Kilpatrick Pond Enhancement Project

Prepared by:

Confluence Consulting, Incorporated:

Scott Gillilan
Jim Lovell

Master
for copies

December 19, 1997

TABLE OF CONTENTS

page

List of Figures ii
List of Tables ii
Executive Summary iii
Introduction and Project History 1
Goals and Scope of Inquiry 1
Relevant Existing Conditions 2
  Sedimentation 2
  Fishery 4
  Avian Use 4
  Aquatic/Riparian Plants 5
  Water Quality 5
Design Concepts/Information Gathered 5
  Field Data 5
  Design Concept 6
  Sediment Removal Options 9
  Island Construction 10
    Bench Test 12
    Field Trial 14
    Loving Creek Trial Project 16
Discussion of Project Size and Cost Alternatives 16
  Iterations 16
  Common Elements of Iterations 18
  Trial 1 Summary 18
  Trial 2 Summary 19
  Trial 3 Summary 19
  Discussion of Preferred Option and Opportunities 19
  Other Considerations 20
Promotional Graphics 21
Potential Benefits/Effects of Project 21
  Fishery 21
  Waterfowl 21
  Vegetation 22
  Sediment Storage 22
Lower Slough Sediment Removal 23
Molyneaux Farm Runoff 24
Summary/Recommendations 26
Literature Cited 27
APPENDIXES 28
APPENDIX A 29
APPENDIX B 30
APPENDIX C 31
APPENDIX D 32
APPENDIX E 39

LIST OF FIGURES

page
Figure 1. Aerial Drawing of the base map 7

Figure 2. Channel island network 8

Figure 3. Conceptual drawing of island attributes 11

Figure 4. Island construction design. 13

Figure 5. Field trials of island construction; building and filling structure. 15

Figure 6. Molyneaux fields 25

LIST OF TABLES

Table 1. Volumes of excavated materials and fill needed for each trial of island construction and estimated costs. 17

Table 2. Estimated costs of dredging the slough channel to various depths. 24

Executive Summary

In its current condition, Kilpatrick Pond is largely full of fine sediment, creating seasonally difficult and limited angling conditions on what is otherwise a world-class fishery. This report summarizes our investigation of the feasibility of removing a significant amount of the sediment to improve angling conditions and stream health, while also enhancing nesting habitat for waterfowl and other riparian dependent species. Our design concept involves creation of deep channels separated by emergent/terrestrial islands on the Preserve, with no islands on the adjoining Double R Ranch. A floating suction dredge was determined to be the most feasible alternative for the majority of the sediment removal, though conventional excavation methods can be used in some areas on the Double R at a cost savings. The preferred alternative was conservatively estimated at $260,000 on the Preserve and $243,000 on the Double R. The construction of islands is technically feasible and methods used likely to meet all permit requirements, though they are a significant portion of the costs on the Preserve portion of the project. Benefits to the fishery and wildlife range from probably neutral for the fish to good for waterfowl and riparian species. Based on our concepts, we developed a number of graphic images to be used for project fund raising, including a commissioned watercolor suitable for auction.

Introduction and Project History

Kilpatrick Pond is located on the Idaho Nature Conservancy's Silver Creek Preserve and has historically been a favorite fishing spot for fly fishermen. The exact age of Kilpatrick Pond is unknown, though it is likely as old as the ditch water rights on the Double R Ranch, which are over 100 years old. Over this time, the 4.5 foot high dam and resulting impoundment have had undeniable influences on the functional attributes of Silver Creek. Not least among these has been the capture and storage of fine sediments being transported to the pond from the network of spring creeks comprising the upper Silver Creek watershed.

In its current condition, angling in the pond area has become more and more difficult due to the heavy aquatic vegetation growth associated with deposits of fine sediment and slow-moving water. In general, the overall depth of the pond has decreased about 4 feet due to in-filling. The combination of decreased depth and increased vegetation growth is ultimately limiting angling experiences. Therefore, increased interest among the Preserve users in improving the angling conditions on Kilpatrick Pond has gained the attention of the TNC's Idaho State Office. As the dominant visitor activity, managing angling has posed challenges for the Preserve managers for some time, and has led to the recent imposition of special angling rules (float only) for the pond area .

With this background, and with a parallel effort to balance Preserve management activities to include non-fishery wildlife benefits, Confluence Consulting, Inc., was hired in the summer of 1997 to develop conceptual plans for improving the pond's fishing potential and enhancing the opportunities for avian nesting. It was clear from the beginning that the high profile of the Silver Creek fishery, combined with the scale of any project capable of significantly improving the existing conditions, would require a careful and technical assessment of opportunities. The following report is a summary of the several lines of research we pursued. Each line of inquiry was a direct result of scoping meetings and information gathering phases.

Goals and Scope of Inquiry

Silver Creek's 5-Year Plan calls for efforts which "Maintain and enhance Silver Creek's aquatic and riparian systems by preserving water quality and quantity, restoring and preserving natural habitats and rare species...." (Todd 1997). Bearing this mandate in mind, and also recognizing that the Preserve serves as an important public relations gateway and introduction to TNC for the primary user group (anglers), our goals for the investigation were:

1. Investigate the feasibility of removing accumulated sediment in Kilpatrick pond to provide deeper water channels, which will serve as additional sediment storage areas and to enhance angling opportunities.
2. Determine the feasibility of creating island habitat in the TNC portion of the pond to attract nesting waterfowl, specifically trumpeter swans, as well as all other riparian dependent wildlife species.

Additional goals of the study were to:

- develop realistic cost estimates for all feasible alternatives:
- develop methods to preserve water quality during proposed construction, and;
- provide presentation materials such as conceptual drawings that will be useful during efforts to raise funds for the project.

This document summarizes the results of our investigation of alternatives that meet TNC's objectives. All of the surveying and engineering information gathered during the investigation has been included so that this document may serve as a platform for final design.

Relevant Existing Conditions

Over the course of the study various issues surfaced that we felt were worth looking into. Included were questions on sediment supply in Silver Creek in terms of a proposed projects longevity, potential impacts on or benefits for the Silver Creek ecosystem, such as fish, birds, aquatic insects and vegetation assemblages. Following is a brief review of the status of these resources. A discussion of potential benefits/impacts are found later in the report.

Sedimentation

The issue of stream sediment is important to the project on several levels. The Preserve has monitored sediment depths on Silver Creek and tributaries since 1991. These findings are inconclusive in terms of an annual transport rate or differences between annual loads, but do indicate that the amount and distribution is influenced by the magnitude and duration of high flow periods. On the conceptual level, it is assumed (NRCS 1996, others) that historic farming and ranching practices contributed a great deal more sediment delivery to the system than is likely being delivered today. Better land conservation measures and TNC's watershed easement acquisitions since 1976 have been largely responsible for these changes. However, a large instream load of sediment is still present in all tributaries, and is slowly being sorted and assimilated through the system.

Data are not available to estimate a transport rate for sediment into the pond, though there is some information characterizing general transport dynamics.

Manuel, et al 1979, suggest that aquatic vegetation plays an important role in stabilizing the instream load of sediment in Silver Creek, reducing its overall rate of transport. On Silver Creek, one sediment monitoring transect below the Visitor Center reported 1 to 4 inches of sediment overlying gravels between 1991 and 1992 (Todd 1992), while another later report (Wolter et al. 1994) gives a single value of 4 inches at an unknown point. The latter report also suggests observable scour and new downstream depositional features (point bars) following runoff. The interactive cycle of vegetative growth, senescence, scour, and deposition of sediments, points to a fairly dynamic and complex system.

Kilpatrick Pond has been a significant sink for these sediments for quite some time. Our topographic pond survey led us to grossly estimate close to 210,000 cubic yards are currently being stored in the 30 acre impoundment area. A uniform gravel layer appears to underlie the sediment over the entire pond. Our estimate of sediment storage includes all sediment above the upper surface of this gravel layer. It is probable that Kilpatrick Pond encompasses areas that were once stream bank and floodplain areas and which have since been flooded due to construction of the irrigation dam. As a result, some of what we have considered to be sediment may actually be material that once comprised the banks and floodplain of Silver Creek.

Sediment depths (depth to gravel) averaged 3 feet (4.8 feet max., 2.0 feet min.) on TNC property and 5.5 feet (6.4 feet max., 4.1 feet min.) on the Double R Ranch property. Particle size analyses performed on pond bottom samples indicated silty sands in the upper pond and silts and sandy silts with some clay layers on the Double R. Organic matter (decaying vegetation) was not quantified but was prevalent in all samples. As one progresses downstream through the ponds, sediment sizes become finer. This is expected behind impoundments and relates to the additional time required for fine grained sediments to settle from slowly moving water.

While the original available sediment storage volume of the pond was fairly significant, over time the pond has filled, and in our judgment, is near capacity. This can be noted by the consistent bed surface elevations measured throughout the pond, which are about 3 to 5 feet (4-foot average) below the maximum pond water surface elevation in the upper pond and 2 to 4 feet (3-foot average) below the maximum pond water surface elevation in the lower pond. As the pond reaches full sediment capacity, water velocities gradually increase to the point where fine sediments no longer settle out and are, therefore, transported to downstream reaches rather than being deposited in the pond.

Past TNC-sponsored activities aimed at reducing the in-channel load of sediments have included dredging on Chaney Creek, a tributary to Silver Creek. Monitoring of pre- and post-dredging sediment volumes in specific cross-sections indicated that while dredging is an efficient means of removing fine sediment from the creek bed, a continuous supply of sediment from upstream reaches resulted in more modest long-term results.

Fishery

Silver Creek has the highest recorded mixed-species trout biomass per mile of any stream in North America, (Wilson 1996) and, some suggest, the world. The high biomass of fish in Silver Creek is supported by an abundant macroinvertebrate food source. In fact, Silver Creek boasts the highest macroinvertebrate densities and diversity ever measured in a freshwater stream (Wilson 1996). While the fishery appears to be thriving, current management efforts have focused on controlling the increase in the piscivorous brown trout population relative to rainbow trout. Brown trout are believed to have been introduced to upper Silver Creek in the last 20 years. Brown trout may have a significant negative impact on rainbow trout and other non-game fish species such as the endemic Wood River sculpin and whitefish, which are also managed on the Preserve. The rare red band strain of rainbow , considered by some to be a native resident, has a genetic presence in Silver Creek, though it has hybridized with introduced strains.

Avian Use

Besides the world renowned trout fishery, the Preserve is also managed for other wildlife benefits. In particular, the unique desert spring creek environment supports a number of water-associated birds such as the trumpeter swan, great egret, white faced ibis and white pelican. Trumpeter swans, a species of concern in the regional ecosystem, have been observed over-wintering since 1991, with 5 or 6 noted in the winter of 1996-97; tundra swans are more abundant, bringing the total swan population last winter to about 70 birds (Todd pers. com.). Beginning in late November, swans migrate to the open water of the pond to feed on the submergent vegetation and associated macroinvertebrates, although no breeding pairs have remained past March to nest. Theoretically, there is nothing preventing the establishment of nesting pairs of trumpeters on the Preserve; in fact cygnets (juvenile swans) were raised in the spring of 1996 on the White Arrow Ranch, west of Bliss, and near Fairfield (Strickland pers. com.).

Ruth Shea, formerly with Idaho Game and Fish IDF&G), has suggested to Paul Todd that human disturbance due to heavy fishing pressure may be one explanation why tumpeter's aren't remaining in the area to breed. This observation was reinforced by Steve Vouffard, IDF&G (pers. com.) who also added that any effort which promoted swans to nest on the pond should be discouraged if human disturbance then lead to nest abandonment.

A wide range of migratory waterfowl also make Silver Creek a part of their annual journeys. Migratory songbirds make use of the riparian corridor. Silver Creek's Conservation Plan & Five Year Plan (May 1997) makes it clear that Preserve activities will include active management for all of the avian species.

Aquatic/Riparian Plants

The current assemblage of submergent macrophytes in Silver Creek include *Veronica* spp., *Chara* spp., *Spyrogyra* spp., and *Potomegeton* spp. Though some historic information exists on bottom coverage of plants in selected transects on Silver Cr. and its tributaries (Wolter et al. 1994), we are not aware of specific information for Kilpatrick Pond. Our informal observation suggests that while *Chara* is currently dominant in the lower end of the pond on the Double R, *Spyrogyra* and *Potamogeton* were better represented in the upper pond.

The existing pond riparian community is a mixture of native and non-native species. While some desirable plant assemblages occur, it has been noted that only 14% of the Silver Creek mainstem retains native plant communities (NRCS 1996).

Water Quality

Water quality of Silver Creek is generally good in normal flow periods, with low flows being implicated in summer levels of dissolved oxygen which can reach points of concern. Wolter et al. (1994) reports that turbidity measurements from 1991-1994 indicate an average NTU score of about 3, with the most turbid periods occurring during spring runoff, with a 13.9 NTU maximum. An NTU of 3 indicates excellent average clarity (about 5 NTU is detectable to the naked eye).

Design Concepts/Information Gathered

Field Data

Field data was collected during a site visit conducted on August 18 and 19, 1997 by Scott Gillilan (Confluence Consulting, Inc.), Bruce Smith (Galena Engineering), Carla Hoops (Intermedia) and Patrick Redmond (formerly Pioneer Technical Services, Inc.). The purpose of the visit was to collect information on sediment size, distribution, and thickness, to assess site features with respect to constructability, to evaluate the likely effectiveness of various conceptual ideas and alternatives, and to generate site topography for the existing stream bottom. Subsequent visits by Mr. Gillilan and Mr. Smith were conducted to gather additional information on site topography in the area of the Molyneaux Fields area, to gather additional information about the Loving Creek Ranch suction dredge, and to meet with permitting agencies.

Site mapping utilized both a global positioning system survey of the pond bottom topography as well as scaled aerial photography commissioned for this study. The resulting mapping was digitized and used to establish a base map in Autocad Release 13. The topographic base map and blue line photos are found in Appendix A. Figure 1 (next page), is the base map referred to most frequently in the rest of this report.

Design Concept

To meet the objectives of improved angling and increasing the area of potential waterfowl breeding habitat, the design team, in consultation with TNC resource specialists and managers, conceived a network of deepened channels flowing between constructed nesting islands in the pond (Figures 1 and 2). The finished project would resemble a stable delta or, similarly, an anastomosed (braided) channel rather than a pond on the TNC property. From a geomorphic perspective, this concept is appealing, since deltaic and anastomosed channels have in common certain attributes of Kilpatrick Pond. Specifically, the abrupt slope break from the dam backwater effectively creates a delta at the head of the pond, and the high, fertile and fine sediment load, combined with slow current velocities, is conducive to anastomosing. In truly anastomosed channels, the islands between channels are stable and well vegetated. The report cover graphic provides a realistic image of what we envision this area to look like after the islands have become vegetated. Owners of the Double R do not want terrestrial islands, so their area of Kilpatrick Pond would look mostly the same, except for the deepened channel areas.

Significant elements of the conceptual design explored in depth included:

- Mechanical options for sediment removal
- Technical feasibility of island construction
- Cost effectiveness of techniques

Removal of sediment issues centered on the trade-offs between traditional excavation methods vs. dredging and how either of those options could meet the stringent state water quality degradation standards during construction. (Water quality standards for the state indicate that turbidity in the mixing zone of the project is not to exceed 50 NTUs over background.) Island construction issues also related to water quality during construction as well as the structural stability of the islands.

Figure 1.

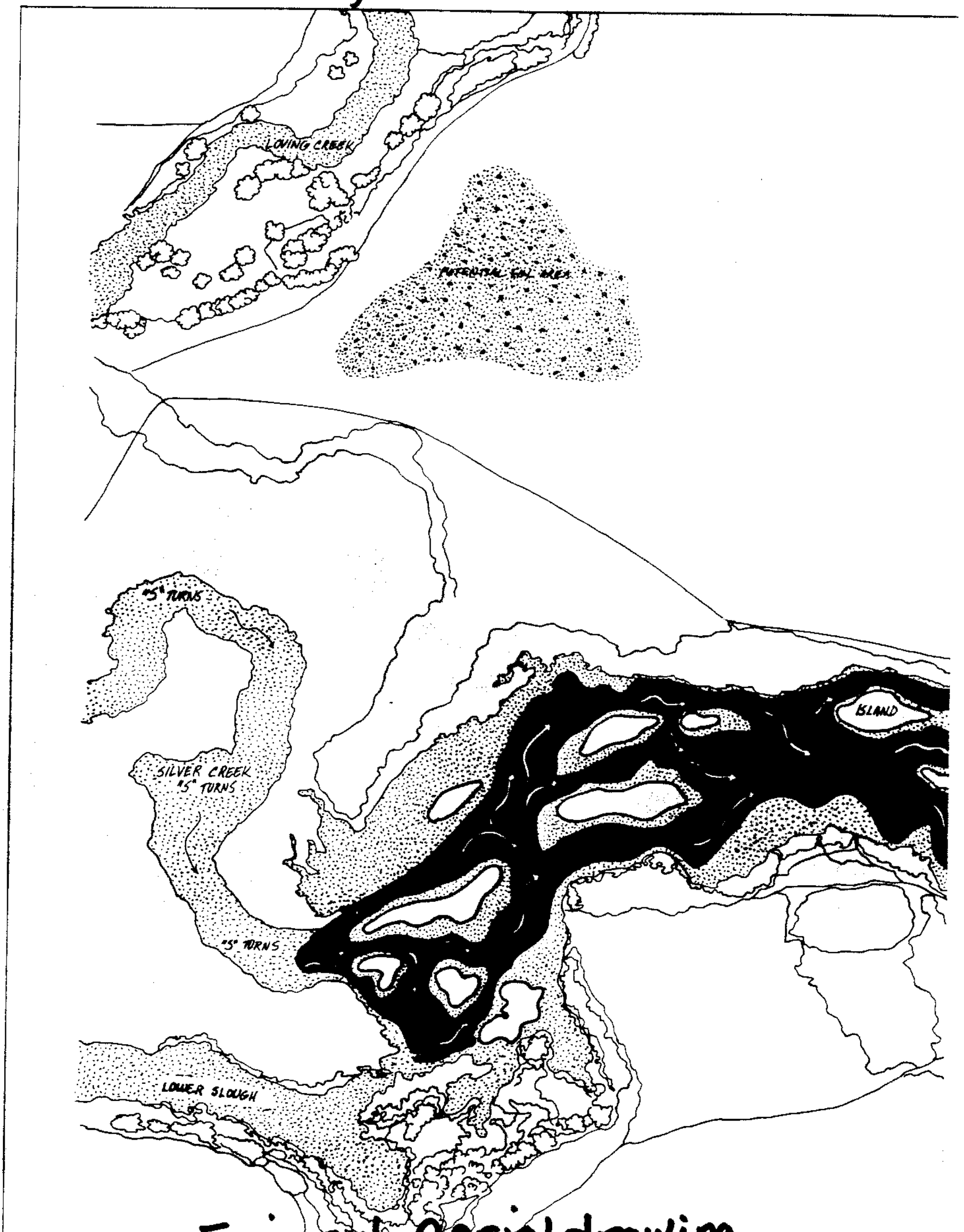


Figure 1. Aerial drawing.

ıels with Islands

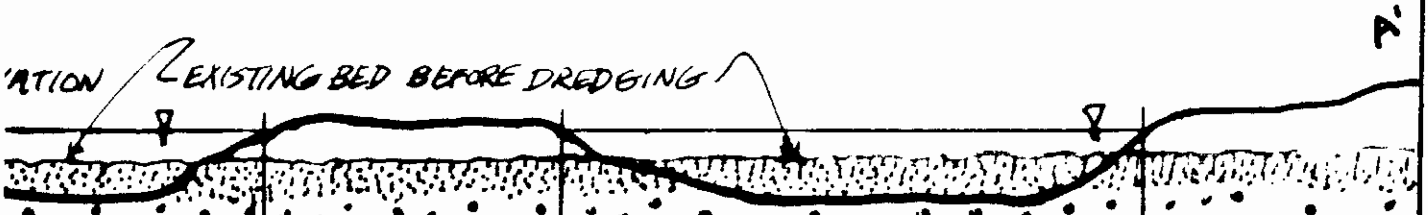


Figure 2. Channel island network.

Regarding project costs and cost effectiveness, meetings with TNC staff indicated interest in a project that could be accomplished for approximately $250,000, inclusive of the Double R Ranch. Early on we suggested that we would provide a conceptual design for a project at this cost or less, but also a conceptual design for what we felt best met the project goals for both the TNC property and the Double R, which are managed differently in some respects. This option is what we have identified as the preferred alternative, and is discussed in a later section.

Below we evaluate sediment removal options, island construction methods, and volumes of excavated materials.

Sediment Removal Options

Sediment removal options consist of either removal by conventional earthmoving methods, such as excavation by dragline or excavator and trucking, or by dredging using a suction-type floating dredge. Each method has advantages and disadvantages, as follows:

Conventional Earthmoving

Advantages:

- low cost per cubic yard of material moved;
- low mobilization cost since equipment is readily available;
- work can proceed rapidly with a minimum of disturbance;
- can create well shaped landforms within the channel.

Disadvantages:

- the area of excavation must be dewatered, which is costly;
- trucking to the disposal area requires construction and reclamation of temporary haul roads;
- equipment is noisy and may affect the solitude of the area

Dredging

Advantages:

- dewatering is not required to excavate stream bed;
- low cost pipelines can be placed to transport dredge spoil to disposal area, thus avoiding the need for haul roads;
- work can proceed with a minimum of disturbance;
- can create shaped landforms within the channel;
- can be used directly in the flowing channel with minimal increase in turbidity.

Disadvantages:

- relatively high cost per cubic yard and low daily production rate for small dredges that could be used in Silver Creek;
- requires construction of one or more sedimentation basins to contain materials pumped by the dredge;

- control over channel shape is limited when compared to conventional equipment;
- noisy and may affect the solitude of the area.

Our first preference was to utilize conventional excavation equipment based on the fact that sediment removal rates, in a well dewatered site, can be far higher than that of the dredges we investigated. This was appealing to us because we hope to minimize the amount of time in construction to limit potential disturbance to wildlife. However, we concluded that dredging is the most desirable removal method for the majority of the pond, due largely to the expense associated with installing a dewatering system. (We are assuming that the entire dam cannot be dismantled during construction. If this were a possibility, much of the sediment would be exposed above water, necessitating a far less intensive dewatering system). For the record, we examined and largely rejected the following dewatering alternatives:

- construction of removable tarp and frame type dewatering fences placed lengthwise in the stream (rejected for estimated $180,000 cost);
- placement of large straw bales lengthwise in the stream (rejected for feasibility), and;
- placement of earthen berms in the stream adjacent to the excavation (rejected for water quality concerns).

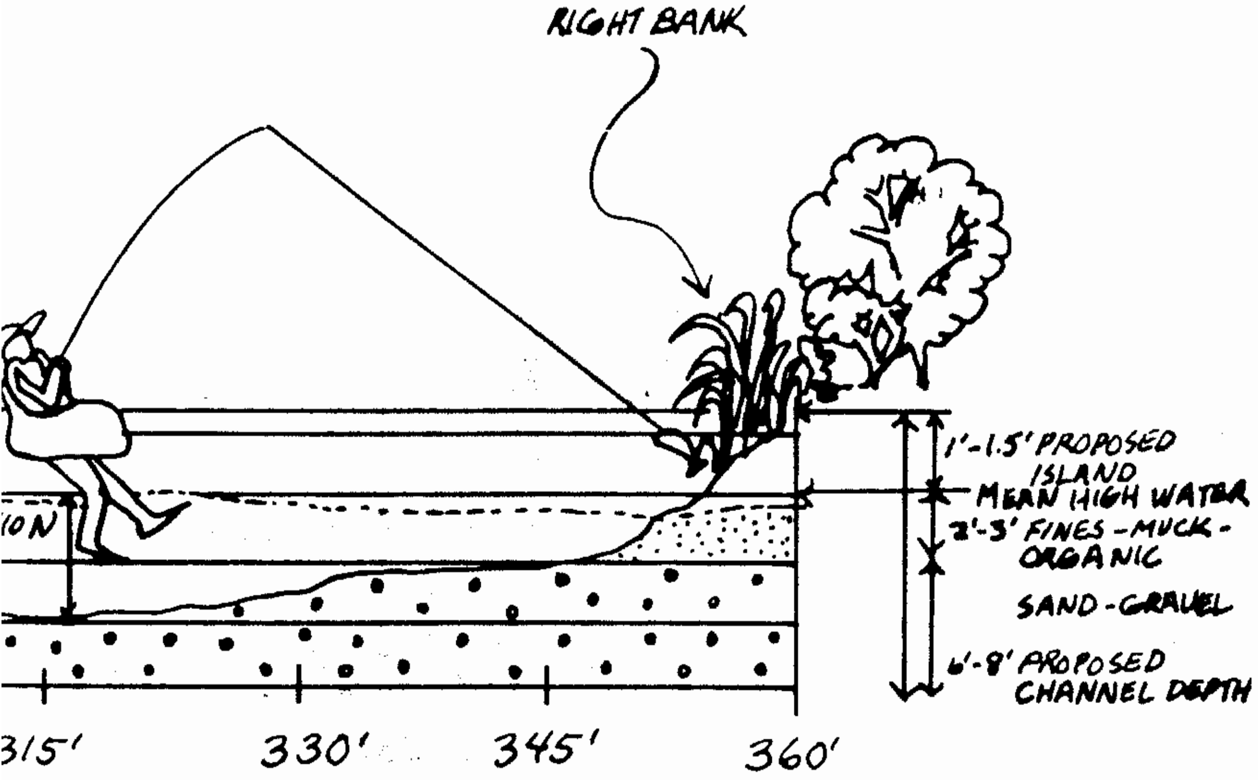
A one page description of these alternatives are found in Appendix B.

Island Construction

With conventional excavation methods rejected (preceding section), conceptual design of the islands on the Preserve portion of Kilpatrick Pond posed some of the most difficult engineering questions and difficulties. A conceptual drawing of the island attributes is included as Figure 3. A central challenge for the team was to develop a system such that pumped dredge spoils could be used to "pour" an island in the pond without exceeding turbidity limitations. Further, for stability, we desired to build the core of the islands out of the relatively stable alluvial gravel layer underlying the finer sediments in the pond, and for rapid and prolific revegetation, a one foot thick surface layer of fine sediment.

The concept of "forms", which could be "poured" into islands by the dredge dominated our design iterations. . Our sampling of existing sediments in the pond suggested that if we could first remove the fine sediments overlying the existing gravel layer, we could pump a gravel dominated slurry into the settling area and create stable islands. These could be covered with a layer of fine and organic laden sediments for a growing medium after the bulk of the island was shaped. While a simple concept, the engineering considerations, in addition to

New Islands



The Nature Conservancy of Idaho — Silver Creek Preserve

CONFLUENCE consulting incorporated

Creative Solutions for Aquatic Resources

Figure 3. Conceptual Drawing.

the water quality restrictions of the project, proved to be most challenging. Three methods of constructing the islands were investigated to determine the merits and drawbacks of each. The methods have in common a containment system which isolates or filters the turbid dredge spoils from the flowing water. Their differences have to do with the materials used in the containment system and whether they are systems that are settling and filter/flow-through or settling/pumping. The three systems investigated included:

- 1) Straw bale forms or a Portadam structure with pumping
- 2) Geotextile Filter on an A-frame with pumping
- 3) Geotextile filter on an A-Frame with filtering and seepage (the preferred option)

The first two systems control water quality through containment of the dredge spoils with an impermeable barrier and are detailed in an earlier project letter. A central feature is that the flow rate of dredge spoils into the contained area must be matched by a pump that removes this inflow rate. Since the water removed will be turbid, it must be pumped to the settling pond or land application areas. The logistical set-up of such systems, combined with the high costs of pumping and previously identified drawbacks with Portadams and straw bales, lead us to seek another solution, which is a flow-through system.

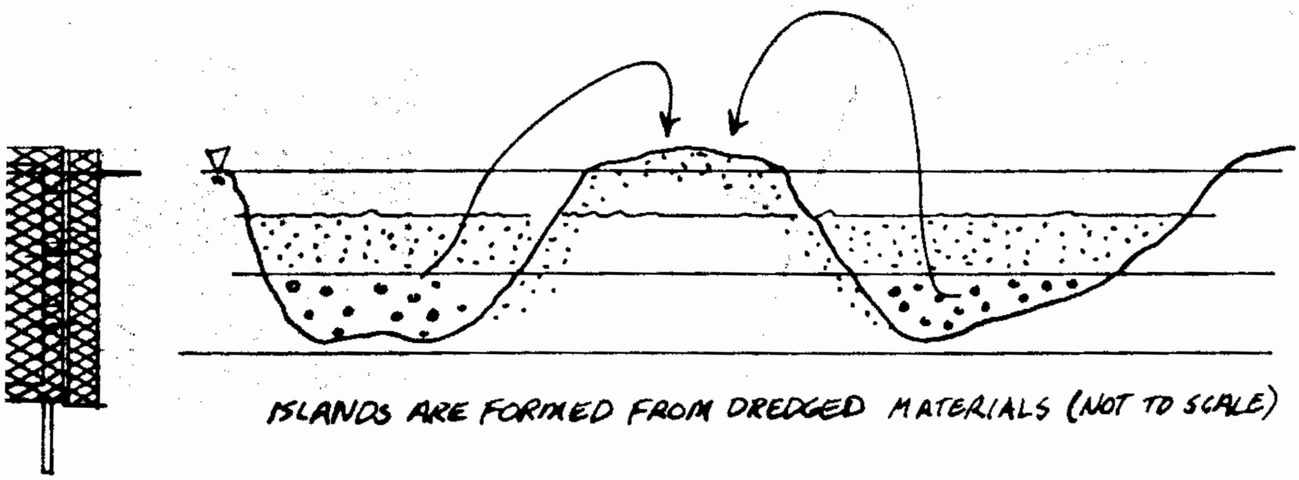
We contracted Redmond Mechanical and Flow Technologies to develop plans and beta-test a flow-through system of "forms" which could be: 1) cost-effective and easy to use, 2) stable under proposed conditions, and 3) demonstrated to be effective in bringing turbidity to acceptable levels. The resultant design is portrayed in Figure 4. Essentially, it is an A-frame design of tubular aluminum upon which a geotextile blanket is attached. It can be manipulated into place with two men operating from a floating platform, which we envision to be a pontoon boat.

The technical considerations of the design looked to minimize weight and fabrication cost, provide stability to flow pressure, and most importantly, control water quality. This method is attractive in that it substantially reduces pumping costs associated with removing the excess dredge slurry within the enclosure. Since this is a method which to our knowledge has not been tried previously, we decided to fabricate some forms and conduct a bench and field trial to evaluate its effectiveness.

Bench Test

The bench test was designed to test filtering capacity of geotextile fabric under the worst possible conditions. It was performed by mixing actual sediment from

onstruction Details



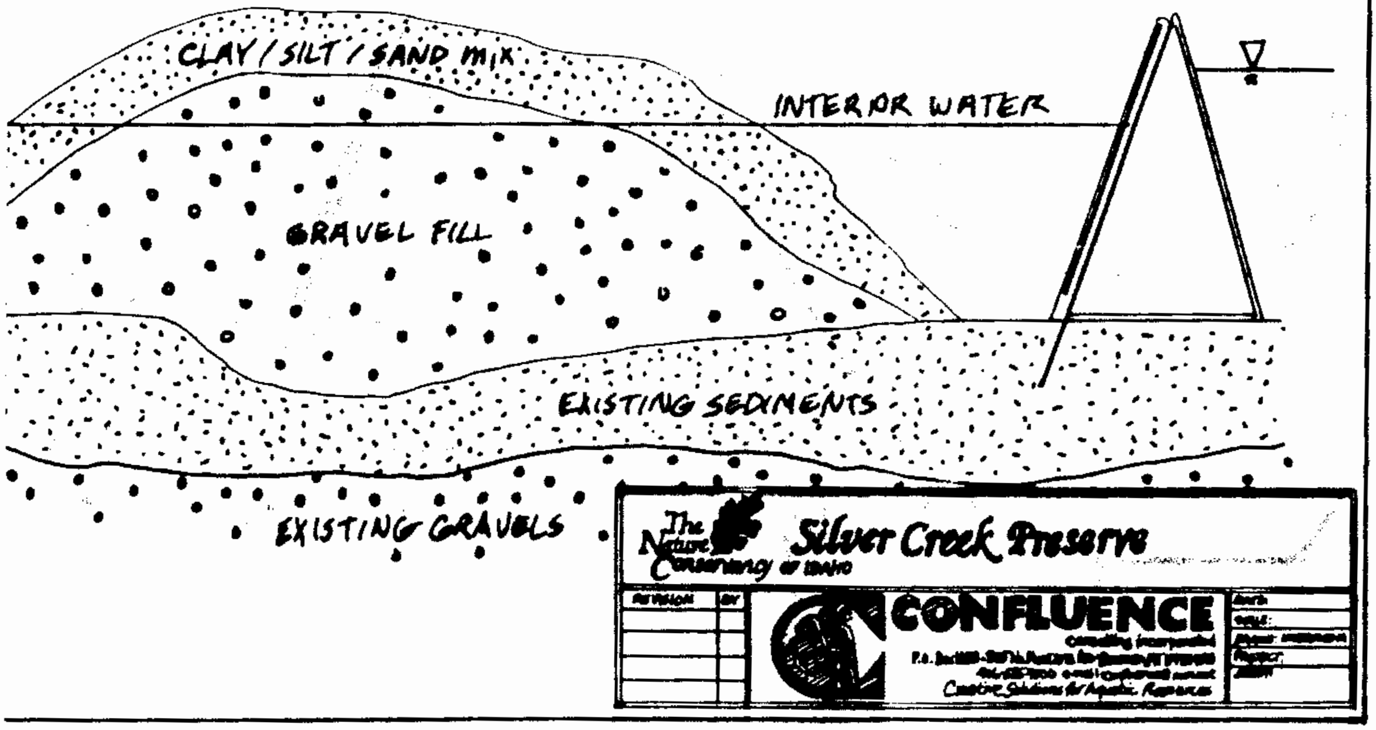


Figure 4. Island construction design.

Silver Creek with water to form a slurry with a mix proportion of 4 parts water to 1 part soil (similar to the dredge slurry) and pouring it directly through the filter fabric. This allowed all particles within the slurry to access the fabric providing a worst case scenario with respect to suspended solids. Measured in mg/l, the fabric was able to filter 66% of the suspended solids (see Appendix C).

Since the "worst case scenario" is unlikely since we are trying to settle solids in the island construction process, not filter them, these results were encouraging enough for us to pursue a field trial.

Field Trial

To determine the filtering effect of our proposed system, we fabricated four A-frames with, 6.5 feet tall and with a 4 foot base. The four A-frames were connected and aligned in a square inside a local gravel pit at about a 3 foot depth (Figure 5). Amoco 4553 non-woven geotextile, a fabric used and selected for specialty sediment filtering purposes associated with its permittivity, was selected to face the A-frames. We then pumped a slurry of various turbid mixtures into the middle of the enclosure at a rate of 200 gallons per minute. We continuously agitated the mixture inside the enclosure while taking turbidity samples on the inside of the enclosure and outside for about 90 minutes was chosen based on its permittivity. The results, found in Appendix C, are summarized by noting:

- the highest measured turbidity inside the barrier was 900 NTU's with outside at 5.5 NTUs
- leaks at corners where fabric was poorly overlapped resulted in one point measurement of 300 NTU exterior; other than that the exterior values were considered good.

These results look very promising, with dramatic variations in turbidity between the interior and exterior portions of the enclosure. This suggests that this type of system could be favorably implemented. Seams within the fabric appeared to be the primary area of concern, pointing to the need to upgrade this design component prior to the project.

From a permitting and environmental perspective, it appears that we could come close to meeting turbidity standards providing that the project area was considered to be the pond as a whole. In other words, while dredging upstream, we believe that samples taken directly below the Double R dam will likely not exceed 50 NTU's, the state standard for stream work. We further calculated the hypothetical increase in NTU's in the mixing zone assuming the total volume of the turbid dredge discharge, after flowing through the fabric, met the total flow volume of Silver Creek; results suggested less than a 1 NTU increase. However, it is entirely possible that point exceedance values, such as at a leaky

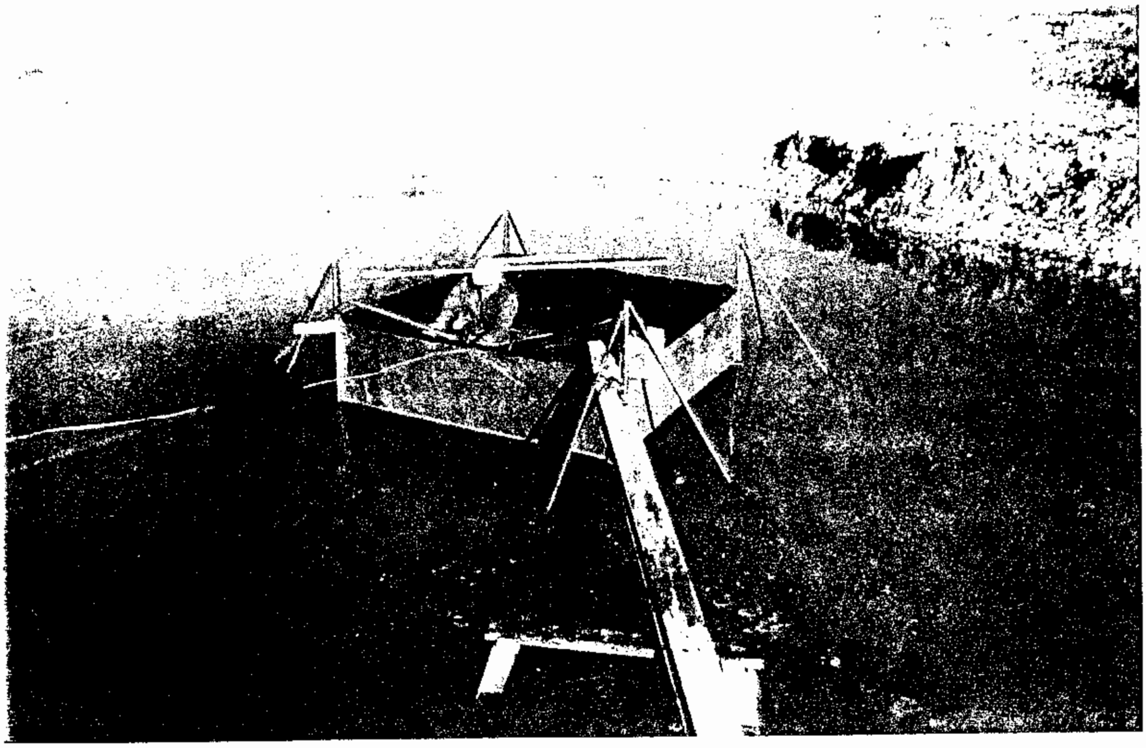


Figure 5a. Frames installed for field trial with slurry being pumped into enclosure.

Figure 5b. Interior of exclosure. Note difference in water clarity inside and outside of structure.

seam, could be over 50 NTU's, as during our test on the protoypes. Recall that Spring runoff has been measured at 13 NTU's, with no apparent influence on the system's health. We personally do not believe that turbidity from the proposed work will negatively affect the creeks biota.

Loving Creek Trial Project

To make absolute sure that the project design is sound, we would like to conduct a small pilot project in the area, using some frame modifications suggested by our field test. After speaking with Len Barney, the Loving Creek Ranch manager and dredge operator, it appeared that we might be able to interest Ward Wood in such a project, as he had also independently approached Confluence about a project on the ranch. At the time of this report we do not have confirmed interest in such a project. A pilot project is highly recommended.

Discussion of Project Size and Cost Alternatives

Iterations

We conducted three project size iterations, referred to also as "Trials" to develop a range of possible costs. The plan view of the project area portrayed in Figure 1 became the basis for all Trial iterations with respect to the surface area of the pond to be dredged as "channels", and the proportion left either as submerged islands, or filled to create islands suitable for avian nesting. The main differences between the first three trials relate to the maximum depth of the dredging in the channels. Our final trial was distinct from the first three as it had no islands. Table 1 is a summary of excavation volumes. Following is a brief description of individual trials, ranging from the largest project (Trial 1) to the smallest (Trial 3). We consider all four trials to be feasible, though for reasons outlined below, we consider Trial 2 to be the preferred option.

Table 1 contains the volumes of excavated material and fill (that needed for islands) in each trial and our estimated cost. Itemized cost estimates for the trials are found in Appendix D. Note that the range of material removed between Trial 1 and Trial 3 is approximately halved. While Trial 1 was the maximum conceivable project, Trial 3 was considered to be a minimum sized project.

Table 1. Volumes of excavated materials and fill needed for each trial of island construction.

	TRIAL 1	TRIAL 2	TRIAL 3
YARDAGES	CU-Y	CU-Y	CU-Y
Excavation Volume TNC	43,523	26,103	26,103
Island Fill TNC	9,592	7,244	0
Excavation Volume Double R	62,632	63,106	21,200
Submerged Fill	4,514	0	0
ISLAND DESRIPTION			
TNC	Emergent/Riparian	Emergent/Riparian	None
Double R Ranch	Submerged	None	None
CHANNEL DESCRIPTION			
TNC Property	8 feet deep, multiple	8 feet deep, multiple	8 feet deep, multiple
Double R Ranch	8 feet deep, multiple	8 feet deep, multiple	8 feet deep, single

Common Elements of Iterations

All options utilize a suction dredge similar to that owned by the Loving Creek Ranch, with some conventional excavation occurring on the lower area of the pond on the Double R, where deposits are above water surface elevation when the dam splash boards are removed. To receive the dredge slurry, at least 2 sediment detention basins/areas will be required, with the likely locations for these identified on Figure 1 (one on TNC property and one on the Double R). If the pits must be located upslope from the creek bed, we will construct berms around the pits to prevent slurry from reentering the creek. The costs of these basins was estimated conservatively at about $40-60,000 each.

For a cost basis for dredged yardage, we used a value of $3.20 per cubic yard in all trials. This value was arrived upon after interviewing various dredge providers, including the Loving Creek Ranch, and assumes standard working conditions, rather than difficult ones, such as encountered in winter. For conventional excavation, where possible, the cost of a removed yard was halved to about $1.50. All iterations also included cost estimates for final design engineering and on-site supervision to arrive at final costs.

Trial 1 Summary

Trial 1 reflects the largest excavation volumes, and includes maximum depth of 8 feet, with side slopes at the angle of repose of the stream sediments. TNC property would have 9 islands. The total surface area affected by the excavation is slightly greater than that portrayed in Figure 1. A finished depth of 8 feet included removal of at least 3 feet of fine sediment and up to 4 feet of gravels (see Figure 3 for a depth schematic). The volume of excavation generated from this estimate is 106,000 cubic yards; about 43,5000 cu-y on TNC property and 62,632 cu-y on the Double R. Regarding fill (islands), approximately 9,600 cu-y is required on the TNC property and to build islands submerged 1 foot below the surface on the Double R, 4,500 cu-y would be necessary.

Given the approximate progress rate of 300 cu-y per day with the dredge, this delivers a 353 day construction period, which we assumed was not feasible, even in a phased approach. Further, at an estimated $3.20/cu-y for much of the work, and combined with sediment basins large enough to hold the volumes discussed, we estimated the total cost at close to $600,000. While this option appeared to meet our goals best, we believe the cost and logistics would be prohibitive.

Trial 2 Summary

Trial 2 reduced the excavation on both the Preserve by about 42% over Trial 1 to an estimated 25,000 cu-y, and held the Double R portion about the same (63,000 cu-y) but eliminated any submerged islands. This iteration is generally portrayed in Figure 1. In the Preserve this includes construction of islands and deepened channels for the main stem flow and bisecting channels through the island complexes, which are excavated to the top of the gravel layer (approximately 7 feet deep). The Double R portion includes excavation of the sediment to the gravel layer (a depth of about 8 feet), while leaving behind areas of no excavation to produce locally elevated, but still submerged, areas.

Due to the total yardage figure and assuming a rate of 300 cu-y/day, the TNC portion of the project could be completed in approximately 84 days.; the Double R Ranch would still be prohibitive at requiring 210 days. The TNC cost would be about $260,000; Double R $243,000.

Trial 3 Summary

Trial 3 presents an attempt to reduce the overall project to what might be obtained for approximately $250,000 to $300,000. This was accomplished by eliminating the islands in the Preserve, and by reducing excavation in the Double R portion to approximately 10,000 cubic yards of dredged material and 11,100 cubic yards of matter excavated by traditional equipment. On the Double R , this would result in a single dredged channel about 50-60 feet wide, from the bridge to the dam. For the Preserve, the 8 foot channel depths would be achieved, though no islands would be constructed. Trial 3 is estimated to cost $290,000 of which $190,000 is for the Preserve property and $100,000 is for the Double R.

Discussion of Preferred Option and Opportunities

While our preferred option is Trial 2, we are aware that the sheer volume of material to be removed from the pond, and the associated cost, may be beyond the resources at hand. Other alternatives that were not closely investigated here should be kept open, and they basically represent options that are scaled down relative to what we looked into. For example, costs could be reduced by:

- reduce the depth of excavated channels
- eliminate or reduce the number of islands
- totally remove the dam and use conventional excavation techniques to remove material

There are other iterations beyond the preferred option that may still meet TNC objectives. For example, reducing the depth of the channels reduces total yardage, as does deepening only one main thread; (similar to Trial 3 on the Double R), all reducing costs. Constructing islands is also expensive due to the need to manufacture forms and a means to place them. Eliminating islands from the TNC portion of the project could result in a savings of approximately $55,000, if the increased size of the sediment ponds is considered.

It should be noted that totally removing the dam during construction would make a great deal more of the pond available for cheaper and more productive conventional excavation of the nature proposed on the lower Double R portion. With exposed sediment, water quality maintenance efforts need not be intensive, and the cost is half of dredging. However, Mr. Purdy did not favor removal and subsequent replacement at the time of this report. Removal of the dam would, however, require that the existing sediment be removed from a main channel prior to removal of the dam. Failure to do so could potentially initiate a headcut through the sediment and impart large sediment loads to the stream below the dam.

Further, the project may wish to be viewed as separate projects from the perspective of fund raising and implementation. Looked at in this context, it is entirely possible that TNC could implement the preferred option, (or some reduced form, as discussed immediately above), for approximately $260,000 or less. Should the TNC be interested in pursuing these option in fundraising, we recommend that all cost estimates be re-visited to look for additional cost savings. Our estimates tend to be conservative so that more is not promised than can be accomplished for the identified amount.

Other Considerations

Regarding the scheduling of the project, an evaluation of the most opportune times for work suggest that the typically cold months of December through March, are not conducive for dredge work due to freezing pipes, etc. This is perhaps unfortunate as this is the off season relative to visitor use at the preserve. When the TNC considers the project, care should be given to assessing the amount of time the project is expected to take and the months it can be accomplished in. There is no reason that the project couldn't be phased in a fall and spring segment, or even over a period of years.

The actual work, if carefully phased and implemented, should be relatively benign to the area's natural qualities. Noise will be an undeniable by-product of the work, as well as some temporary aesthetic issues during construction (pipe line for dredge slurry, open sediment ponds) before reclamation.

Promotional Graphics

A significant portion of our efforts for this project involved the creation of graphics images portraying the proposed project. The purpose of these images, beyond that needed for the report, were aimed at future fund raising activities that TNC might undertake. A complete list of images produced, and their reproduction potential, uses, and approximate costs, is found in Appendix E. The highlight these images is an original commissioned water color of trumpeter swans landing on the pond with the new island habitat. A black and white image is included as Figure 7. The framed watercolor original is the property of TNC.

Potential Benefits/Effects of Project

Fishery

Regarding fish habitat, we believe a great deal of careful study would be required to determine the effects of the proposed work on the resident fish population. Our experience suggests that the proposed alterations, (changing bed topography, velocity gradients, and vegetative dynamics) will neither help or hinder the already excellent productivity. One can speculate about the affects on macrophytes or other elements of pond ecology, but we have no real concern, nor an easy way to measure these variables.

Regarding created angling habitat, the Preferred Alternative design emphasizes lots of channel "edges" in overall deeper water with higher velocity – ideal and interesting belly-boating water. Rather than concentrating channel flow in the two existing channels on each bank (defined by the vegetation mats in the center) velocity will be distributed into several channels. This velocity, combined with increased depth, should keep the water fishable. Another angling benefit will be the visual separation of anglers on the TNC portion of the pond, as the proposed islands will screen anglers from each other. We hope this will reduce the "crowded" feeling at peak season, thereby enhancing the angling experience. This esthetic benefit will not be manifested on the Double R, since it is without islands.

Waterfowl

If islands are constructed we will be creating nesting opportunities for both waterfowl and riparian utilizing species. We believe that we can physically create excellent trumpeter swan nesting habitat, though whether the swans will accept it is perhaps not in our control. If a breeding area is created, attention should be given to the its management, as swan brooding and rearing habits may require special provisions in terms of human use of the area. This may be contrary to the promotion of angling use. We believe that by building secure nesting areas (islands) the chances of a nesting pair will be very good. On a final note, expanding the trumpeter's breeding range is an important part of Idaho Game and Fish's current management plan. As for other nesting waterfowl and passerines, the islands and channels between should provide excellent and diverse habitat for many life stages.

Vegetation

Given only 14% of the mainstem of Silver Creek has native riparian vegetation, the surface area of the created islands provide an opportunity to restore this area to native species. We anticipate that TNC staff will take an active role in the project planting plan and utilize this opportunity to demonstrate state-of-the-knowledge riparian restoration/reclamation strategies.

Under the preferred option of islands and channels, we will be affecting approximately 60% of the existing vegetation beds in the ponded area. This will undoubtedly reduce, at least short-term, the total biomass of submergent vegetation in the pond. Given our experience with other ponds in the area (Aubrey Springs Ranch, Dick Springs property), we don't expect this reduction to be significant in terms of measurably degrading the habitat for swans, waterfowl, or fish. By selectively deepening some areas, and changing velocity distributions, we expect some changes in species assemblages, but cannot predict what they will be.

Sediment Storage

All alternatives will create a larger sediment storage area, and should decrease the through-transport rate of sediment to Silver Creek below the irrigation dam on the Double R. From what we understand of the habitat issues downstream, we can't say one way or another whether this will result in ecological improvements. Anecdotal evidence from the Loving Creek Ranch suggests that dredging favorably influences the rate of deposition of fines downstream in following years, improving spawning opportunities. Generally, reducing sediment loads (removing the effects of current and historic watershed uses) tends to be beneficial for restoration objectives. Recall that some of the sediment load in Silver Creek, and particularly in Kilpatrick Pond, has a history of at least 100 years (approximate age of the dam). Removing this stored load will re-set the clock to conditions more representative of the early 1900's in the pond.

Lower Slough Sediment Removal

Removal of sediment from the lower slough was evaluated to determine the feasibility of providing a better hydraulic connection of the lower slough and Silver Creek. Presently the area at the confluence of these two water bodies is choked with a thick layer of sediment derived from the Molyneaux Fields and with thick mats of vegetation. They combine to effectively eliminate the fishery in this location. Removal of the vegetation and sediment would open the waterway to increase diversity in the stream and increase the area available for fishing opportunities.

Since this area was not initially scoped with respect to sediment depths the exact nature of the sediment is not known. It will likely consist of silty sands and sandy silts with thin layers of clay. This type of deposit should possess similar dredging characteristics to those materials in the stream. However, since the source area of the sediment is nearer to the depositonal site, it is likely that these materials will be slightly more fine grained with slightly lower dredge production rates.

Since the depth of excavation to reach gravel is not known, several trial excavation depths were evaluated in order to provide estimates of expected removal costs. No islands were considered for this portion of the project but the excavation will extend eastward to the small island group proposed in the upper end of the Kilpatrick Pond (see Plan Figure 2). In order to minimize costs it would be advisable to perform this sediment removal in conjunction with dredging in Silver Creek. A common sediment basin can then be used for both sites and mobilization and pipeline construction requirements can then be either eliminated or reduced substantially. Estimates were prepared with this assumption in mind.

Excavation in the main channel of the slough was estimated to consist of an area approximately 400 feet long with a width of 75 feet. An additional connector channel to the main branch of Spring Creek was estimated to require excavation of an area approximately 170 feet long and 60 feet wide. Cost estimates were prepared for assumed dredging depths of 2, 3, 4, and 5 feet (Table 2). We would guess that excavation depths between 3 and 4 feet are likely, based on gravel elevations in the neighboring channel.

Table 2. Estimated costs of dredging the slough channel to various depths.

Excavation Depth	Cubic Yards	Cost/C.Y.	Additional	Cost
2	2980	$3.20	$2000	$11,500
3	4470	$3.20	$3000	$17,300
4	5960	$3.20	$4000	$23,100
5	7440	$3.20	$5000	$28,800

Sediment from this removal area would be piped to the sedimentation basin prepared for the dredge spoil from Silver Creek. These estimated costs are not included on the cost estimates for Trials 1, 2, and 3.

Molyneaux Farm Runoff

Runoff from the Molyneaux Fields currently impacts the lower slough by concentrating runoff in the southern portion at the point nearest the existing road (Figure 6). The sediment travels unimpeded along the road and enters the slough by overtopping the road. It is apparent that the drainage contains considerable sediment during infrequent runoff events based on observations of the sediment load and shallow nature of the pond in this area.

Although a detailed feasibility study has not been performed, preliminary survey data suggests that construction of a culvert under the road, combined with a drainage ditch with incorporated distributary channels could provide the necessary method to slow runoff and reduce the sediment load to the pond. Infiltration would be enhanced and sediment deposited on the vegetated slopes above the pond. It is estimated that a relatively simple fix such as this would cost between $5,000 and $10,000.

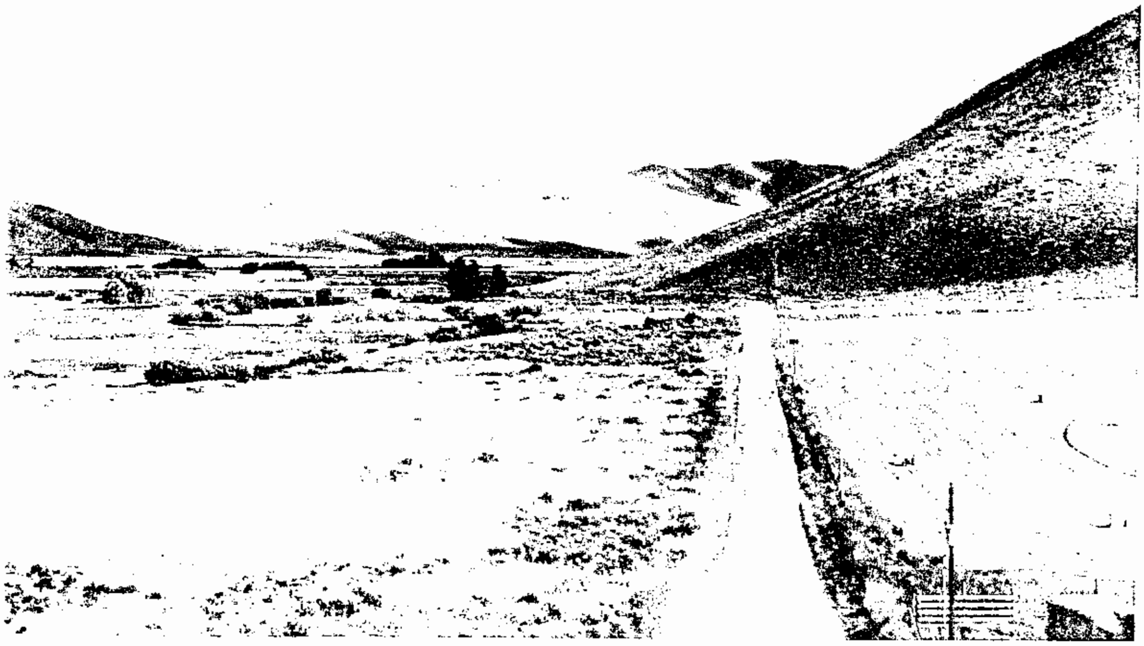


Figure 6a. Molyneaux fields.

Figure 6b. Organic laden runoff discharging to the Lower Slough.

Summary/Recommendations

In summary, we believe that the project described here is feasible from a technical perspective, though internal decision making within the Idaho TNC office is warranted with respect to the scale of the project. While constructed islands on the TNC property add to the costs of the project, we believe that there esthetic and physical function makes them worthwhile. We had hoped that the project costs for the preferred alternative would prove to be less, though our best estimates at this point indicate a significant financial commitment. Be aware that our costs are conservative; further investigation may lead to less expensive estimates. The issue of the islands ability to attract trumpeter swans also must be reconciled with the management issues surrounding human pressure by fishing at critical periods.

Should TNC pursue the project, we strongly recommend that a pilot project of smaller scale be undertaken first. The Loving Creek Ranch is one area where such a trial could be possible. It is also our recommendation that TNC consider the option of a project on a scale smaller if fund raising issues are a problem. Ultimately, the size of the project funded relates to the goals of the project. Our preferred option is one which we believe would meet the long-term objectives of sediment control and angling enhancement in a highly visible and world-class angling destination. Very little additional design or investigation work would be necessary to estimate costs on a smaller project since costs presented here are based on a unit basis. Phasing the project over a number of years is also a possibility, but should consider the implications of repeated entry into the site with heavy equipment. Some consideration should also be given to separating the TNC portion of the project from the Double R with regards to financing the project. Aside from the larger Kilpatrick Pond project, addressing runoff problems from the Molyneaux fields is relatively easily implemented, and therefore, highly recommended.

Literature Cited

Manuel, C. Y., J. S. Griffith, and G. W. Minshall. 1979. The sources and causes of sedimentation in Silver Creek, Blaine County, Idaho. Final Report.

Natural Resources Conservation Service. 1996. Silver Creek Watershed, Preliminary Investigation, Blaine County, Idaho. U. S. Department of Agriculture. Blaine Soil Conservation District, Hailey, Idaho.

Todd, P. 1992. Silver Creek Preserve Water Quality Monitoring, Project overview and summary from June 1991 to April 1992. Silver Creek Preserve, The Nature Conservancy, Picabo Idaho.

Todd, P. 1997. Silver Creek, Site Conservation Plan. Silver Creek, Site Conservation Plan. The Nature Conservancy, Sun Valley, Idaho.

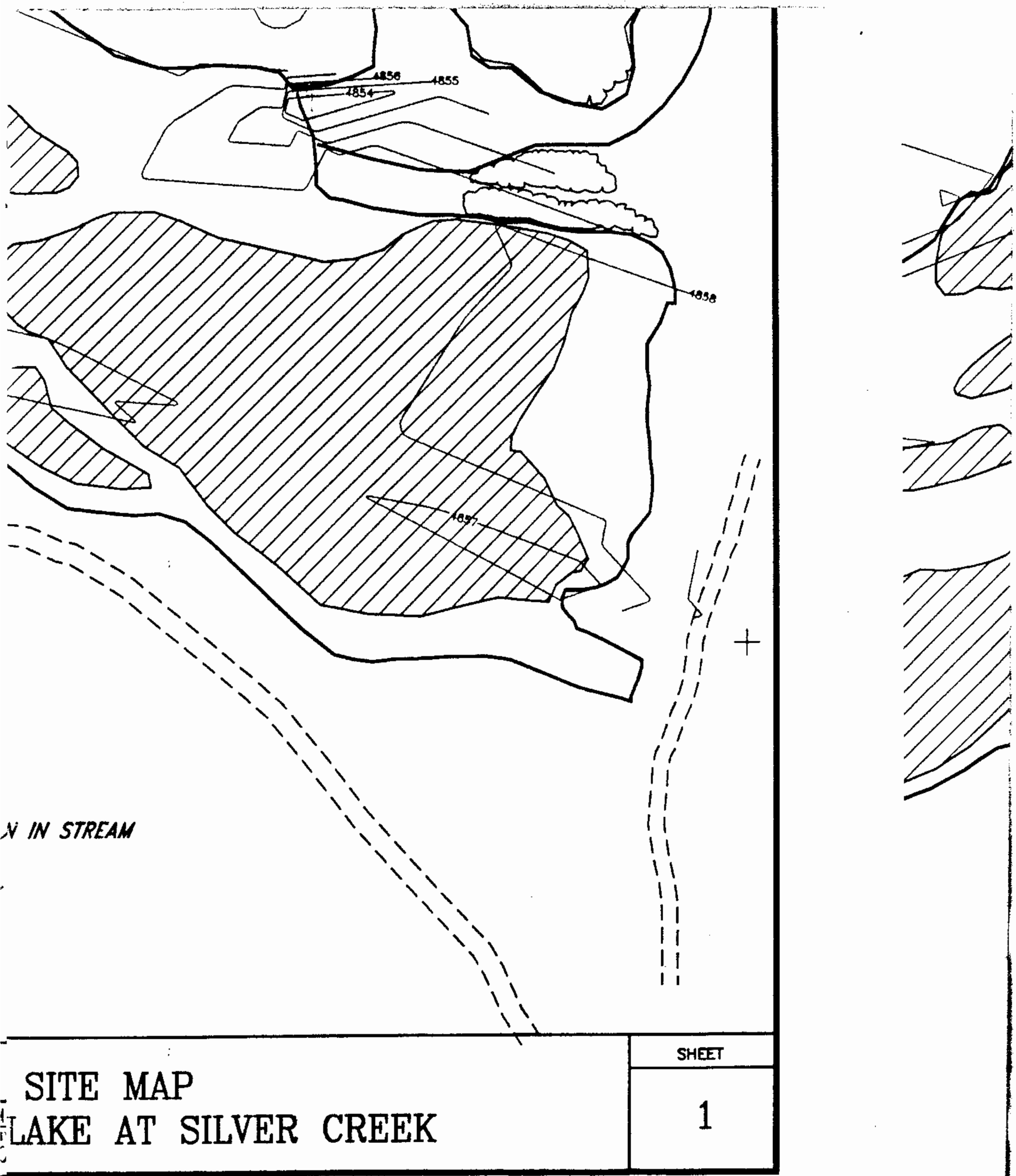
Wilkison, R. A. 1996. Fish Community and Brown Trout Predation in Upper Silver Creek, Idaho. MSc. Thesis, Idaho State University, Pocatello, Idaho.

Wolter, M., P. Todd, and E. Watters. 1994. Silver Creek Preserve Stream Quality Monitoring Summary. Silver Creek Preserve, The Nature Conservancy, Picabo, Idaho.

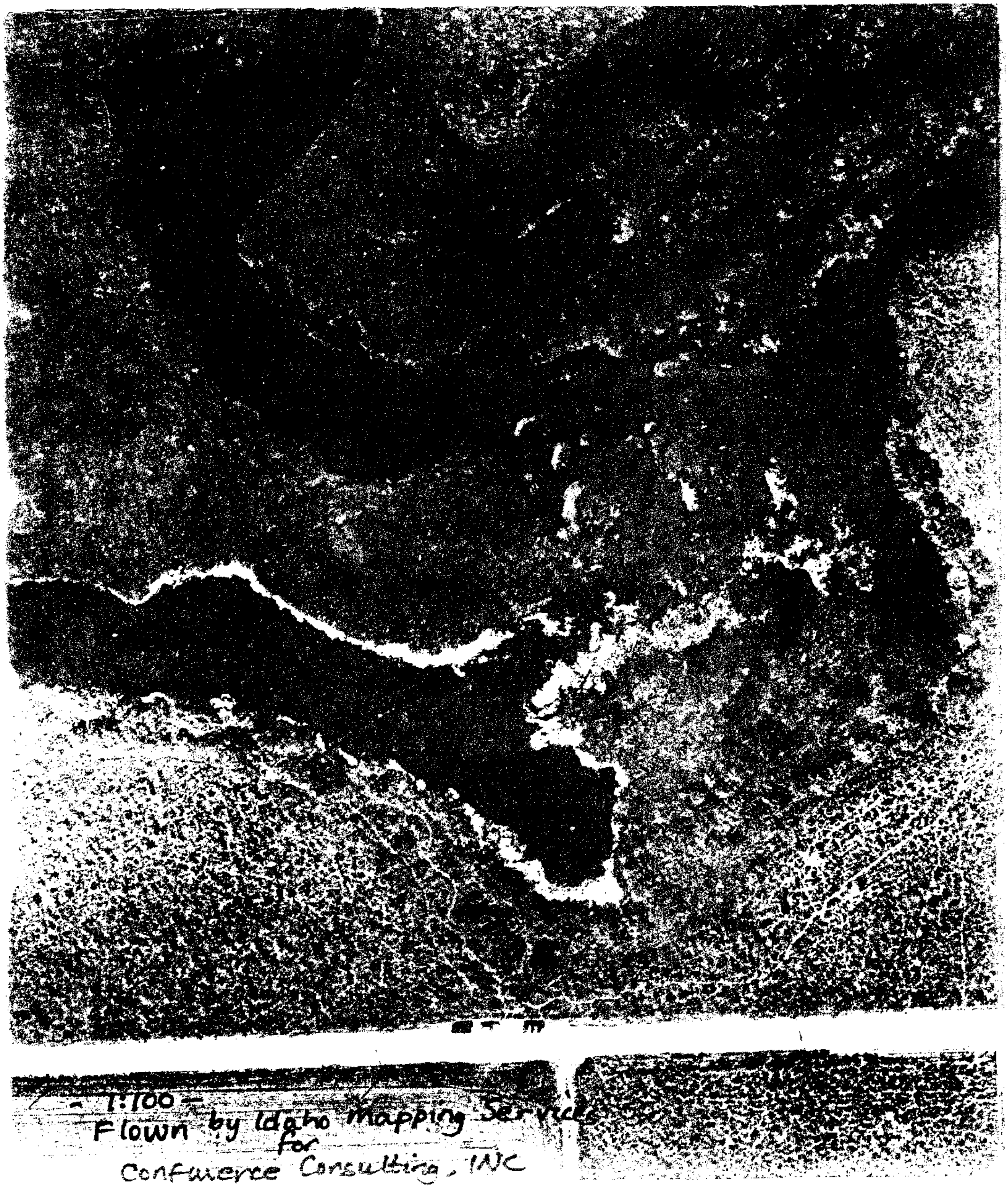
APPENDIXES

APPENDIX A

TOPOGRAPHIC AND AERIAL MAPPING



Appendix A. Topographic map.


- 1:100 -
Flown by Idaho Mapping Services
for
Confluence Consulting, INC

APPENDIX B

INVESTIGATED DEWATERING SYSTEMS

We investigated three methods for dewatering Silver Creek to the point that we could isolate the channel from construction using conventional excavation equipment:

- construction of removable tarp and frame type dewatering fences placed lengthwise in the stream;
- placement of large straw bales lengthwise in the stream, and;
- placement of earthen berms in the stream adjacent to the excavation.

All three methods would require multiple placements (staging) as only a portion of the stream could be dewatered at a given time. This involves a great deal of logistical problems in setup and tear-down.

Tarp and frame dewatering structures are impermeable membranes stretched over a heavy steel frame. The completed structures can be hundreds of feet in length and form a very water-tight barrier, but are time consuming and very expensive to install. Frame rental for upward of three to four months, labor to erect and dismantle the frames multiple times, and groundwater pumping within the dewatered enclosure could approach $150,000 to $180,000. Therefore, this method of dewatering was considered unfeasible for this project.

Straw bale placements were investigated and rejected due to the cost associated with placing them, the difficulty in removing them once placed, and the uncertain stability of the bales when submerged to nearly their entire height. We looked at large bales (approximately 4' x 4' x 6') which saturate and sink, forming a reasonable coffer dam. Expected costs for this type of barrier construction and associated dewatering were estimated to be approximately $50,000. While a potentially reasonable value, we could not satisfy ourselves that the placement and removal logistics could be overcome.

Placement of earthen berms was rejected for all locations except possibly the lower end of the pond on the Double R, as the nature of their construction would not be possible without violating turbidity standards. Berms may be a possibility on the lower Double R portion of the pond with sufficient silt fencing and in conjunction with removing the dam splash boards.

APPENDIX C

TURBIDITIY RESULTS FROM FIELD AND BENCH TRIAL

Notes: 1) Time 0 background NTU = 12.5, which should be subtracted from all readings. 2) The maximum difference between inside turbidity and outside was 900 to 5.5 NTU at 30 minutes. 3) The highest point sample of exterior NTU's was 300 at a leak point between adjacent frames.

Time (min)	Location	Total Solids in mg/L	Turbidity in NTU
0	Prior to Test Exterior	0.32	12
0	Prior to Test Exterior	0.26	13
0	Interior Enclosure	4.18	550
30	Interior Enclosure	5.6	900
30	Exterior Enclosure	0.28	5.5
40	**Exterior Enclosure** At leak at corner	**1.40**	**300**
40	Exterior Enclosure South Side	0.29	27.5
40	Exterior Enclosure East Side	0.28	17.5
40	Exterior Enclosure West Side	0.30	13.0
40	**Exterior Enclosure** North Side	**0.60**	**76.0**
40	Interior Enclosure	3.70	400
72	Interior Enclosure After Clay Addition	7.20	650
72	Exterior Enclosure South side	0.25	7.2
	Bench Test Initial	**10.1**	**2350**
	Bench Test Final	**3.40**	**800**

APPENDIX D

COST ESTIMATES

Silver Creek at Silver Creek Preserve
Volume Calculations

Trial 1

Assumptions:

Upper Pond

1) Maximum potential extent of excavation in Nature Conservancy portion of Project

2) Islands exposed approximately 1-2 feet above the surface in Nature Conservancy portion

3) Channel excavated to an elevation of 4852 (depth of ~8')

4) Gravel encountered at elevation of 4855 in upper portion and 4833 to 4834 near Bridge

5) Water Surface at Approximately 4860.5 near Bridge and 4861 in upper portion

6) Excavation carried to approximately the edge of the existing stream channel

7) Islands sized approximately as first indicated by Confluence

Lower Pond

1) Excavation approximately to original proposed limits

2) Islands submerged approximately 1 foot below the surface

3) Channel excavated to an elevation of 4852 (depth of ~8')

4) Gravel encountered at elevation of 4853 in upper portion near bridge and 4851 at downstream extent

5) Water surface at approximately elevation 4860

6) Excavation limits carried to approximately the edge of the existing stream channel

7) Islands sized approximately as first indicated by Confluence

Trial 1 Volumes:

Total Volume of Excavation (Both upper and lower ponds):	106155
Total Volume of Fill (Both upper and lower ponds):	14106
Estimated excavation in upper pond:	43523
Estimated fill in upper pond:	9592
Estimated excavation in lower pond:	62632
Estimated fill in lower pond:	4514

COST ESTIMATE FOR SILVER CREEK CONSTRUCTION
TRIAL 1

Item	Unit	Quantity	Unit Cost	Cost	Subtotal	Total
Sediment Pond Construction						
Nature Conservancy for 33933 C. Y.						
Topsoil Excavation	C.Y.	8480	$0.95	$8,056		
Subsoil Excavation	C.Y.	25450	$1.25	$31,813		
Subsoil Replacement	C.Y.	25450	$0.95	$24,178		
Topsoil Replacement	C.Y.	8480	$1.25	$10,600		
Seeding	Acre	5.5	$600.00	$3,300		
Total Sediment Pond Construction					$77,946	
Purdy Property for 21920 C. Y.						
Topsoil Excavation	C.Y.	5480	$0.95	$5,206		
Subsoil Excavation	C.Y.	16440	$1.25	$20,550		
Subsoil Replacement	C.Y.	16440	$0.95	$15,618		
Topsoil Replacement	C.Y.	5480	$1.25	$6,850		
Seeding	Acre	3.4	$600.00	$2,040		
Total Sediment Pond Construction					$50,264	**$128,210**
Channel Deepening						
Nature Conservancy for 43523 C.Y.						
Dredging - two man local crew	C.Y.	43523	$3.20	$139,274		
Mobilization	Lump	$2,000	1	$2,000		
Total Channel Deepening					$141,274	
Purdy Property for 62632 C.Y.						
Dredging - two man crew	C.Y.	21920	$3.20	$70,144		
Mobilization	Lump	$2,000	1	$2,000		
Dragline and Trucking	C.Y.	40710	$1.50	$61,065		
Mobilization	Lump	$2,000	1	$2,000		
Haul Road Construction	Lump	$6,700	1	$6,700		
Total Channel Deepening					$141,909	**$283,183**
Island Construction						
Nature Conservancy						
Construct and Mobilize Frames/Barge	Lump	32,000	1	$32,000		
Place and Remove Frames	L.F.	5800	$7.65	$44,370		
Shape and Revegetate Island	Lump	$3,000	1	$3,000	$76,370	**$76,370**
Purdy Property - No Constructed Islands						
Site Supervision						
Nature Conservancy						
Construction Supervision	Lump	$50,000	1	$50,000		
Engineering	Lump	$20,000	1	$20,000		
Total Channel Deepening					$70,000	
Purdy Property						
Construction Supervision	Lump	$40,000	1	$40,000		
Engineering	Lump	$10,000	1	$10,000		
Total Channel Deepening					$50,000	**$120,000**
Total Cost on Nature Conservancy Property						**$365,590**
Total Cost on Purdy Property						**$242,173**
Total Project Cost						**$607,763**

Trial 2

Assumptions:

Upper Pond

1) Reduced potential extent of excavation in Nature Conservancy portion of Project

2) Islands exposed approximately 1-2 feet above the surface in Nature Conservancy portion

3) Channel excavated to an elevation of 4852 (depth of ~8')

4) Gravel encountered at elevation of 4855 in upper portion and 4833 to 4834 near Bridge

5) Water Surface at Approximately 4860.5 near Bridge and 4861 in upper portion

6) Excavation limits moved toward stream channel and islands connected by channels to top of gravel

7) Islands sized approximately as first indicated by Confluence

Lower Pond

1) Excavation approximately to original proposed limits

2) No islands created in the Purdy property

3) Channel excavated to an elevation of 4852 (depth of ~8')

4) Gravel encountered at elevation of 4853 in upper portion near bridge and 4851 at downstream extent

5) Water surface at approximately elevation 4860

6) Excavation limits moved in from the edge of the existing stream channel

7) Islands sized approximately as first indicated by Confluence

Trial 2 Volumes:

Total Volume of Excavation (Both upper and lower ponds):	89209
Total Volume of Fill (Both upper and lower ponds):	8697
Estimated excavation in upper pond:	26103
Estimated fill in upper pond:	7244
Estimated excavation in lower pond:	63106
Estimated fill in lower pond:	1453

COST ESTIMATE FOR SILVER CREEK CONSTRUCTION
TRIAL 2

Item	Unit	Quantity	Unit Cost	Cost	Subtotal	Total
Sediment Pond Construction						
Nature Conservancy for 18860 C. Y.						
Topsoil Excavation	C.Y.	4715	$0.95	$4,479		
Subsoil Excavation	C.Y.	14145	$1.25	$17,681		
Subsoil Replacement	C.Y.	14145	$0.95	$13,438		
Topsoil Replacement	C.Y.	4715	$1.25	$5,894		
Seeding	Acre	2.9	$600.00	$1,740		
Total Sediment Pond Construction					$43,232	
Purdy Property for 22100 C. Y.						
Topsoil Excavation	C.Y.	5525	$0.95	$5,249		
Subsoil Excavation	C.Y.	16575	$1.25	$20,719		
Subsoil Replacement	C.Y.	16575	$0.95	$15,746		
Topsoil Replacement	C.Y.	5525	$1.25	$6,906		
Seeding	Acre	3.5	$600.00	$2,100		
Total Sediment Pond Construction					$50,720	**$93,952**
Channel Deepening						
Nature Conservancy for 43523 C.Y.						
Dredging - two man local crew	C.Y.	26103	$3.20	$83,530		
Mobilization	Lump	$2,000	1	$2,000		
Total Channel Deepening					$85,530	
Purdy Property for 62632 C.Y.						
Dredging - two man crew	C.Y.	22087	$3.20	$70,678		
Mobilization	Lump	$2,000	1	$2,000		
Dragline and Trucking	C.Y.	40545	$1.50	$60,818		
Mobilization	Lump	$2,000	1	$2,000		
Haul Road Construction	Lump	$6,700	1	$6,700		
Total Channel Deepening					$142,196	**$227,726**
Island Construction						
Nature Conservancy						
Construct and Mobilize Frames	Lump	$32,000	1	$32,000		
Place and Remove Frames	L.F.	5800	$7.65	$44,370		
Shape and Revegetate Island	Lump	$3,000	1	$3,000	$76,370	**$76,370**
Purdy Property - No Constructed Islands						
Site Supervision						
Nature Conservancy						
Construction Supervision	Lump	$40,000	1	$40,000		
Engineering	Lump	$20,000	1	$20,000		
Total Channel Deepening					$60,000	
Purdy Property						
Construction Supervision	Lump	$40,000	1	$40,000		
Engineering	Lump	$10,000	1	$10,000		
Total Channel Deepening					$50,000	**$110,000**
Total Cost on Nature Conservancy Property						**$265,132**
Total Cost on Purdy Property						**$242,916**
Total Project Cost						**$508,048**

Trial 3

Assumptions:

Upper Pond

1) Same volume of excavation as in Option 3 for Nature Conservancy

2) No islands constructed in Nature Conservancy portion

3) Channel excavated to an elevation of 4852 (depth of ~8') as in Option 3 without islands

4) Gravel encountered at elevation of 4855 in upper portion and 4833 to 4834 near Bridge

5) Water Surface at Approximately 4860.5 near Bridge and 4861 in upper portion

6) Excavation limits same as Option 3

Lower Pond

1) Excavation on Purdy decreased to reduce total cost to less than $300,000

2) Dredging on N.C stays the same

3) Channel excavated to an elevation of 4852 (depth of ~8') and 50 feet wide bottom @ 2:1

4) Gravel encountered at elevation of 4853 in upper portion near bridge and 4851 at downstream extent

5) Water surface at approximately elevation 4860

6) Excavation and dredging will give 900 l.f. of dragline and 800 l.f. of dredging

7) Road construction, construction supervision, and enginering reduced to bare minimum

Trial 4 Volumes:

Total Volume of Excavation (Both upper and lower ponds):	47303
Total Volume of Fill (Both upper and lower ponds):	0
Estimated excavation in upper pond:	26103
Estimated fill in upper pond:	0
Estimated excavation in lower pond:	21200
Estimated fill in lower pond:	0

COST ESTIMATE FOR SILVER CREEK CONSTRUCTION
TRIAL 3

Item	Unit	Quantity	Unit Cost	Cost	Subtotal	Total
Sediment Pond Construction						
Nature Conservancy for 26103 C. Y.						
Topsoil Excavation	C.Y.	6525	$0.95	$6,199		
Subsoil Excavation	C.Y.	19577	$1.25	$24,471		
Subsoil Replacement	C.Y.	19577	$1.25	$24,471		
Topsoil Replacement	C.Y.	6525	$0.95	$6,199		
Seeding	Acre	2.9	$600.00	$1,740		
Total Sediment Pond Construction					$63,080	
Purdy Property for 10000 C. Y.						
Topsoil Excavation	C.Y.	2500	$0.95	$2,375		
Subsoil Excavation	C.Y.	7500	$1.25	$9,375		
Subsoil Replacement	C.Y.	7500	$0.95	$7,125		
Topsoil Replacement	C.Y.	2500	$1.25	$3,125		
Seeding	Acre	1.6	$600.00	$960		
Total Sediment Pond Construction					$22,960	**$86,040**
Channel Deepening						
Nature Conservancy for 43523 C.Y.						
Dredging - two man local crew	C.Y.	26103	$3.20	$83,530		
Mobilization	Lump	$2,000	1	$2,000		
Total Channel Deepening					$85,530	
Purdy Property for 62632 C.Y.						
Dredging - two man crew	C.Y.	10000	$3.20	$32,000		
Mobilization	Lump	$2,000	1	$2,000		
Dragline and Trucking	C.Y.	11183	$1.50	$16,775		
Mobilization	Lump	$2,000	1	$2,000		
Haul Road Construction	Lump	$3,500	1	$3,500		
Total Channel Deepening					$56,275	**$141,804**
Island Construction						
Nature Conservancy						
Construct and Mobilize Frames	Lump	$0	1	$0		
Place and Remove Frames	L.F.	0	$7.65	$0		
Shape and Revegetate Island	Lump	$0	1	$0	$0	**$0**
Purdy Property - No Constructed Islands						
Site Supervision						
Nature Conservancy						
Construction Supervision	Lump	$25,000	1	$25,000		
Engineering	Lump	$15,000	1	$15,000		
Total Channel Deepening					$40,000	
Purdy Property						
Construction Supervision	Lump	$15,000	1	$15,000		
Engineering	Lump	$5,000	1	$5,000		
Total Channel Deepening					$20,000	**$60,000**
Total Cost on Nature Conservancy Property						**$188,610**
Total Cost on Purdy Property						**$99,235**
Total Project Cost						**$287,844**

APPENDIX E

PROMOTIONAL GRAPHICS

KILPATRICK POND ENHANCEMENT PROJECT

PRESENTATION MATERIALS: *Potential Use*

ARTIST WATERCOLOR

1. Auction original at dinner or gathering
2. Reproduce artist prints and posters
   - A. $2,000 for 2,000 reproductions
     - i. Sign Artist Proof and use as gift for largest donor
     - ii. Sign and number 10 limited issue - use as gifts for designated donations
     - iii. Sell remaining 1,990 as posters
3. Use watercolor digital file for publications and electronic communications
   Digital file on Zip removable disk $45.00 plus shipping
4. Line illustration for watercolor study is available for black and white printing
   Digital file available at no charge with watercolor digital file on Zip removable disk

DIGITAL FILE

1. Send via e-mail to interested parties
2. Use on host web site (find donor)
3. Print color copies for distribution ($12.00 first copy, $2.00 each additional copy)
4. Make slides from digital file for presentations ($20.00 plus film/dev for 24 slides)

* The original digital file is much higher resolution and suitable for publication printing
Copies of file are available on ZIP removable disks for $38.00 plus shipping.

MYLAR DRAFTED MATERIALS:

1. Original mylar
   - A. Reductions for inclusion in reports and presentations
   - B. Reproductions to digital files for slides, e-mail, and publication printing
     $25.00 per hour plus material costs and shipping