Restoration of Degraded Riparian, Wetland, and Deltaic Environments on Mill Creek, Mono County, California

Report to

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Introduction

With a length of ~13 miles and an average annual flow of approximately 22,000 acre feet, Mill Creek is the third largest stream in the Mono Basin. It heads at the Sierran crest, and flows eastward over the bedrock of Lundy Canyon, then over glacial and deltaic sediments to Mono Lake.

Since before the early 1880s water has been diverted from Mill Creek, initially for irrigation, and later (beginning in 1905) for hydropower generation. These diversions have had a substantial impact on the lower ~11,000 feet of the stream, destroying much of the vegetation, and transforming the multi-channeled "Mill Creek bottomlands" into a single-channeled system.

The lowermost 5000 feet of the stream has been further impacted since the 1940s, when Mono Lake began to fall in response to the trans-basin diversion of Rush and Lee Vining creeks by the Department of Water and Power (DWP). This drop in base level, totaling 45 vertical feet by 1982, forced Mill Creek to incise its exterior delta, creating two elongate trenches up to 10 feet deep.

This report documents the history of diversion-induced impact to Mill Creek; it examines the measures that could be taken to restore the riparian and wetland environments of the Mill Creek bottomlands; and it proposes measures to maximize hypopycnal-ria-type waterfowl habitat on the incised exterior delta of Mill Creek.

Environmental Setting

Hydrologically, geologically, and geomorphologically Mill Creek is divisible into three reaches: a bedrock canyon of approximately 9.25 miles (~49,000 feet), composed of crystalline rocks of the Sierra Nevada; a "Pleistocene delta" reach of approximately 3.45 miles (18,200 feet), the bed of which is underlain alternately by permeable gravels and relatively impermeable lacustrine silts; and a "Holocene delta" reach of approximately 2.15 miles (~11,200 feet), underlain by permeable cobbles and gravels. This latter reach is further divisible into an "interior delta" (length ~ 7800 feet), and an "exterior delta" (length ~ 5000 feet).

<u>The bedrock reach (Lundy Canyon)</u>. Mill Creek heads in a cirque at the crest of the Sierra Nevada. It flows eastward over the glacially scoured bedrock of Lundy Canyon for approximately 49,000 feet, exiting the canyon mouth at elevation ~7200 feet (approximately 3.25 miles downstream from Lundy Dam). Hydrologically, this bedrock reach is the most productive portion of the catchment, receiving roughly 85% of the watershed's precipitation. Lundy Canyon thus generates the great bulk of the water for the lower two reaches. It is the stream's sole gaining reach, and the only reach characterized by tributaries (including the perennial Deer Creek, and numerous unnamed intermittent water courses). A primary feature of this reach is Lundy Lake, a natural water body dammed by recessional moraines of the Tioga glacial advance.

Glaciation during Late Pleistocene time eroded most of the soil and sediment mantle from Lundy Canyon, leaving only a small potential for storing groundwater. This small storage potential, coupled with the marked seasonality of precipitation and runoff, contributes to a strong season-to-season variation in the natural flow regime of Mill Creek. Unimpaired flows measured immediately downstream from Lundy Lake typically reach an annual maximum between late May and early July (average monthly flow for June = 89 cfs), and then decline to a base flow (averaging 14 $\pm$ 4 cfs) between September and late April[1] (FW Env. Corp, 1995; Perrault, 1995).

<u>The Pleistocene Delta Reach</u>. Mill Creek debouches from its bedrock canyon at an elevation of ~7200 feet. For the next 3.45 miles it flows eastwardly through a narrowly incised late Pleistocene delta over a bed of alternating coarse-alluvial and fine-lacustrine sediments. Aerial photos and field observations indicate that this Pleistocene Delta Reach of Mill Creek was characterized over most of its length by a single channel lined with a narrow band of riparian vegetation (mainly willows, cottonwoods, aspens, and Jeffrey pines). Only locally did the stream braid into

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[1] A gain ("accretion") of 3 to 10 cfs occurs downstream of this gauge in the lower portions of the bedrock reach (EBASCO, 1995). Thus, both the base flow and the average monthly maximum flow at the foot of the bedrock reach are slightly higher than the figures given above.

multiple channels. Observations made since 1980 leave no doubt that water seeps to the ground along this portion of the stream, with an estimated loss of perhaps 2-4 cfs over the length of the reach.

The Holocene Delta Reach--Mill Creek's interior and exterior delta. At elevation ~6630 feet the narrow, eastward-trending gorge of Mill Creek begins a sweeping bend to the south, and becomes progressively wider along its bottom. For purposes of this report, this change in valley orientation and width at elevation ~6630 feet marks the boundary between Mill Creek's Pleistocene Delta Reach and its Holocene Delta Reach. The Holocene Delta Reach stretches 2.45 miles to Mono Lake.

The downstreamward widening of the canyon bottom beginning at ~6630 feet is the result of Holocene deltaic sedimentation on Mill Creek. Simply put, progradation (lengthening) of Mill Creek resulting from the construction of its "exterior delta" (stretching from the county road to Mono Lake, a distance of ~5000 feet) has instigated agradation or backfilling into the Mill Creek canyon, creating the stream's "interior delta" (stretching from the county road upstream to the aforementioned bend, a distance of ~7800 feet). Under natural conditions, this interior delta, like all active interior deltas, was characterized by multiple channels, or "distributaries". These narrow channels distributed the stream flow widely across the valley bottom, creating a "bottomlands environment" characterized by wooded wetlands. Riparian woodland was common along these narrow distributaries, and on the interfluves that separated them, as evidenced by the dead snags that remain abundant on the ground today.

History of Diversions

By the late 19th century irrigation interests were diverting water from the upper two reaches of Mill Creek by way of ditches. The highest of these irrigation diversions--the Upper Conway Ditch--tapped the left bank of Mill Creek at an elevation of ~7520 feet. It irrigated lands near the present-day site of the Lundy Power Plant, and near the base of the Bodie Hills. Approximately 1.5 miles farther downstream, near the boundary between the Bedrock Reach and the Pleistocene Delta Reach (elevation of 7185 feet), the Upper Thompson Ditch bifurcated from the right bank of Mill Creek, transporting water east- and southward to the Thompson Ranch (now DWP lands) near Dechambeau Creek. At slightly lower elevation (~7080 feet) the Lower Conway Ditch diverted water from the left bank of Mill Creek toward the Conway and Dechambeau ranchlands to the north and east. The right bank was again tapped at elevation 6920 feet by the Thompson Main Ditch. The lowest of the Mill Creek ditches, the "McGahn Ditch", departed from the stream's left bank at an elevation of 6650 feet, approximately 1 mile downstream from the Highway 395 stream crossing. It watered an ~80-acre parcel of land (now owned by DWP) lying between Mill and (present-day) Wilson creeks.

In 1905 the predecessors to Southern California Edison constructed a power generating facility (the "Jordan Power House") at a site north of Mill Creek (and indeed beyond the boundary of the Mill Creek watershed). Shortly after its construction, this facility was obliterated by an avalanche. It was replaced in 1911 by the Lundy Power House (Vorster, pers. com., 1995).

As part of this hydroelectric project, a dam was built on Lundy Lake that raised the outlet by ~37 vertical feet (from elevation 7766 feet to 7803 feet). This dam was constructed near the mouth of Deer Creek, and was intended to capture the flow of that main tributary.[1] The stored water is diverted from near the Lundy Dam into an aqueduct and penstock that feeds the powerhouse. This facility has the capacity to accommodate a diversion of up to 70.6 cfs (Perrault, 1995).

Following completion of the Lundy Dam, Southern California Edison and its predecessors in all but the wettest years diverted the bulk of water from the Mill Creek watershed into the power plant. Once through the plant and into the tailrace, the flow was split: a high percentage was directed into the Conway-Dechambeau ditch system (this rendered unnecessary the direct off-stream diversions at the Upper Conway Ditch and the Conway-Dechambeau Ditch); the relatively small (and occasional) remainder entered a newly constructed return ditch that carried the water back to Mill Creek, ensuring a supply to downstream diverters.

[1] Sometime between 1956 and 1968 Deer Creek shifted eastward on its alluvial fan, so that today it enters Mill Creek immediately below the dam. This flow is typically taken up by downstream irrigation interests.

Throughout Mill Creek's upper two reaches, dewatering due to irrigation and hydropower diversions was rare. Accretion below Lundy Dam, together with minor seepage from the dam and small obligatory releases to downstream diversion interests, kept this portion of the stream perennially watered. As a result, riparian vegetation has remained largely intact, protecting the streambanks from wholesale erosion.

Degradation of the Mill Creek Bottomlands

In contrast to Mill Creek's upper two reaches, which were seldom devoid of flow, the lower reach of the stream was frequently dewatered. Death of the riparian vegetation appears to have come early (possibly even before the turn of the century), so that by 1929, when the first aerial photos of the Mono Basin were produced, most of the riparian stand had already been lost. Today, long-dead remnants of trees and shrubs testify to the once-widespread woodland.

The 1929 photos also show the geomorphological consequences of this vegetation degradation: Much of the system of multiple channels has been abandoned, and the single existing channel is in the process of being widened over some segments. Further channel degradation, including overwidening along lengthy new segments, is evident on the 1940 photos (presumably this more recent degradation occurred during the high-runoff year of 1938). Later photos show that by 1955 nearly the entire reach has been transformed into a straight, wide wash with little to no channel definition.

Beginning in the early 1960s a series of natural and artificial events conspired to force the frequent watering of Mill Creek's lowest reach. In September of 1961 the Lundy Powerhouse was damaged, apparently by a landslide. The facility remained inoperative over the ensuing 7 years, during which time a diminished amount of water was diverted to the Conway-Dechambeau lands. As a consequence, Mill Creek carried flow during most of the months of that period. Following the powerhouse repair, the stream received flow during the peak snowmelt times of numerous normal to wet years: 1969, '73, '74, '78, '80, '82, '83, '84, '86, '93, and '95. As a consequence of these releases, riparian vegetation, though largely confined to the active wash, is more abundant today than it has been at any time during the past 65 years. The stream channel, however, remains wide and ill-defined along most of its length. While braiding across the wash is evident in numerous places, there is no indication of a return to a system of narrow distributary channels.

Restoring the Mill Creek Bottomlands

Introduction. Many of the narrow distributary channels that characterized the Mill Creek bottomlands under natural conditions are still in existence. Their heads are typically plugged by sediment generated during the periods of erosion-induced widening of the existing channel.

Rewatering these channels would accomplish the following:

- distribute streamflow widely across the valley bottom
- raise the water table across the valley bottom
- promote ponding in the numerous natural depressions
- promote growth of riparian vegetation across the valley bottom by dispersing seeds, raising the water table, and providing natural irrigation

The abandoned channels: Delineation. The abandoned channels of the Mill Creek bottomlands were mapped during the late summer and early fall of 1995. That map is included here as Figure 1. Descriptions of the channels are provided in Table 1. A discussion of the channels follows.

The abandoned channels: Discussion. The multiple channels of the Mill Creek bottomlands were abandoned when the loss of vegetation destabilized the channel banks. This loss of bank stability not only caused the stream to cut a new, straighter path at weakened meander points, but it also mobilized sediment which then clogged the entrance of the distributaries. Thus, in most cases, rewatering the abandoned distributaries would entail removal of these plugs of sediment. (Note that these plugs are typically far smaller than the deposits of quarry waste that today clog the abandoned channels of the Rush Creek bottomlands.) Along most of their length, the abandoned channels of Mill Creek retain their former width and sinuosity, though at a few highly localized sites rewatering would require improving the channel definition.

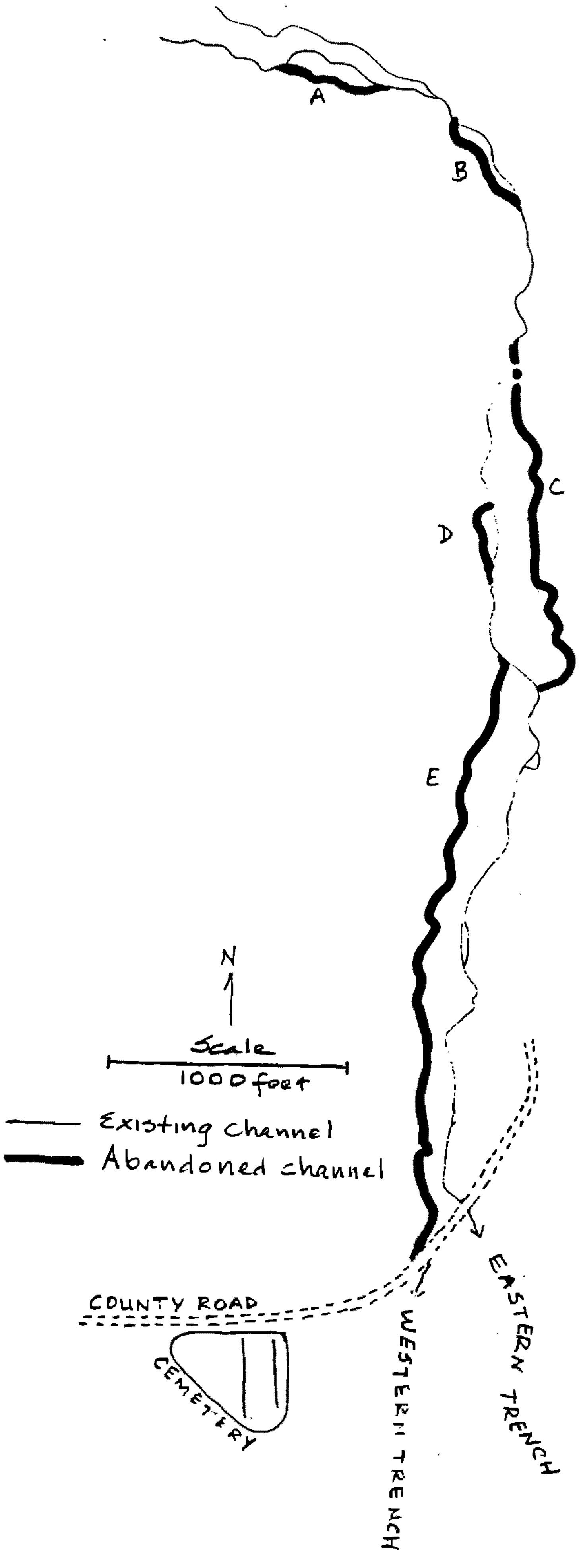

Figure 1
Abandoned Channels of the Mill Creek Bottomlands (see Table 1 for descriptions)

Sources: USDA Forest Service aerial photo 8-22-93; field observations of 9/93 and 10/93

TABLE 1

ABANDONED CHANNELS OF THE MILL CREEK BOTTOMLANDS
(see Figure 1 for channel locations)

The table that follows outlines the characteristics of the abandoned channels of the Mill Creek bottomlands. Each of the channels has been designated by capital letter (A through E). This designation is by elevational sequence, with Channel A being the upstream-most of the abandoned channels, and Channel E being the downstream-most. The channel lengths given here are based on analysis of aerial photos, and so should be considered approximate.

In addition to the objective information provided in the table, each of the channels is assigned a restoration priority (either 1 or 2). While admittedly subjective, the assigned priorities are based on objective criteria, including length of channel, ease of rewatering, degree to which a rewatered channel would spread flow across the bottomlands, and other factors explained in the "Priority" subsections.

Channel A. This abandoned channel lies west of the main channel, immediately above the very big westward bend (upstream) of the stream. It is reasonably well-defined at its upper and lower ends.
Approximate Length: 450 feet
Elevation at upper end: ~6620 feet
Grade at upper end: 4-5 feet above existing active channel
Grade at lower end: 4-5 feet above existing active channel
Sinuosity: Variable, though greater than the modern channel complex.
Priority: 2. The stretch of stream along which Channel A runs is already characterized by 2 well-formed channels, offsetting the need to spread the water laterally. Furthermore, Channel A is stranded 4 to 5 feet above the existing active channel, and so presents a problem in entrance and exit design.

Channel B. This abandoned distributary lies west of the modern channel complex. It has carried water this year, and will continue to do so during times of high flows.
Approximate Length: 450 feet
Elevation at upper end: ~6600 feet
Grade at upper end: In grade with existing active channel
Grade at lower end: In grade with existing active channel
Sinuosity: moderate– greater than most of the modern channel complex
Other characteristics: Channel B is part of the modern channel complex. It might be encouraged to take more water, since the lower portions of the channel constitute a fine wetland.
Priority: 1. Channel B is presently watered at high flows; it should be examined to determine suitability for augmenting flow, with an eye to retaining wetland habitat during fall and winter seasons.

TABLE 1 (cont.)

Channel C. This abandoned channel lies east of, and runs parallel to, the modern channel complex. It is reasonably well-defined, though blocked by a fallen cottonwood trunk, at its upper end. Because of this blockage, and a cobble that extends down channel for a short distance, the channel entrance lies approximately 2-3 feet above the modern channel complex. Rewatering might entail getting semi-permanent flow into a portion of the modern complex that, presently, carries water only during moderate to high flows. The channel is well-defined near its head, locally clogged in some of the middle sections, and exceptionally well defined in its lower reaches. In these lower reaches it runs along the canyon wall *a la* Rush Creek's channel 10. It enters the existing channel at grade, and through an aspen-lined lowland with a small (1- acre) depression which, when watered, would constitute a pool.

Approximate Length: ~1510 feet

Elevation at upper end: ~6570 feet

Grade at upper end: ~3 feet above modern channel complex, due to fallen cottonwood and sediment clog.

Grade at lower end: In grade with modern channel complex

Sinuosity: Variable, though greater than the modern channel complex.

Priority: 1. Channel C is considered a high-priority channel, since it would a) spread water far to the east, and indeed graze the east canyon wall along its lower reaches; b) encourage the growth of riparian woodland over a long (~1500-foot) stretch which today is largely lacking in arboreal growth; and c) encourage ponding of water at several points, most notably at the downstream end of the channel. Channel definition would be required at several sites through the middle reaches of Channel C.

Channel D. This channel lies west of the main stream complex. It is a small meander that was cut off sometime between 1930 and 1940 (likely in 1938).

Approximate Length: 300 feet

Elevation at upper end: ~6540 feet

Grade at upper end: 2-3 feet above modern channel complex

Grade at lower end: near grade

Sinuosity: high

Priority: 2. Channel D represents only a small departure from the modern channel complex. While it is might provide both direct and indirect benefits to waterfowl, it is relatively short. Assuming that Channel C were rewatered, the rewatering of Channel D would then create three active channels abreast, perhaps leading to a problem of water sharing in years of only moderately high flows.

<u>TABLE 1</u> (cont.)

<u>Channel E</u>. This abandoned channel lies west of, and runs parallel to, the modern channel complex. It follows a course marked in places by large amounts of dead and downed willow. It heads near a dead (but standing) cottonwood tree. With a length of ~2600 feet, this is by far the longest of the abandoned channels. It is characterized by numerous small depressions, and one extensive depression (the "Big Hole", approximately 800 feet upstream of the County Road) that would become ponds when rewatered.

Approximate Length: ~2610 feet

Approximate Width: Variable, typically 3-4 feet bottom width and 6-9 feet top width

Elevation at upper end: ~6520 feet

Grade at upper end: ~3 feet above modern channel complex

Grade at lower end: In grade

Sinuosity: Variable, though greater than the modern channel complex.

Priority: 1. Channel E is considered a highest-priority channel, since it would a) spread water far to the west of the bottomlands; b) encourage the growth of riparian woodland over a long (~2600-foot) stretch which today is largely lacking in arboreal growth; c) encourage ponding of water at several points, most notably at the "Big Hole" (approximately 800 feet upstream of the County Road); and d) provide a means of getting water down the westernmost of the two trenches that trisect the Mill Creek delta trench. Channel definition would be required along 5% to 10% of its length, most notably through the middle sections of the abandoned channel.

Based on such considerations as channel length, ease of rewatering, degree to which a rewatered channel would distribute flow widely across the bottomlands, and other factors, each of the abandoned channels was assigned a priority of 1 (highest) or 2. Three of the 6 channels (B, C, and E) are deemed Priority 1. Channel B is already watered at high flows, but might be modified slightly to insure that it carries flow during the fall and winter seasons. Channels C and E share the following traits: They are long (with a total length of 4100 feet); they spread water to the edges of the bottomlands (to the east side in the case of Channel C, and to the west side in the case of Channel E); and they are characterized by depressions that would become ponds when rewatered. Channel E has an additional advantage in that it terminates at the county road immediately upstream of the westernmost of the two trenches that trisect the exterior delta of Mill Creek, and would thus provide a means of rewatering that trench. A discussion of the two trenches follows:

Mill Creek's Entrenched Exterior Delta: The Potential for Creating Hypopycnal Rias and Wooded Wetlands

Creation of the trenches. The artificially-induced drop in the level of Mono Lake since 1940 has caused the lake's main feeder streams to incise their deltas. While Rush and Lee Vining creeks have each cut a single trench, Mill Creek has cut two--an eastern one, which has carried most of the flow of the stream, and a western one, which was cut in 1969 when high flows plugged the culvert under the county road and caused the stream to avulse westward. Similar short-lived freshets, leading to further deepening of the western trench, occurred in 1980 and 1986.

Creation of hypopycnal rias and wooded wetlands. As Mono Lake rises toward 6391 feet, as ordered by the California State Water Resources Control Board, it will engulf the lower reaches of these two trenches, creating two elongate embayments, or "rias". Deposition of bay-mouth bars at the foot of the trenches will create highly sheltered, slack-water conditions within the rias. At times when fresh water is flowing down the Mill Creek trenches, it will override the heavy salt water of the embayment, creating "hypopycnal" conditions (density-induced stratification of waters). Such sheltered, hypopycnal conditions were favored by waterfowl at Mono Lake during the early and middle decades of this century.

To the extent that water is flowing down Mill Creek's delta trenches, the presence of rias will induce agradation, avulsion, and bifurcation of the stream. This, in turn, will create, within each of the trenches, wooded wetlands characterized by a high water table, dense riparian vegetation, multiple channels, and ponds. Such an environment can be expected to stretch roughly 1000 feet upstream from the saltwater embayments. All told, with fresh water flowing down both of the two trenches and Mono Lake standing at an elevation of 6391 feet, approximately 14 acres of slack-water hypopycnal ria, roughly 16 acres of wooded wetlands, and roughly 25 acres of stream-side riparian vegetation, will exist on Mill Creek's exterior delta.

Desirability of groundwater flow to the Mill Creek trenches. Streamflow through much of Mill Creek's Pleistocene Delta Reach, and through most of its Holocene Delta Reach, results in loss of water to the ground. This "lost" water runs through the permeable alluvium of the two reaches, then reappears as springs and seeps near the lower ends of the delta trenches. This subsurface flow contributes water to the woodlands, wetlands, and hypopycnal layer in the trenches throughout the year, most importantly during periods when surface flow in the stream is low. Equally as importantly, the seeps and springs will keep these habitats wetted into the early winter, after the stream itself has frozen up. For these reasons, groundwater replenishment should be considered an essential component of Mill Creek restoration.

Modification of the county road. Neither rewatering the two delta trenches, nor creating the hypopycnal rias and wooded wetlands, will require in-channel manipulations on the exterior delta. (Indeed, the hypopycnal rias and the wooded wetlands will be highly dynamic and self-perpetuating.) Getting water into the western trench, however, will require modification of the county road. Presently the road blocks that trench, directing all flow down the eastern watercourse.

The amount of road modification required to rewater the two trenches would be minimized if the flow of Mill Creek above the county road were split between the presently existing channel system (which would continue to feed the eastern trench) and the now-abandoned Channel E (which would deliver water to the western trench). Presently the downstream end of Channel E lies close to the upstream end of the western trench; only the road prevents the two from being a continuous channel. Insertion of a culvert or bridge on the county road would eliminate this blockage.

Since the eastern trench is both wider and deeper than its western counterpart, it would seem reasonable that the eastern trench should receive a greater portion of the stream flow. With this in mind I suggest a 2/3 - 1/3 split, with the division occurring where Channel E (which would receive the 1/3 flow) bifurcates from the existing channel system (which would receive 2/3 of the flow).

Required Flow Regime

Introduction. Successful restoration of woodlands, wetlands, and hypopycnal rias along Mill Creek's Holocene Delta Reach (i.e. the Mill Creek bottomlands and the exterior delta) would require release of water throughout the year. Ideally, these releases would mimic (though would not necessarily need to duplicate) the natural flow regime of the stream. Presently, use of water for irrigation, and regulation of flows for hydropower generation, preclude duplication of the natural flow regime.

The flow regime necessary for restoration of the bottomlands and exterior delta of Mill Creek can be generalized into three components:

1) *Base flows, September through April.* Under natural conditions, flows on Mill Creek are low during the period September through April, fluctuating between monthly averages of roughly 10 to 20 cfs. This includes the period September through December, during which the largest numbers of migrating waterfowl inhabit the Mono Basin. Thus, by feeding marshes, ponds, and rills, and by maximizing hypopycnal conditions within the delta trenches, the flows during these months are of direct use to the birds. It is therefore highly desirable, and perhaps essential, that the small amount of water that is naturally available in the Mill Creek watershed in fall and winter all be in the stream during these months.

2) *Channel- and riparian-maintenance flows, late spring and early summer.* Under natural conditions, peak flows on Mill Creek coincide with the period of peak snowmelt (typically May in dry years, June in normal years, and early July in wet years). For the period 1941-1990, the average unimpaired flow is 89 cfs for June and 73 cfs for July. In the wettest June (1983) of this period, flow averaged roughly 167 cfs, while in the wettest July (1967) it averaged approximately 166 cfs. In each of these cases, peak daily and weekly flows were higher.

Because of the small capacity of Lundy Reservoir, water in many years spills from the dam (in such years it is also released from the dam in anticipation of spillage). As a result, lower Mill Creek occasionally receives flow for a short time in late spring or early summer. Such existing flows, if augmented and prolonged with additional water from water-rights holders, and with unappropriated water from the powerplant tailrace (see below), would contribute greatly to the restoration of Mill Creek's bottomland and deltaic environments, which in turn constitute waterfowl habitat. Such flows are required to maintain channel form, build floodplains, disperse seeds of riparian vegetation, and irrigate that vegetation. (Note that these channel- and riparian-maintenance flows would need to be ramped up and down to avoid damaging the channels. A discussion of such ramping is beyond the scope of this paper.)

3) Groundwater replenishment, late spring, summer, and early fall. For reasons described above (maximization of fresh water at the mouths of the trenches during the low-flow months, and emission of relatively warm groundwater during months of freezing temperatures) it is beneficial to replenish the groundwater reservoir by maintaining water in Mill Creek whenever possible. It is thus desirable to maintain flows in Mill Creek not only in the summer (when riparian and channel maintenance dictate that flows be high) and in the winter (when flows are of direct use to waterfowl), but in the spring and fall as well.

Rewatering Mill Creek: Formulating a Plan

Introduction. Any plan for rewatering Mill Creek must take into consideration the needs of the stream (see above), as well as the limitations imposed by nature, by water rights, and by facilities (i.e. ditches, dam gates, etc.). These limitations, and potential future changes in these limitations, are taken into account in the following consideration of a plan for rewatering Mill Creek.

Potential sources of water--the appurtenant rights. The rights to Mill Creek water are summarized by priority on Table 2, and by land ownership on Table 3. These tables are based on data generated during the Aitken Case proceedings of 1934. They differ in several respects from the water rights table compiled by Mr. J.R. Perrault of the LADWP in his revised document of August 18, 1995. The differences generally involve small amounts of water and low-priority rights, and so bear little on the broad issues being discussed here. Note that all discussions of quantity and priority of water rights hereafter are based on Tables 2 and 3, and that they are subject to adjustment as the differences in the water-rights lists are resolved.

It is clear from Tables 2 and 3 that Conway Ranch and the Department of Water and Power hold highest priority rights to the largest quantity of water. In both priority and water quantity, the United States Forest Service ranks third in importance. (The only other existing right is that of Simis. While of relatively high (No. 4 of 12) priority, it consists of only 1.6 cfs, and is exercised only during the irrigation season. The Simis

Table 2
Summary of Mill Creek Water Rights
(by Priority and Current Land Owner)

Priority	Current Owner	1914 Claimant	Lands	Ditch	Volume (cfs)
1.	DWP	NCP Co.	Cemetery	Mill Cr pasture	1.0
2.	Conway Ranch	Conway	Conway	Conway-Mattly	12.0
3, 4.	DWP	Miller, Felosina	Miller, Felosina, Allen	Upper Thompson	9.4
4.	Simis	Sylvester Estate	Sylvester	Upper Thompson	1.6
5.	DWP	Cain Irr.	Thompson Ranch	Thompson Main	14.0
6, 7.	Conway	Mattly, Conway	Conway-Mattly	Conway	5.0
7.	US Forest Service	LW Dechambeau	Dechambeau Ranch	Wilson	12.6
8, 9.	DWP	D. Currie M. Felosina	Currie and Felosina	Main & Upper Thompson	6.0
10.	Conway	H. Mattly	Mattly Ranch	Conway-Mattly	1.0
11.	DWP	Cain Irr.	McGahn	"McGahn",	2.0
12.	DWP	Cain Irr.	Lundy Lk	storage	6.0

Source: FW Env. Cons., 1995, with ditch data by Vorster, pers. com., 1995.

Table 3

Summary of Mill Creek Water Rights
(by Current Land Owner and Location of Lands)

Current Owner	Priority	Lands (location)	Volume (cfs)
DWP	1, 3, 4, 5, 8, 9, 11, 12.	97% s. of Mill Creek	32.4 (+6 storage in Lundy Lk)
Conway	2, 6, 7, 10.	NE of Mill Creek	18.0
US Forest Service	7.	NE of Mill Creek	12.6
Simis	4.	S. of Mill Creek	1.6

right is thus considered to be insignificant to discussions of rewatering Mill Creek.)

Historical peculiarities in the distribution of tailrace water. A portion of the DWP right has historically been satisfied by water released from, and accreted below, Lundy Lake. But the remainder of the DWP right, like all of the Conway right and all of the Forest Service right, has been supplied by water that has first passed through the Lundy Powerhouse, and thence out the tailrace.

Historically, allocation of the tailrace water from the powerhouse by Southern California Edison has been peculiar in several respects. While the lands northeast of Mill Creek have water rights totaling just 31.6 cfs (Conway = 18 cfs; Forest Service = 12.6 cfs; DWP = 1 cfs), far more water than this has typically been diverted toward those lands during much of the irrigation season. The excess has ended up in lower Wilson Creek, rather than being returned to Mill Creek. Equally as curious is the historical allocation of Mill Creek water during the non-irrigation season. By late in October, the application of water onto the grazing lands east of Mill Creek has ceased. But even after cessation of irrigation, virtually all of the Mill Creek water that has passed through the powerhouse tailrace has been diverted northeastward toward Wilson Creek, rather than being returned to Mill Creek through Southern California Edison's Return Ditch.

Rewatering Mill Creek: A Plan for Discussion and Debate

Plan elements. The plan for restoring the woodland, wetland, and deltaic habitats on Mill Creek consists of 4 elements, each of which is discussed below. Included in this discussion is 1) a list of the changes in the facilities, facilities management, and exercise of water rights that would be required for the implementation of each element, and 2) an appraisal of the extent to which each element would satisfy the "Required Flow Regime" outlined above.

I stress that the plan presented here is intended to be a point of departure for discussion and debate rather than an exhaustive dissertation of all possible actions. Additionally, note the following:

a) The plan assumes that hydroelectric generation will continue to be a factor in the future operation of the Mill Creek system, with most of the water from the drainage basin passing through the powerhouse and out the tailrace before being further distributed. (This is not to say that flow to the powerhouse could not be curtailed in the future, with more water being released from Lundy Lake into Mill Creek.)

b) The 4 elements are not mutually exclusive, but rather are complementary and cumulative.

c) For the sake of simplicity, the discussions of channel- and riparian-maintenance flows focus on the effect of the plan in years of normal and high runoff. In years of low runoff, neither the plan, nor nature, can be expected to provide ideal, or even adequate, channel- and riparian-maintenance flows.

d) The plan is intended to address broad issues, rather than the intricacies that come with such complications as change-in-use permits, future Federal Energy Regulatory Commission requirement on Southern California Edison [1], precise ramping, dam-release, and power generation schedules [2], etc.

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[1] FERC is in the process of relicensing SCE's Lundy operation. At issue is how much water should be released immediately below Lundy Dam. This release, whatever its amount, will obviously impact Mill Creek flow in a way that affects the plan described below.

[2] It may be possible for SCE, without loosing revenue, to regulate hydropower releases such that October flows are kept at higher than historical levels, thus making more water available available for potential releases down Mill Creek.

Element 1: ***The Los Angeles Department of Water and Power dedicates its Mill Creek water right to instream use on Mill Creek.***

Description:

As part of its overall program to restore waterfowl habitat to the Mono Basin, the Los Angeles Department of Water and Power will exercise its non-storage rights to Mill Creek water by returning that water to (via the tailrace and Southern California Edison's Return Ditch), or not diverting it from, Mill Creek. This will contribute, during the peak runoff period of most years, a total of 32.4 cfs to the flow of Mill Creek. Owing to the higher-priority right of Conway Ranch, and to rights held by the Forest Service, this contribution will necessarily decrease through the summer , and will likely be near zero during the late fall and winter .

Required changes in existing facilities:

Of DWP's total non-storage Mill Creek water right of 32.4 cfs, a portion (9.4 cfs) is appurtenant to lands fed by the Upper Thompson Ditch. This ditch lies above Southern California Edison's Return Ditch (which heads at the powerplant tailrace), and so must be fed by water released from the Lundy Dam (at "Farmer's Gate"), and/or by water that accretes below the dam. The remainder of DWP's Mill Creek water right (= 23 cfs minus whatever water in excess of 9.4 cfs is in the Mill Creek channel immediately below the Upper Thompson Ditch) will have to be returned to Mill Creek by way of Southern California Edison's Return Ditch. T o the extent that only 9.4 cfs is in the Mill Creek channel at the Upper Thompson Ditch, and that there is sufficient water in the Mill Creek system to furnish the DWP with their entire water right, the capacity of the Return Ditch, presently rated at 16 cfs, will have to be upgraded to 23 cfs. (Less upgrading will be required if, at such times, more than 9.4 cfs is present in Mill Creek at the Upper Thompson Ditch.)

Components of the "Required Flow Regime" satisfied by Element 1:

During the late spring and early summer of moderately wet to very wet years, when water is spilling from Lundy Reservoir (or is being released from the dam by Southern California Edison in anticipation of a spill), the return of DWP's water (at such times, 32.4 cfs) to Mill Creek will contribute in an important way to riparian- and channel-maintenance flows. In years when little or no water passes through or over the Lundy Dam, streamflows high enough to benefit riparian- and channel-maintenance will likely not occur. Even in these years, however, DWP's summertime contribution will provide important environmental benefits, by replenishing groundwater supplies, and by providing riparian irrigation during the growing season.

The return of DWP's rightful water to Mill Creek will contribute only a very small amount of water to the stream during the months of September through April. This is because, for all intents and purposes, the bulk of DWP's total right is junior to the bulk of the Conway right. Thus, in an average month of, say, November, with only ~10-12 cfs present in the Mill Creek system, Conway will have the right to nearly all the available flow, and DWP's potential contribution will drop to near zero. While DWP's contribution of its water right is an important, indeed essential, first step in the restoration of Mill Creek, it will do little to insure that the Mill Creek bottomlands are wetted, or that hypopycnal conditions in the delta trenches are available, during the months of peak waterfowl abundance.

Element 2: ***All Mill Creek water not used for irrigation is returned to (via Southern California Edison's Return Ditch), or retained in, Mill Creek, to satisfy instream uses.***

Description:

All tailrace flow in excess of the water rights associated with the Conway and Forest Service lands will be returned to Mill Creek by way of Southern California Edison's Return Ditch. As a result, the maximum flow of tailrace water that will be diverted toward the Conway and Forest Service lands will be 30.6 cfs (Conway total = 18 cfs; Forest Service total = 12.6 cfs).

Any tailrace water that is not used for irrigation by Conway Ranch and/or the Forest Service, even if that unused water is within the flow specified in the Conway and Forest Service water rights, will be returned to Mill Creek by way of the Return Ditch. Thus, in the late summer, fall, and winter, at times when the tailrace flow exceeds the amount of water spread onto the Conway and Forest Service lands for irrigation, the excess water will be returned to Mill Creek.

Required changes in existing facilities:

The capacity of Southern California Edison's Return Ditch, presently rated at 16 cfs, will have to be upgraded to at least 40 cfs (this figure is derived by subtracting the Conway and Forest Service rights--total 30.6 cfs--from the powerhouse capacity of 70.6 cfs).

The water in the Return Ditch (up to 40 cfs) will need to pass under the Lundy Canyon Road. As part of increasing the capacity of Return Ditch, it will likely be necessary to increase the capacity of the culvert that passes under the road, or to replace that culvert with a more suitable structure.

Components of the "Required Flow Regime" satisfied by Element 2:

Because it will increase irrigation-season flows in Mill Creek by up to 16 cfs above that outlined in Element 1, Element 2 will contribute substantially to channel- and riparian-maintenance flows, and to summertime groundwater replenishment.

Element 2 will result in all, or nearly all, tailrace flows being returned to Mill Creek in the non-irrigation season. As a result, in the months October through April, Mill Creek on average will receive an additional 10 to 16 cfs beyond that provided in Element 1. Flow through the bottomlands and across the exterior delta of Mill Creek will be close to that which would occur under natural conditions. By watering ponds, rills, and marshes, and by insuring hypopycnal conditions within the delta trenches, this additional water will directly benefit waterfowl during the months when they are in greatest abundance.

<u>Element 3</u>: *The United States Forest Service dedicates its water right to instream use on Mill Creek.*

Description:

The United States Forest Service, in the interest of restoring the Mill Creek environment, will exercise its right to Mill Creek water by returning that water to (via the tailrace and Southern California Edison's Return Ditch), or not diverting it from, Mill Creek. This middle-priority right (7th out of 12), comprising up to 12.6 cfs, can begin to be exercised only at times when divertable flow exceeds 43 cfs. Such flows are typically exceeded only during June and July . The Forest Service contribution would thus occur in the weeks prior to, during, and following, the period of peak runoff.

Required changes in existing facilities:

Under this element, the maximum amount of flow that will be diverted northeastward from the powerhouse tailrace will be 18 cfs (the Conway right). The remainder of the tailrace flow (up to 52.6 cfs) will be returned to Mill Creek by way of Southern California Edison's Return Ditch. The capacity of the Return Ditch, presently rated at 16 cfs, will thus have to be upgraded to at least 52.6 cfs.

The water in the Return Ditch (up to 52.6 cfs) will need to pass under the Lundy Canyon Road. As part of increasing the capacity of Return Ditch, it will likely be necessary to increase the capacity of the culvert that passes under the road, or to replace that culvert with a more suitable structure.

Under this element, Mill Creek below the Return Ditch will receive all of the flow from the drainage basin except 18 cfs. Thus, all other things being equal, during years of high runoff Mill Creek below the Return Ditch will experience flows up to 52.6 cfs higher than have occurred historically . It may therefore be necessary to modify the Highway 395 crossing of Mill Creek, to insure that it can accommodate flows up to 52.6 cfs higher than have occurred since the highway was constructed.

Because of the increase in flow noted immediately above, it may be necessary to modify the county road crossing of Mill Creek. Any need to accommodate higher flows at the county road would be minimized if both of Mill Creek's delta trenches were rewatered, since this would necessitate 2 county road crossings.

Components of the "Required Flow Regime" satisfied by Element 3:

Because the Forest Service water right can typically be exercised only during May through August, the dedication of that right to instream use will necessarily occur when flows on Mill Creek are naturally near their annual maximum. It will thus constitute an important (to 12.6 cfs) contribution to channel- and riparian-maintenance flows, as well as to summertime groundwater replenishment, on Mill Creek.

By contributing to groundwater replenishment during the summertime (and thus to springflow during the fall and winter), the return of the Forest Service's rightful water to Mill Creek will directly benefit waterfowl during the months when they are in greatest abundance.

<u>Element 4</u>: *The Conway Ranch dedicates its Mill Creek water right to instream use on Mill Creek.*

Description:

The present or future owners of the Conway Ranch, in the interest of restoring the Mill Creek environment, will exercise their right to Mill Creek water by returning that water to (via the tailrace and Southern California Edison's Return Ditch), or not diverting it from, Mill Creek. T wo-thirds (= 12 cfs) of the Conway right (= 18 cfs), holds high priority (No. 2 of 12). It, or at least a large portion of it, is thus theoretically available throughout the year .

Required changes in existing facilities:

Under the full extent of this element, no water will be diverted northeastward out of the Mill Creek drainage. Thus, the entire tailrace flow (up to 70.6 cfs) will be returned to Mill Creek by way of Southern California Edison's Return Ditch. The capacity of the Mill Creek Return Ditch, presently rated at 16 cfs, will thus have to be upgraded to 70.6 cfs.

The water in the Return Ditch (up to 70.6 cfs) will need to pass under the Lundy Canyon Road. As part of increasing the capacity of Return Ditch, it will likely be necessary to increase the capacity of the culvert that passes under the road, or to replace it with a more suitable structure.

Under this element, Mill Creek below the Return Ditch will receive all of the flow from the drainage basin. Thus, all other things being equal, during years of high runoff Mill Creek below the Return Ditch will experience flows up to 70 cfs higher than have occurred historically . It may therefore be necessary to modify the Highway 395 crossing of Mill Creek, to insure that it can accommodate flows up to 70 cfs higher than have occurred since the highway was constructed.

Components of the "Required Flow Regime" satisfied by Element 4:

Element 4 will return Mill Creek to a condition in which it functions very much as it did under natural conditions. (The continued operation of Lundy Dam for hydroelectric generation will prevent precise duplication of the natural regime, by delaying, and attenuating, peak runoff in most years.) It will thus provide the greatest and most thorough environmental benefits to Mill Creek.

Literature Cited

Foster Wheeler Environmental Corporation, 1995. Draft Instream Flow and Habitat Restoration Investigation for Mill Creek, Mono County, California. Study for the California Department of Fish and Game, Stream Evaluation Report 95-1.

Perrault, J.R., 1995. Mill Creek Watershed Report, prepared for the Mono Basin waterfowl habitat restoration technical advisory group meeting of July 28, 1995 (revised August 18, 1995).

Stine, S., 1995a. Historical and Future Waterfowl Habitat at Mono Lake, California. Report to the California State Lands Commission and the California Department of Parks and Recreation, 61 pp.

______, 1995 b. Waterfowl Habitat Restoration in the Mono Basin: A Preliminary Examination of Constraints and Possibilities. Report to the California State Lands Commission and the California Department of Parks and Recreation, 7 pp.

______, 1993. Historic and Modern Distribution of Lake-Fringing Wetlands, Mono Lake, California. Report to the California State Water Resources Control Board and Jones and Stokes Associates, Sacramento, 59 pp.

______, 1992. Past and Present Geomorphic, Hydrologic, and Vegetative Conditions on Rush Creek, Mono County, California.

______, 1991. Extent of Riparian Vegetation on Streams Tributary to Mono Lake, 1930-1940: An assessment of the streamside woodlands and wetlands, and the environmental conditions that supported them. Report to the California State Water Resources Control Board and Jones and Stokes Associates, Sacramento, 73 pp.

______, S. English, and T. Taylor, 1994. Feasibility of Rewatering Abandoned Channels of the Rush Creek Bottomlands, Mono County, California, 73 pp.