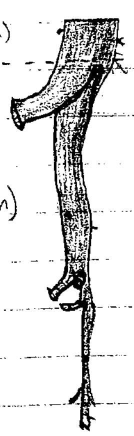
(7 cm)  TR-5-GS nail = GS

(~5.5 cm)  TR-5-1-M nail = M

(~9cm)  TR-5-2

(4 cm)  TR-5-3 -L nail = L

(4 cm)



cut

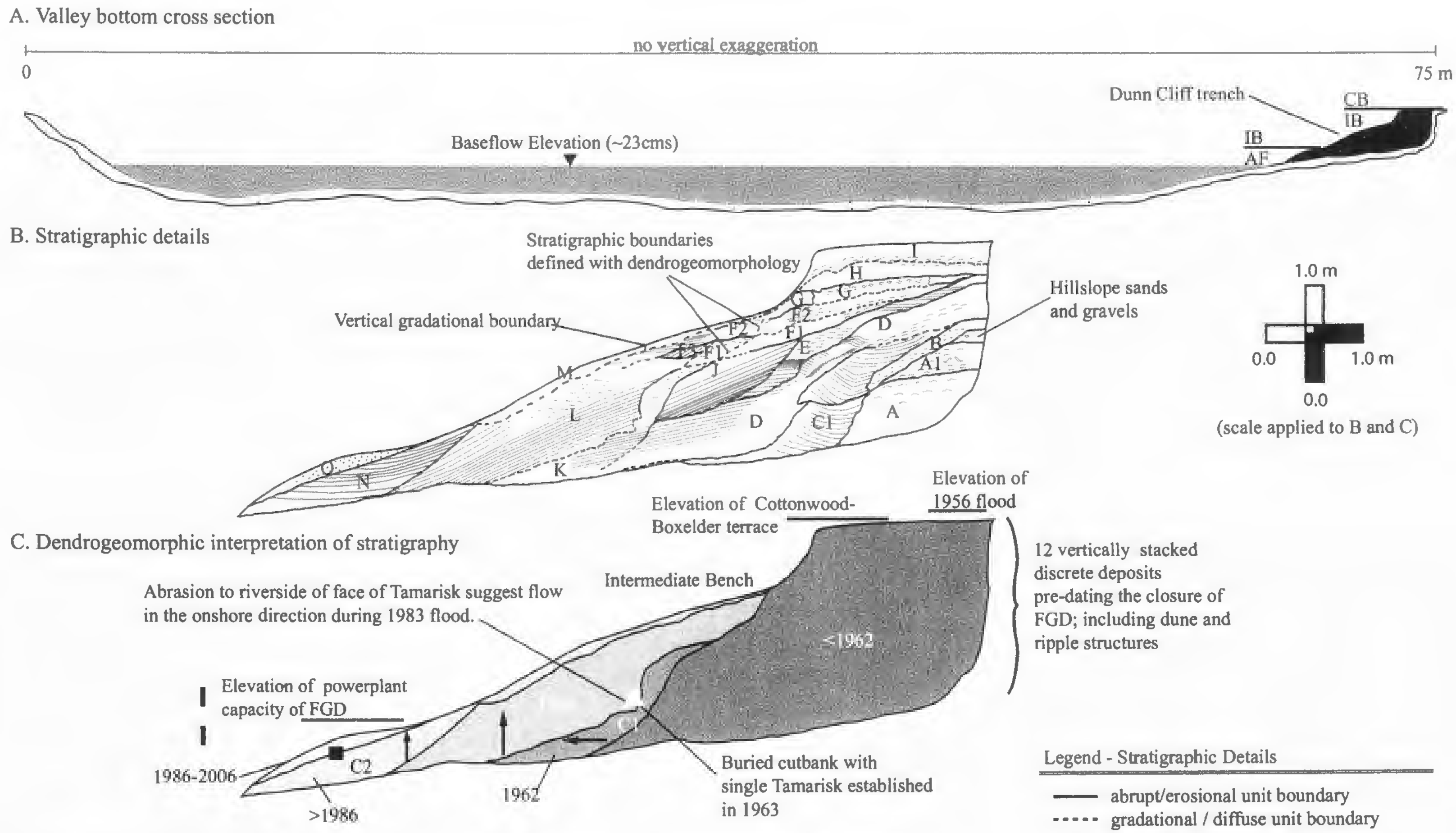
TR-5-4

TR-5-5

(~43cm)

APPENDIX A4

SUPPLEMENTAL STRATIGRAPHIC AND DENDROGEOMORPHIC DATA FOR THE DUNN CLIFF TRENCH



Stratigraphic details of the Dunn Cliff trench excavation; all views facing in the downstream direction. (A) total channel/valley bottom cross sectional profile along trecnh (B) stratigraphic details of floodplain deposits including sedimentary structures, unit contacts, and the location and establishment elevation of the trees used in the dedrogeomorphic analysis (C) dendrogeomorphic interpretation of the age of each stratigraphic deposit and the direction of grain coarsening.

Legend - Stratigraphic Details

- —— abrupt/erosional unit boundary
- - - - - gradational / diffuse unit boundary
- orientation of bedding
- ▲ old Tamarisk est. elevation
- * est. elevation of Tamarisk
- ■ approximate est. elev. of Tamarisk
- / direction of grain coarsening
- X# discrete unit
- BS basal sands
- ▪ ▬ estimated offshore location of eddy fence

Descriptions of stratigraphic units within the Dunn Cliff Excavation

Unit	Description
A	Brown unit which generally coarsens upward from very fine sand to interbedded fine sand and sand; climbing ripple structure near top; basal conact below water table, abrupt upper contact; inclusions of hillslope pebbles of Uinta Mountain Group; D_0 = 9.6 mm; GSD = 2.0
A1	Buff colored unit which generally fines upward from medium/coarse sand with Unita Mountain Group pebbles to fine sand interbedded with medium sand; abrupt basal and top contactsclimbing ripple structure; capped by red hillslope wash deposit; D_{50} = 18 mm; GSD = 1.48
B	Brown unit composed of clay and silt with iron mottling and abrupt basal and upper contacts*
C	Buff colored unit which generally fines upward from fine sand to sand; low-angle thinly laminated ripple and dune trough stratifications indicating upstream/downstream flow directions; abrupt basal and upper contacts; D_{50} = 16 mm; GSD = 1.6
C1	Buff colored unit composed of interbedded coarse, medume and fine sand dune and ripple cross stratification indicating upstream/downstream flow directions; basal contact below water table, upper contact is both abrupt and gradational; unit generally coarsens offshore; D_{50} = 29 mm; GSD = 1.5
D	Brown/buff colored unit which generally coarsens upward and onshore from silts and clays to well sorted very fine and fine sands with climbing ripple structures indication onshore migration direction; upper contact is abrupt, lower contact is both abrupt and gradational*
E	Brown colored unit which generally coarsens upward from silt and very fine sand with climbing ripples to well sorted fine sand with low-angle climbing ripples showing onshore flow direction; abrupt upper and lower boundaries; D_{50} = 7 mm; GSD = 1.9
F1	Brown/gray unit with generally coarsens upward and offshore from a silty-clay to well sorted very fine sand with clibming ripple structure indicating onshore flow direction; upper boundary is both abrupt and gradational and lower boundary is gradational*
F2	Light brown unit which generally coarsens offshore from a very fine sand, silt and clay with climbing ripple structure to interbedded fine sand and sand with low-angle climbing ripples indication onshore flow direction. Basal and upper contacts are generally gradational for their extent; D_{50} = 4.7 mm; GSD = 1.8
G	Buff/brown colored unit which generally coarsens upward from clay/silt/very fine sand with climbing ripples to a well sorted fine sand with climbing ripple structure; gradational basal contact and abrupt upper contact; D_{50} = 7.4 mm; GSD = 1.5
H	Buff/brown unit which coarsens upward from very fine sand/silt/clay with climbing ripples to well sorted fine sand climbing ripple structure indicating onshore flow direction; basal contact is abrupt, upper contact is gradational; D_{50} = 6.4 mm; GSD = 1.7
I	Buff colored unit composed of fine sand with climbing ripple structure indicating both onshore and onshore flow diections; ripples in upper part of unit are bioturbated; lower contact is gradational, upper part of unit is ground surface; D_{50} = 6.8; GSD = 1.6
J	Buff colored unit composed of a coarsening upward sequence grading from very fine sand with some clay and silt into well sorted fine sand; unit has fine laminated low-angle climbing ripple structure with onshore flow direction; abrupt upper and lower contacts; D_{50} = 13 mm; GSD = 1.7
K	Brown/gray unit which generally fines onshore from interbedded fine sand, silt, and clay with ripple structure to silty clay with low-angle climbing ripple structure; ripples indicate onshoree flow directions; basal and upper contacts are abrupt at their onshore locations then become gradational offshore; D_{50} = 7.5 mm; GSD = 1.7
L	Brown/gray unit which generally coarsens upward from interbedded clay/silt/very fine sand to very fine sand with some clay and silt; fine laminations of low-angle climbing ripples span the unit and indicate onshore flow directions; lower contact is generally abrupt but also gradational; upper contact is gradational for its extent; D_{50} = 8 mm; GSD = 1.80
M	Brown colored unit composed of mixed fine sands and duff; bioturbated bedding; basal contact is gradational, upper part of unit is the ground surface; D_{50} = 7.7 mm; GSD =1.7
N	Light brown colored unit which coarsens upward and offshore from very fine sand with some silt and clay to well sorted fine sands; fine laminated, low-angle climbing ripple structure span the unit and indicate onshore flow direction; basal contact is gradational, but shows cross-cutting relationship with L; upper contact is both abrupt and gradational; D_{50} = 14 mm; GSD = 1.5
O	Red/brown colored unit composed entirely of very fine sand with clay and silt; structureless or bioturbated; lower contact is generally abrupt, upper contact is the ground surface with duff; D_{50} = 7.4 mm; GSD = 1.85

* not sampled for grain size

GSD - geometric standard deviation

DUNN CLIFF STAGE DISCHARGE RELATIONSHIP

Water Surface Elevation Data from Grams XS22

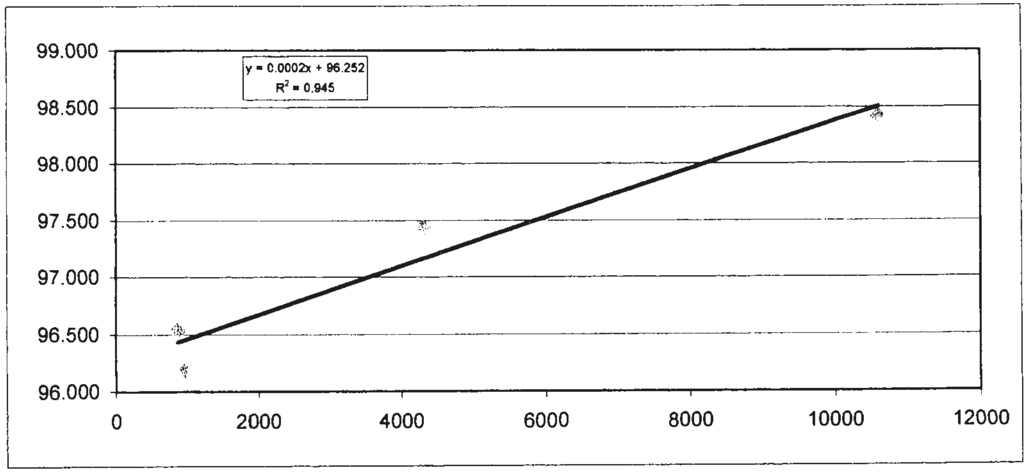
Date	Q (cfs)	WSE (m)
6/29/1990	956	96.18
7/2/1991	4300	97.43
5/10/2002	1600	97.33
8/20/2002	860	96.53

Data used in stage relation for Dunn Cliff XS

Discharge	WSE (m)	Data Source
4300	97.431	Grams
956	96.181	Grams
10600	98.411	Grams
860	96.534	Alexander

Stage from Trench Survey; May 2006

Q (cfs)	Stage (m)	Actual Stage (m)
1600	96.57	5999.43



Stage-discharge data generated using linear fit

Q (cfs)	Stage (m)	Adj. Stage (m)
800	96.41	5999.27
4600	97.17	6000.03
8400	97.93	6000.79
11200	98.49	6001.35
11600	98.57	6001.43
13700	98.99	6001.85
15100	99.27	6002.13
17200	99.69	6002.55
19600	100.17	6003.03
16700	99.59	6002.45
9300	98.11	6000.97
2000	96.65	5999.51
5000	97.25	6000.11

The stage relation at Dunn Cliff is synthesized from two data sets: (1) the stage relation at Gram's cross section 22, which is upstream about 100 ft. and in the same backwater reach and (2) water surface elevation data taken at the trench. The stage relation was generated from data taken by Grams and Alexander at XS22. The stage relation was then used to generate the array of discharges wanted for the trench cross section. The data were then adjusted realtive to the value generated for the 1600 cfs flow by taking the difference between the surveyed value and the value generated from the stage relation.

Jason S. Alexander

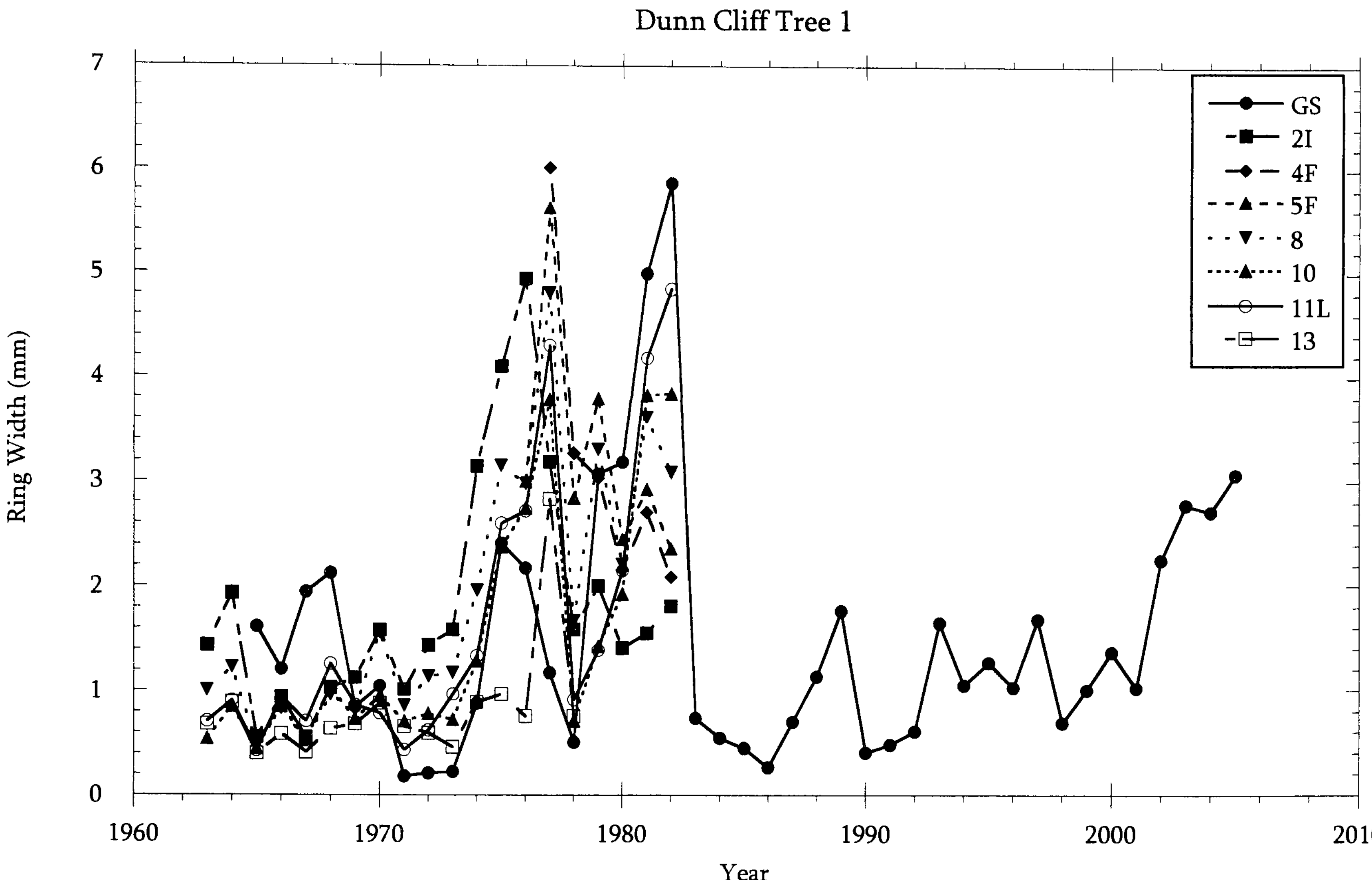
Tamarisk Tree Nomenclature Key for Dunn Cliff Ring Reading Notes

Chapter 2 –Name	Growth Rate Plots and Ring Reading Notes Name
C1	Tree 1
C2	Tree 3

Dunn Cliff Tree Interpretations: from Ring Reading Notes and Stage Discharge Relations- reviewed by Mike L. Scott and Julie Roth.

DC-TREE1 (Established ~1963)
This tree shows establishment near the "L" contact in 1963 as indicated by the absence of pit on the slab below "L" (slab 13). Stage discharge relations show that this elevation was not even close to inundated in 1963, suggesting it established on the remnant 1962 deposit. I put the establishment at the top of "K" because there are no other contacts below, and the stratigraphy in this area indicates that the establishment was on a "cutbank", which would mean that the "K" unit may have been eroded before the "L" unit was deposited. Severe stem injury to the offshore face, the cutbank in "K" and the anatomical and r/w suppression in all slabs up to the "GS" units indicate this tree was deeply buried in 1983. Ring suppression near the GS in 1986, and the establishment of Tree 3 on the "N" surface sometime before 1994 indicate that upper units are younger than 1986.

DC- TREE3 (Established <1994)
This tree was flood trained sometime before 1994 on a surface nearly equivalent to powerplant capacity, but the unit does not indicate deposition from multiple floods (it is continuous). Thus, I will put the age of the unit it established on ("N") as >1986 since it likely was deposited during or immediately after the 1986 flood, the last major flood prior to 1994. Accretion above this point cannot be constrained, so I have designated the unit as deposited between 1986 and 2006.



Dunn Cliff Tree 1
Ring Width (mm)
Year
0
1
2
3
4
5
6
7
1960
1970
1980
1990
2000
2010
GS
2I
4F
5F
8
10
11L
13

Triplet Trench - Ring Reading Notes

Ring Reader: JSA

Reading Date:

Site ID: Triplet (TP)

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: 0-1 (Top) (2+ centers) (Above ground surface)

Ring Counts/Notes:

J2X Filename: TP1J2X.txt

Number of radii measured: 2

J2X Series Id:

NOT J2X'D

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radius A (1972-2005)

98'-02' - narrower
96' - narrower
95' - wider
90'-92' - narrow set
86, 84, 83' - narrow set
82' - wide
79' - wide
78' - narrower
76' - wider
73' - narrower

'72 - injury, maybe center - wood dead

Radius B (1972-2005)

00'-05' - complacent
98' - narrow
95' - wider
90' - very narrow
83-86' - narrow set
82' - wide
78' - very narrow
73' - narrower

Triplet Trench - Ring Reading Notes

Ring Reader: JSA

Reading Date:

Site ID: Triplet (TP)

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: 0.1 (Bottom) (above ground surface)

Ring Counts/Notes:

J2X Filename: TP1J2X.txt

Number of radii measured: 2

J2X Series Id:

NOT J2X'D

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

Radius C (1965-2005)

02'-05' - complacent
98'-01' - narrower set
90-92' - narrow set
89' - wider
83'-87 - narrow + "vessely"
82' - wide
79-82 - wide set
73', 72' - narrow pair
69' - wide
65-68' - complacent
65' - cent w/ pith ⊙

Radius D (1965-2005)

00'-05' - complacent
96' - narrow
94' - narrow
90-92' - narrow set
89' - wider
83-86' - narrow set
82' - wide
78' - very narrow band
76' - wider
71-73' - narrow set
70' - wide
66' - narrow
65' - center w/ pith

Triplet Trench - Ring Reading Notes

Ring Reader: JSA

Reading Date: ~~12/14/~~2006

Site ID: Triplet (TP)

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: GS (Top + bottom Sanded) (multi centered)

Ring Counts/Notes:

J2X Filename: TP1J2X.txt

Number of radii measured: 2

J2X Series Id: TP1GSA, TP1GSB

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Top

Wood Anatomy Change Notes:

Radius A (1965-2005)

- 02'-05' - Complacent
- 98'-99' - narrow pair
- 90'-92' - narrow set
- 86' - really small
- 83-86' - narrow set
- 82' - wide
- 78' - really small
- 71'-73' - really narrow set
- 69' - narrower
- 65' - center w/ pith ⊙

Radius B (1965-2005)

- 02'-05' - complacent
- 98'-02' - narrow set
- 97' - wider
- 90'-92' - narrow set
- 83'-87' - narrow set
- 82' - wide
- 78' - narrow very
- 71'-74' - very small - not readable
- 69'-70' - narrow
- 65-68' - complacent
- 65 - center w/ pith ⊙

Triplet Trench - Ring Reading Notes

~~Ring Reader:~~ JSA

~~Reading Date:~~ ~~7/~~14/06

Site ID: Triplet (TP)

Collection Date: May 2006

Tree/Hole ID: 1

Slab ID: 2 I

Ring Counts/Notes:

J2X Filename: TP1J2X.txt

Number of radii measured: 2

J2X Series Id: TP12IA, TP12IB

J.R.: Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Burial after '82

Wood Anatomy Change Notes:

Radius A (1963 - 1982)

- 82' - wider
- 76' - wide - injury?
- 71' - narrower
- 67' - narrow
- 65' - narrow
- 64' - wide
- '63 - center ⊙ some rot

Radius B (1963 - 1982)

- 80'-82' - complacent
- 76' - wide - injury?
- 74'-76' - wide set
- 70'-75' - complacent
- 67' - narrow
- 65' - narrow
- 64' - wide
- '63 - center ⊙ some rot

Triplet Trench - Ring Reading Notes

~~Ring Reader:~~ J.R.

~~Reading Date:~~ 12/14/06

Site ID: Triplet (TP)

Collection Date: May 13, 2006

Tree/Hole ID: 1

Slab ID: 4 F 2
(pieces broken + Tied together)

Ring Counts/Notes:

J2X Filename: TP1J2X.txt

Number of radii measured: 2

J2X Series Id: TP14F2A, TP14F2B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. Burial after 1982.

Wood Anatomy Change Notes:

center rotted out!

Radii A + B - 1977 - 1982

'77-'79 - wide

'80-'82 - narrower

Triplet Trench - Ring Reading Notes

~~Ring~~ Reader: J.R.

~~Reading~~ Date: 12/14/06

Site ID: Triplet (TP)

Collection Date: May 13, 2006

Tree/Hole ID: 1

Slab ID: 5F1

Ring Counts/Notes:

J2X Filename: TP/J2X.txt

Number of radii measured: 2

J2X Series Id: TP15F1A, TP15F1B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

J.R. - Burial after '82.

Wood Anatomy Change Notes:

Center rotted out!

Radius A (1976 - 1982)

Radius B (1977 - 1982) '82 - narrow on 'B'.

Triplet Trench – Ring Reading Notes

Ring Reader: J. R.

Reading Date: 12/14/06

Site ID: Triplet (TP)

Collection Date: May 13, 2006

Tree/Hole ID: 1

Slab ID: 8

Ring Counts/Notes:

J2X Filename: TP1J2X.txt

Number of radii measured: 2

J2X Series Id: TP18A, TP18B

J.R. – Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. – Burial after '82.

Wood Anatomy Change Notes:

Radius A – 1963 – 1982 Radius B – 1963 – 1982

Center cracked, but possible pith.

1981 – wide

'78 – narrow

'77 – wide

'75 + 76 – similarly wide

wood Δ after '76.

'65 – narrower

'64 – wide

'63 – center

Triplet Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 12/14/06

Site ID: Triplet (TP)

Collection Date: May 13, 2006

Tree/Hole ID: 1

Slab ID: 10

Ring Counts/Notes:

J2X Filename: TP/J2X.txt

Number of radii measured: 2

J2X Series Id: TP110A, TP110B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

J.R. - Buried after 1982

Wood Anatomy Change Notes:

Radii A+B (1963-1982)

1981 - wide
'78 - narrow
'77 - wide
'75 & 76 - similarly wide
anatomy Δ after '76.

'67 - narrow
'66 - wider
'65 - narrower
'64 - wide
'63 - center pith? si
60's & 70's compressed.

Triplet Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 12/12/06

Site ID: Triplet (TP)

Collection Date: May 13, 2006

Tree/Hole ID: 1

Slab ID: 11L
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X Filename: TP1J2X.txt

Number of radii measured: 2

J2X Series Id: TP111LA, TP111LB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:
Start Year:	Stop Year:	Proportion:

J.R. - Buried after 1982.

Wood Anatomy Change Notes:

Top (pith on top + bottom)

Radii A + B (1963-1982)

63 - center of tiny pith

Triplet Trench – Ring Reading Notes

~~Ring Reader~~: J.R.

Reading ~~Date~~: 12/14/06

Site ID: Triplet (TP)

Collection Date: May 13, 2006

Tree/Hole ID: 1

Slab ID: 13
(Top + Bottom Sanded)

Ring Counts/Notes:

J2X Filename: TP1 J2X.txt

Number of radii measured: 2

J2X Series Id: TP113A, TP113B

J.R. – Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

Start Year: ____ Stop Year: ____ Proportion: ____

J.R. – Burial after '77 + '82.

Wood Anatomy Change Notes:

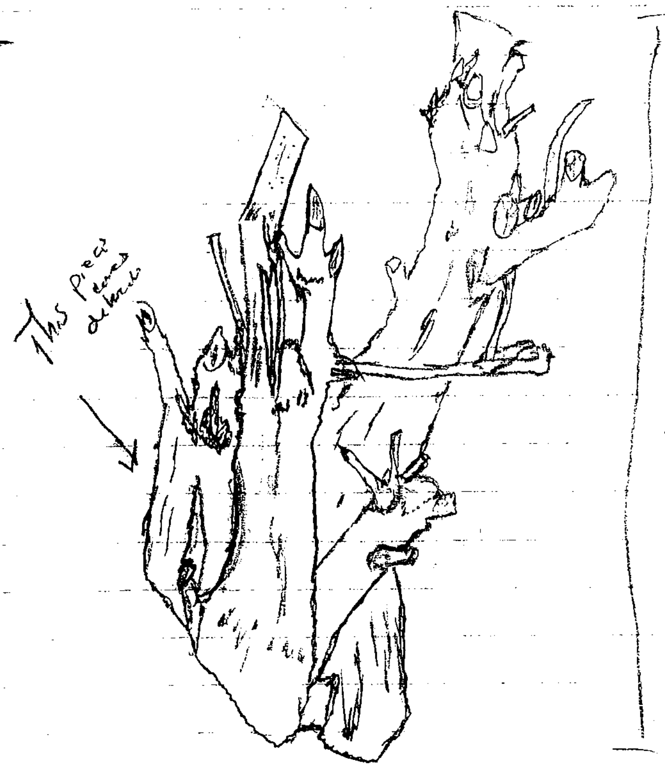
~~Top~~ Radii A + B (1963 – 1978)
Mostly rooty
center is '63 w/tiny pith.

Bottom
all Root

Triplet Trench - Tree #1

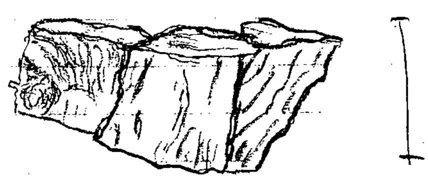
Collected - May 2006

Page 1 of 3



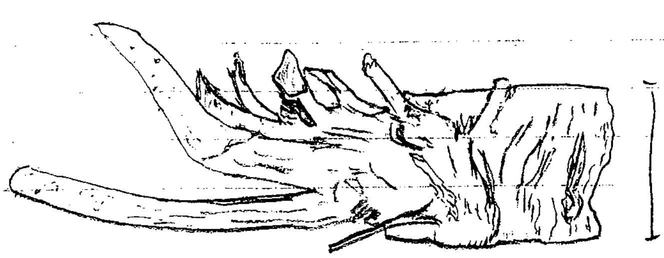
~45cm

TP.1-0



6-9cm TP.1.0.1

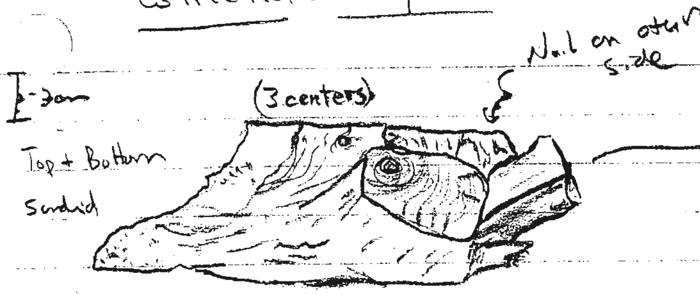
Top + Bottom Sanded

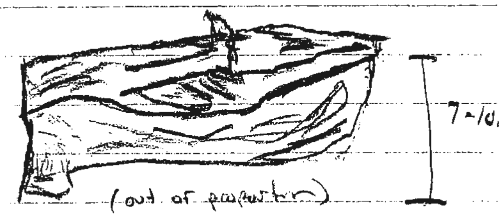


10cm TP1.0.2

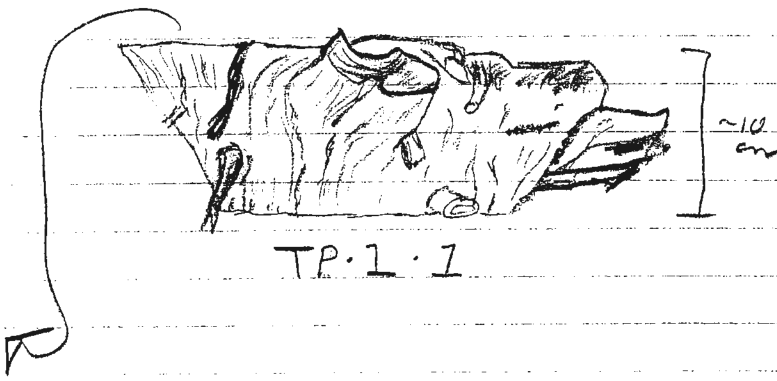
Triplet Trench - Tree #1

Collected - May 2006



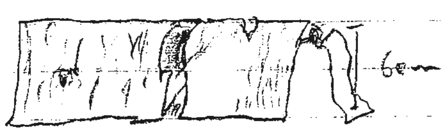


TP1·65 TP·1·65 (detached side stem)

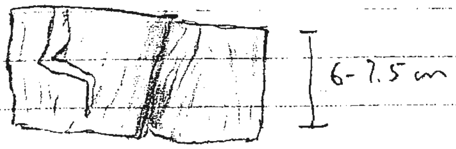


TP·1·1

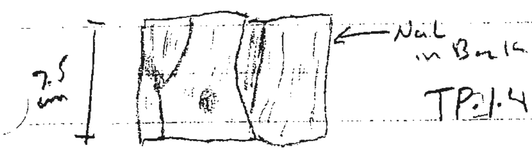
TP·1·1



TP·1·2I
(Top·Sanded) Center Rotted



TP·1·3



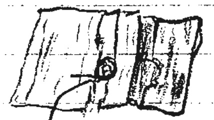
TP·1·4·F2 (top Sanded) Center rotted out!

Triplet Trench - Tree #1

Collected - May 2006

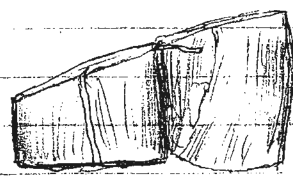
Page 3 of 3

I ~3cm

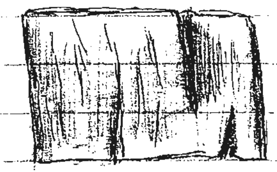


~6cm TP.1.5.F1 (Top Sanded Center Rotted out)

Nail For F1

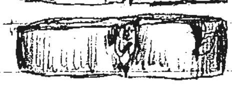


4-8cm TP.1.6 (Rot diminishing)

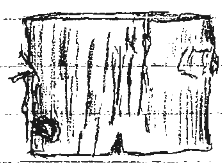


9cm TP.1.7

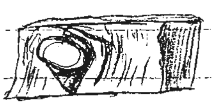
4.5cm TP.1.8 (top Sanded) → center intact but cracked.



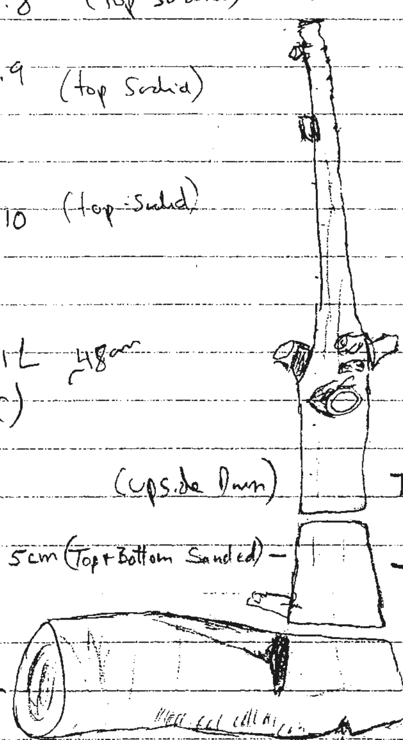
~3cm TP.1.9 (top Sanded)



8cm TP.1.10 (top Sanded)



4cm TP.1.11L ~48cm (top + Bottom Sanded)

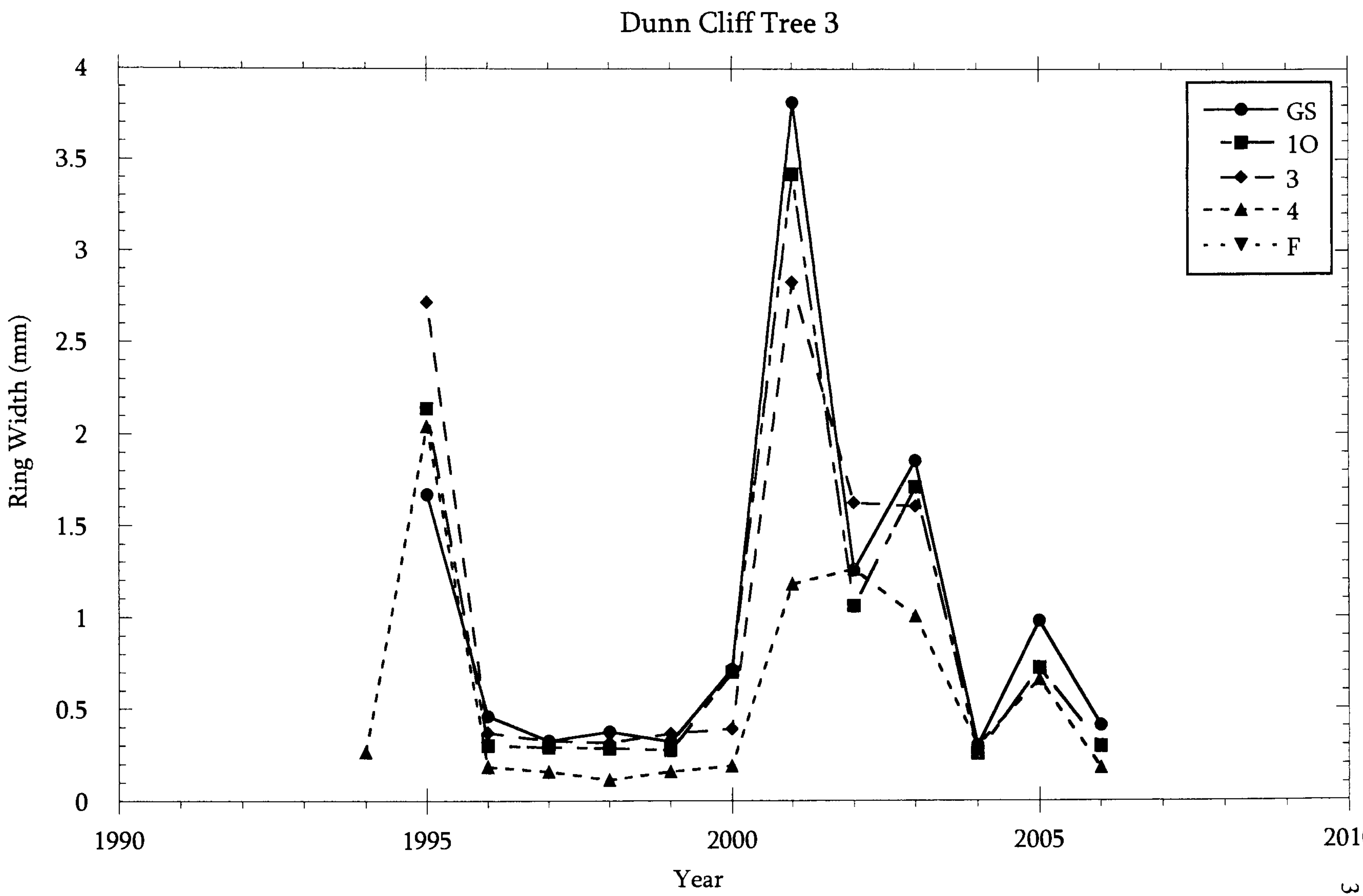


(upside Down) TP.1.14

5cm (Top + Bottom Sanded) – TP.1.13

TP.1.12

Top


Dunn Cliff Tree 3
GS
1O
3
4
F
Ring Width (mm)
0
0.5
1
1.5
2
2.5
3
3.5
4
1990
1995
2000
2005
2010
Year

Triplet Trench - Ring Reading Notes

~~Ring Reader~~: J.R.

~~Reading Date~~: 12-29-06

Site ID: Triplet (TP)

Collection Date: May 2006

Tree/Hole ID: 3

Slab ID: GS

Ring Counts/Notes:

J2X Filename: TP3J2X.txt

Number of radii measured: 2

J2X Series Id: TP3GSA, TP3GSB

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radii A + B (1995 - 2006)

'06 - narrow

'05 - wider

'04 - narrow

'01 - '03 - wide

'96 - 2000 - narrow

'95 - wide center w/teeny pith.

Triplet Trench - Ring Reading Notes

~~Ring~~ Reader: J.R.

~~Reading~~ Date: 12-29-06

Site ID: Triplet (TP)

Collection Date: May 2006

Tree/Hole ID: 3

Slab ID: 1-0 (Top Sanded)

Ring Counts/Notes:

J2X Filename: TP3J2X.txt

Number of radii measured: 2

J2X Series Id: TP310A, TP310B

J.R. - Recorded radii A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radii A + B (1995-2006)

'06 - narrow
'05 - wider
'04 - very narrow
'01-'03 - wide
'96-'99 - narrow
'95 - wide center w/pith

Triplet Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 12-29-06

Site ID: Triplet (TP)

Collection Date: May 2006

Tree/Hole ID: 3

Slab ID: 3 (2 centers)

Ring Counts/Notes:

J2X Filename: TP3J2X.txt

Number of radii measured: 2

J2X Series Id: TP33A, TP33B

J.R. - Recorded radius A + B into J2X.

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Wood Anatomy Change Notes:

* New center appears 1 yr. older than previous center.

Radius A+B 1995 - 2003

'96 - 2000 - narrow

'01 - '03 - wide

'95 - wide center w/pith

Triplet Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date: 12-29-06

Site ID: Triplet (TP)

Collection Date: May 2006

Tree/Hole ID: 3

Slab ID: 4

Ring Counts/Notes:

J2X Filename: TP3J2X.txt

Number of radii measured: 2

J2X Series Id: TP34A, TP34B

J.R. - Recorded radii A+B into J2X.

Proportion of circumference with secondary growth:

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Start Year: ______ Stop Year: ______ Proportion: ______

Wood Anatomy Change Notes:

Radii A + B (1994 - 2006)

'06 - Tiny (1 row)
'05 - wider
'04 - very narrow
'01-'03 - wide

'96-2000 very narrow
'95 - WIDE

'94 new center w/pith

Triplet Trench - Ring Reading Notes

Ring Reader: J.R.

Reading Date:

Site ID: Triplet (TP)

Collection Date: May 2006

Tree/Hole ID: 3

Slab ID: 5N

Ring Counts/Notes:

J2X Filename:

Number of radii measured:

J2X Series Id:

NO J2Xing

Proportion of circumference with secondary growth:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

Start Year: Stop Year: Proportion:

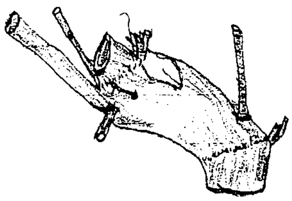
Wood Anatomy Change Notes:

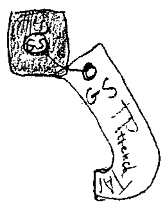
— Contact 'N' was viciously run through w/a nail. The area just above 'N' is no older + has pith.

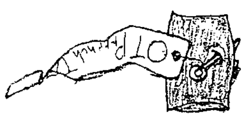
— The end of the stem also still has pith. and is no older than 1994.

TRIPLET TREE 3

J.R.
Dec. 2006
Pg. 1 of 1

~11cm  TP-3-0

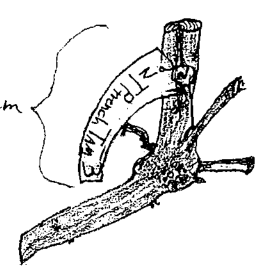
~2.5cm  TP·3·GS (Top Sanded)

~3cm  TP·3·1·0 (Top Sanded)

~5cm  TP-3-2

 TP-3-3 (Top Sanded - 2 centers)

3.5cm  TP·3·4

~9cm  TP·3·5N (Top + Bottom Sanded)