EARTHWORK ON THE BERRY GLEN SLIDE

Redwood National Park

New Growth Forest Services
P.O. Box 61
Ukiah, California 95482
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BACKGROUND AND PERSPECTIVE

In September of 1977, New Growth Forest Services (NGFS) was awarded a contract by the Redwood National Park (RNP) to demonstrate and evaluate land rehabilitation efforts in the Berry Glen slide, within a larger 230 acre zone designated as Area 3. Prior to this, NGFS made three field inspections of the site.

On the slopes of Berry Glen Creek, in the middle 1960s, just prior to initial RNP acquisition, an unprecedented series of tractor (bull-dozer) clearcuts of virgin redwood forest was initiated by the Arcata Redwood Company (ARCO).

> "The management-induced erosive processes, so prevalent in the Redwood Creek Basin and surrounding watersheds, have been initiated primarily because road construction and yarding operations commonly have obliterated the finer details of the natural drainage pattern, and concentrated runoff in a limited number of pre-existing channels."[1]

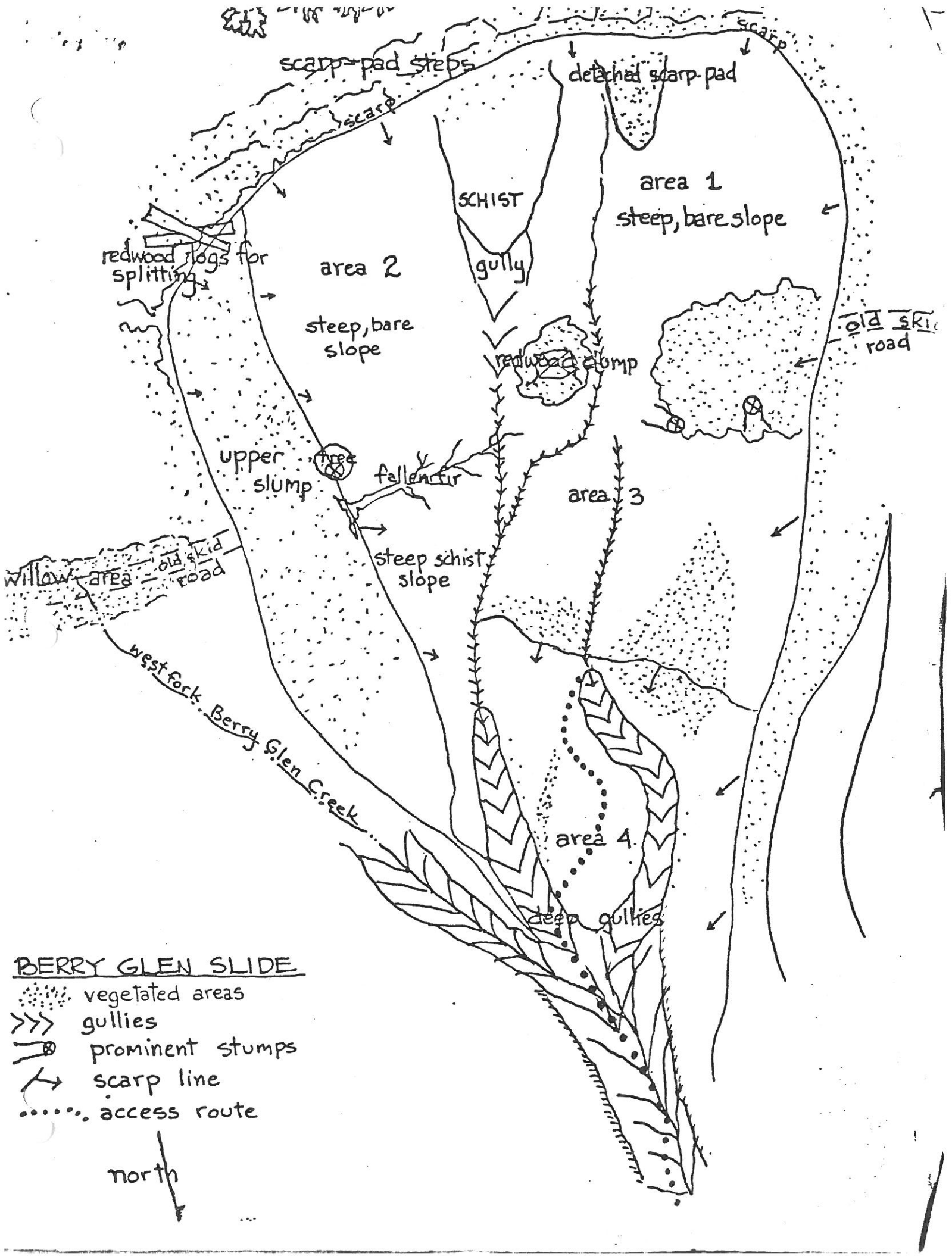
This was the case of the Berry Glen Slide. The slide itself occurred in the heavy rains of 1972-73; no specific details of its cause have been documented. The area where the slide occurred faces almost due north, receiving almost no sunlight for at least two months of the year. Clear traces of the old skid road can be seen on each side of the massive slope failure.

Berry Glen Creek is a third order stream (not documented) located in the NW$\frac{1}{4}$ Section 26, Township 11 North, Range 1 East, Humbolt Bay Meridian. The Berry Glen slide is a large (about three acres), deep-seated, compound landslide or debris avalanche with

Berry Glen Slide Site Description (see map on next page)

Below the exposed scarp head is a steep (50 to 80 degree) bowl-shaped area, from which large amounts of material have moved down slope. From a distance it seems to be all bare soil with intermittent, shallow (up to 12 inch) gullies. The central part of this north-facing bowl has more gullies and less soil, tending to bare schist. The bowl sides (Areas 1 and 2) are composed of a reddish, clayey soil. Vegetation was very sparse: limited grasses and forbes with an occasional young redwood or sitka spruce, willow or coyote bush; all of these were small (usually less than a foot high) and in a state of questionable health. One detached scarp pad, next to Area 1, seemed to be holding on precariously with the roots of its thorny passengers.

Below and to the center of the upper bowl is a relatively flat to gently sloping (0-20°) area (#3) anchored by a large redwood stump with numerous sprouts already above head height. Two large stumps (dead), coyote bush, willow, alder, berries, small conifers, and numerous grasses and forbes were healthy occupants of this zone. The sides of the bowl continue with steeper barren slopes of red clay to the west and blue, sometimes clayey, schist to the east. Those to the west, having a northeasterly aspect, are less steep and have more soil than those to the east where large steep banks of bare schist have been exposed. Some willow and alder were vigorously taking hold on this


scarp
scarp-pad steps
detached scarp-pad
scarp
SCHIST
area 1
steep, bare slope
redwood logs for splitting
area 2
gully
steep, bare slope
redwood clump
old skid road
upper slump
tree
fallen fir
area 3
steep schist slope
willow area
old skid road
west fork Berry Glen Creek
area 4
deep gullies
BERRY GLEN SLIDE
vegetated areas
gullies
prominent stumps
scarp line
access route
north

bare east slope just below a fallen fir tree, the branches of which had apparently helped to stabilize this soilless revegetation.

Below the central gently sloping zone, two extensive gully systems had formed, leaving ridges of bare-red clayey soils in between (Area 4). The gullies were 10 to 15 feet deep near their heads, and the eroding and exposed banks cut into blue clay on the western gully and schist (in the eastern one). To the west of the shallower (western) gully was another barren clayey slope with a northeasterly aspect. The gullies were approximately 120 to 180 feet long, merging with the perennial stream below.

PLANNING

Goals

The plan for rehabilitating any damaged forest area is critically site specific; nevertheless, we feel that some broad principles apply to all sites:

1. ". . . the purpose of rehabilitation is to check erosion at its source and prevent further expansion of actively eroding areas . . . to restore natural systems to the degree possible."[4]
2. "In general, sedimentation problems can be more successfully solved by attempting to hold soils in place on hillslopes and by trapping sediment in small gullies and ephemeral water courses

than by controlling sediment in large perennial stream channels."[5]

3. "We look to vegetation, not dams, for permanent control and to that end our efforts are directed towards hastening the process of vegetative recovery."[6]
4. Small problems need to be stabilized before they become large ones.

The four interlocking goals of our work effort have been: slope stabilization, collection of sediment, reduction of erosive forces and re-vegetation.

Mapping

As part of our final contract negotiations, before work commenced, we drew an initial map for work planning (see appendix A) of Areas 1, 2, 3, and 4 to identify the areas to be wattled. At the end of our twelve-day fall work program, we drew a map identifying the sites of changes made to the landform. Neither of these maps was to scale.

The final map (dated 1/26/78) updates the October map. It was not surveyed but is more to scale. We appreciate RNP's study map, which we used as a base.

We feel that our efforts could have been more effective if detailed (1:2500) maps and aerial photos were available beforehand. Orientation to site features, surroundings and mass-movements is essential

to foster confidence and accuracy in planning and on-the-job decision making.

Accurate maps and photos can document mass-movements, also facilitating the planning of permanent access routes and the location of resource material areas. We feel it is appropriate that the park, or other owners of cutover forest land, should provide these maps on a tributary watershed basis.

Identified Problem Areas (Work Plan)

1. Trails
   a. Access. Clear a safe, non-eroding trail for the transport of personnel, tools and materials.
   b. Resource-materials. Obtain maximum branches for wattle bundles without significantly depleting vegetative cover; harvest in a manner so as to encourage fast regeneration; transport split materials from production site without disturbing slopes.
2. Areas with bare soils (Areas 1, 2, 3, and 4): Stabilize and re-vegetate (construct wattles, plant cuttings, seeds and conifers).
3. Areas with bare schist: revegetate, plant cuttings.
4. Correct upslope drainage problems, if any.
5. Gullies: stabilize (plug gully heads), collect sediment, check-dams, revegetate with cuttings.

6. Creekbed: stabilize, prevent erosion, armor banks, remove debris.
7. Upper scarp zone: stabilize with low buttresses, plant with cuttings and conifers.
8. Resource areas--willow, alder, redwood: procure on site with minimal transportation and future impact.

Contractual Limitations and Work Constraints

This work program was discussed with the RNP contract office. Due to NPS staff reservations and contract limitations, the buttresses envisioned for the upper scarp zone, eastern high slump and gully heads were eliminated along with stabilization and debris removal along the lower creek beds.

The primary concern of the RNP contract was the demonstration of erosion control measures proposed by the Forestry Network[7], plus an "evaluation of them as elements of a rehabilitation program for cut-over forest lands in this region."[8] We felt that a wholistic approach to the rehabilitation of Berry Glen Slide was of prime importance, many elements of which would be transferable to the repair of other cutover forest lands. Our group was really concerned with healing a wounded landscape. We have directed our energies towards the stabilization

and revegetation of the watershed rather than just the landslide.

Not being able to work with the scarp-pads at the top was frustrating, noticeably affecting worker morale from time to time (i.e., "what's the use anyway? It'll all cave in from the top" and "wattling below without that buttressing at the top is putting the cart before the horse"). Our evaluations also focus on the broad approach rather than just the work on the landslide proper. Through contract negotiations, it was agreed that a follow-up survey, repair work and winter planting would be accomplished with submittal of field notes after the fall work.

Having to set up camp elsewhere was experienced as a limitation. Commuting caused increased travel time to and from the site, more energy use, a trailer rental, campsite rentals, an extra vehicle, a daily detachment from the site, and a broken sense of community.

Work Schedule (as proposed and accomplished)

A. Organization, equipment assembly, transportation, camp setup and project education.

B. Safe access for tools, personnel and resources to the slide.

C. Control of drainage above slide (if any).

D. "Before" documentation.

E. Collection and production of wattle bundles and stakes.

F. Building of upper wattles.

G. Seeding and planting of cuttings between wattles.

H. Rock work in gullies and along creek/trail.

I. Production of check-dam materials.

J. Construction of check-dams to collect sediment.

K. Building of lower wattles.

L. Seeding and planting.

M. Discussions, evaluating, documentation.

N. Final first phase documentation.

O. Follow-up surveys and notes.

P. Mid-winter repair work and planting

Q. Final second phase documentation; final evaluation report.

Tools, Equipment and Materials

2 pruning clippers

4 long-handled loper clippers

2 pruning saws (folding)

2 large bow saws

1 small bow saw

1 gando-noko (Japanese green timber saw)

2 sledge hammers (3 would have been better)

3 wedges

1 checker wedge

1 froe

1 axe

2 hatchets

1 stonebar

1 stone hammer

1 chainsaw (and gas and oil and tool box)

1 mattock

1 McCloud

2 hoedads

3 line levels (one got buried)

1 chisel

individual knives

200 feet $\frac{1}{2}$" manila rope

200 feet $\frac{1}{4}$" poly rope

1 snatch block (4")

about 7500 feet binding cord, for tying wattle bundles

1 spool #14 wire, for tying fir bundles

1 tarpaulin

$1\frac{1}{2}$# 20d nails, for water ladder

assorted containers

2 files (for sharpening)

4 shovels

2 sharpening stones

Work Crew (See also Appendix for credits)

All N. G. F. S. members were involved in this effort with the exception of two very pregnant partners, one of whom participated on a limited basis. We usually compose our work crews according to the skills needed on a specific job (i. e., contracts for thinning second-growth coastal redwood forest call for mostly chainsaw work; therefore, the job is not open to any and every member who wants to work).

On this project, none of us possessed all the skills needed, yet all of us wanted to learn new skills and broaden our experience in this field. Time and weather conditions also demanded numbers of people on the job to add to work momentum.

Planning the work schedules required individuals to make commitments on the calendar. Those who would arrive later (than start-up) were asked to coordinate ordering and transportation of needed supplies and tools.

The work crew varied in number from day to day, ranging from eight to twelve, sometimes with several more who volunteered to work "just for the experience of it."

Work tasks were broken down into specific activities which took people to different locations on the watershed. Pre-planning and planning as work progressed involved an orchestration of many activities, integrating pre-requisite activities of one work task with follow-up of another.

For further evaluation of crew interaction and mode of operation, see "Evaluation of Work Methodology".

WORK TASKS AND EVALUATIONS

Trail Construction

An existing uncleared route direct from the Berry Glen Road (see photograph P-1, Appendix J) up an old haul road (graveled) to the creekbed was suggested by the RNP contract officer and chosen, for lack of knowledge of an alternative route. We shared a concern for a less damaging access route, as there was a constant articulation of the need to minimize introduction of sediment into the stream bed.

The trail was cut with long loper pruning shears (P-11) and small folding pruning saws, heavy-duty orchard types. We felt a three foot by eight foot profile (P-2, P-3) was required for tool and wattle bundle transportation. The cut willow and alder branches were carefully stacked (P-4), with resident banana slugs, along the upper side of the trail for future transport to the slide. The reason for this was

emphasized when two cut alders somehow got into the creek and caused a small side bank slump.

Two bridges were constructed; the first required cutting and staking wooden treads into the side bank, reinforcing abutments with rock stakes, and fitting an appropriate piece of nearby slash into a prepared foundation (P-5). The second bridge was a simple span to climb around an unstable bank to a stable terrace above (P-6). Three water bars were dug in the trail and several dozen treads were built across unstable zones. For most of the upper half, the trail merged with the creek, following the same course (P-7, P-8, P-9). A treaded path was constructed across the lower (Area 4) part of the slide for stable wet-weather access across the clayey soil (P-10). Small redwood split boards were used as treads, retained by 18" x $1\frac{1}{2}$" x $1\frac{1}{2}$" redwood stakes. Certain paths on the upper east slump got treads when they got soggy.

Evaluation

The access trail is in the wrong place. Trails don't belong in actively eroding creekbeds. Vigorous willow and alder growth is essential for the stabilization of these creekbanks; yet some of the tree cover had to be cut in blazing the trail back and forth across the creek terraces. Also, removal of the trail-blazing debris was

time-consuming because of the close proximity to the creek channel. Aside from its location, we feel the trail we made here is a good one. (Collectively, N. G. has built approximately 40 miles of trail, and some individual members have more extensive experience.) But we feel a better access trail already exists, coming down from Ladybird Johnson Grove. Also, a trail from the bottom up, away from the creek, could have been (and still could be) scouted, flagged, blazed, treaded and waterbarred in a matter of days. The construction of such an alternative route should have been incorporated into the contract schedule.

We cannot stress enough the need for more pre-planning of safe and appropriately located access trails. In the case of Berry Glen, the continuing need for access to monitor, maintain and demonstrate the erosion control features there demands that an alternative trail route be constructed in the near future.

Split Products

Our production site, the "rhythm section," was on the northeast edge of the upper east slump (P-13). Two 30" clear heart redwood logs, left from the clearcut, were bucked with a chain saw into different bolt length and then split into wattle stakes ($1\frac{1}{2}$" square by 24" long), check-dam stakes (3" or so square by 48" long) and boards for treads and check-dams ($1\frac{1}{2}$" x 12" x 3-6 feet)(P-14 through 16, 20-21). A

checker wedge, froe and three wedges were used with two sledge hammers (which were shared with other work tasks). Stakes were sharpened with hatchets (also in short supply). We broke two sledge handles, for which we had spares, but still spent a lot of time replacing them. The chainsaw was the only power tool on the slide. We tried to use it in the early morning hours before the rest of the crew had breakfast and came to the slide.

An overhead cable "low line" trolly system was set up to shuttle split materials and wattle bundles down over the bare slopes to the flat (Area 3) below (P 17-19). This helped prevent at least 100 round trips across a seeping section of the slide. A 4" snatch block was rigged as a free moving wheel carrying its load from a suspended sling. The block slid along a taut manila rope ($\frac{1}{2}$" by 200 ft. long); a $\frac{1}{4}$" poly rope was used as a safety brake and return towing line.

Evaluation: None of us really likes to work around chain saws; clear straight heart wood is the only way to split. Experience at splitting is necessary. In other locations redwood may not be available, stakes and check dams are not limited to split redwood.

Check-Dams

> "With respect to dams and other control structures, it should be clearly understood that these are regarded as temporary but necessary aids in the process of revegetation."[9]

We designed our check-dams as solid, long-lasting barriers to catch sediment, slow the runoff, and reduce the erosive force on the gully bottom. We designed these check-dams for a height of two feet, thus creating short falls with flat terraces in between.

Check-dam planks were cut to size (P-24), placed perpendicular to the center line of the creek and pounded with a sledge into the softened banks until closing the channel bottom. A second, wider plank was driven on top of the first, stakes were driven at an angle into the side banks, and flush against the downstream side of the dam (P-25). Spillway notches were cut in the center of the top board. Splash dissipation bundles of fir boughs were wired (#14 wire) to stakes and driven into place below the spillways (P-26). Fir bundles were also staked into place between the check-dams; intervals between dams varied with steepness and site specific conditions. One shallow gully was plugged with wattle bundles (P-29). Several months after initial construction, the check-dams were repaired. To prevent side bank washouts, fir boughs were staked into place along the sides of the check-dams and new terraces. As a control, Gully A was not armored in this fashion.

Planter boxes are the names we gave to the low buttresses built along the lower scarp face (P-47 and 48). A water ladder is designed to allow the movement of water down a slope without causing erosion;

it is not a sediment collector, although some sediment will naturally be deposited. We feel that water ladders can be used as alternatives to down drain culverts. The water ladder on Berry Glen Slide was built in a gully which only receives storm runoff and hence did not receive a fair test (P-45 and 46).

Evaluation: Check-dams need to be strong, well-anchored, adequate spillways need to be provided (10" wide at the top by 4" wide at the bottom and 6" deep seemed adequate for the larger gullies). Repairs consisted of side bank armoring, re-centering the runoff, deepening the spillways and plugging three side bank washouts (out of 25 large check dams (P-40 and 41; 43 and 44). Fir bundles and willow bundles, wired and staked, make excellent low-profile sediment collectors. The willow bundle in Gully A has sprouted profusely. We found check-dams easier to build than anticipated, but feel that poorly built ones could fail easily. We built 16 wood checkdams in Gully A (western, less deep)(P-31, 32, 33) and nine wood dams (P-34 through 39) and 12 rock dams in Gully B (P-27 and 28), seven small (one board) ones were constructed in gullies between Areas 1 and 2 (P-30). Eleven of the 12 rock dams washed apart, due it seems to small rock sizes, but with no noticeable negative result. We feel that a series of fat bundles (willow/alder and fir) could function as a one-step, low maintenance, safer alternative to redwood planks in

shallow gullies and gully heads. The fir splash-bundles could contain regenerative branches as well. Time used to cut and prepare splash-bundles is listed separately on the work-hour chart. We thinned overcrowded areas of douglas fir and Monterrey/~~digger~~ Knobcone pine (non-native, ~~aerially seeded~~ planted by ARCO). Spruce proved to sharp for our clothes, but heavy aprons and gloves could help. Details of check-dam repairs are found in the "Gully Survey" in Appendix D.

Wattling

Except for the nearly vertical scarp faces, all of the bare steep soils of the landslide were wattled. Wattles are live bundles of branches, buried and anchored to the side of the hill, forming sediment collecting terraces which regenerate into a thick network of roots and foliage (P-49). Live willow and alder branches were tied into cable-like bundles; they were from 6 to 12 inches thick, 5 to 10 feet long and bound with heavy binding twine at least three times (P-50, 51, and 55). The transportation of these bundles to the slide was a time-consuming task (P-11, 12, 52, 53, and 54). Trenches were dug along the contours, angled into the hill (half as deep as the bundles which were placed in the trenches) and covered with soil from the next uphill trench (P-58 and 59).

We used line levels, string, hoedads and mattocks, beginning from the bottom of the slope and working uphill, taking care not to disturb non-contoured portions of the slope. Stakes were pounded

through the bundles into the hill; the stakes were 18" apart and driven at alternating 45° angles (P-60, 61, and 62). Bundles were interwoven as they overlapped each other laterally (P-63).

The wattle bundles were spaced at approximately three-foot vertical intervals (P-64 through 68) and, being flexible (P-69 through 72), adapted to site-specific features like small gullies. Once completed, the slopes had a series of narrow, stable terraces from which we planted cuttings, seeds and seedlings. 1820 linear feet of wattle were constructed.

Evaluation: Transportation of wattle bundles was a time-consuming task, especially when carrying them long distances up hill. After several months, the wattles were firm, stable parts of the hill, growing roots and sprouting quite vigorously; no repairs were required (P-73 through 78). Wattling is a great technique for stabilizing large unstable slopes; it uses considerable amounts of branches which needs consideration. We used twine in preferance to wire, so as to avoid possible danger to grazing animals (elk and deer) in the area.

Planting

Cuttings: We planted 1400 willow, 90 bigleaf maple, 140 alder and 160 coyote bush cuttings (see map and notes in appendices). Some

plantings were terminal buds, others mid-branch; small and large sizes were tried.

The canes were usually 18" to 24" long, cut the night before planting and placed in a pool of water to soak (P-79 and 80). The ground was moist during planting. Twelve-inch deep holes were made with metal rebar rods (survey stake type)(P-81) with the cane placed in the snug hole (P-82 and 83). Three small rocks were placed at the base of the fall plantings (P-88 and 89), winter plantings were tied with blue flagging tape. Cuttings were planted about three feet apart and between wattles (P-84 and 85). Clumps of willows were planted to provide shade for existing sunburned redwood seedlings as well as in moist pockets. Pitons (redwood) were driven into steep schisty banks making them accessible for planting (P-86 and 87).

Evaluation: planting of cuttings in this manner is a fast revegetation method, if it doesn't get grazed. Only the willow has positively rooted and sprouted (P-88 and 89), sprouts and swelling buds were observed on both the alder and maple, which also had what appeared to be pre-emergent root nodules. See field notes. Cuttings are a simple means to revegetate bare soil areas, especially road fills and gullies.

Seeding: Forty pounds of common vetch and 60 pounds of annual rye seeds were broadcast, as shown on the map. The vetch sprouted well, but was apparently eaten by quail. A few vetch seedlings

survived by falling into the wattle bundles. The rye is growing well, concentrated on the wattle terraces.

496 sitka spruce trees were planted at 8-10 foot intervals. The trees had a 092-05 seed source classification and were obtained through the Louisiana-Pacific Nursery at Crannel.

Rock Work

We noticed a number of small, actively-eroding bank spots. We gathered rocks and placed them against the eroding banks (P-90 through 93). This technique was effective, especially when the rocks had an 8" minimum size, but the removal of rocks from the creekbed caused downcutting of the channel. If rocks are used for bank stabilization, they should be gathered from the outside of the creek and be large enough to remain in place during storm runoff. Contract limitations prevented work along the creek banks (P-94).

EVALUATION OF WORK METHODOLOGY

Mode of Operation

Perhaps one of the most important aspects of our work on the Berry Glen Slide was the cooperative, creative and energetic spirit of our workers. This was a collaborative effort! Because our partnership functions on an equal pay, shared responsibility basis,

worker motivation was high. Leadership varied with different aspects of the work. People were most assertive in their respective skill areas (i.e., split-making, check-dam construction, trail-treading, peton installation, etc.), but they were not hesitant to tackle work tasks they had never done before. Part of the reason for this willingness was the pure challenge of acquiring new skills. Part of the incentive was the supportive nature of our work group: failures were assessed objectively rather than ridiculed. Also, we were eager to get a better feel for the realities of repairing cutover forests.

This contract involved a felt, personal commitment by over a dozen individuals to heal an open sore on the face of the land. Because all the partners in NGFS are active homesteaders, we experience a deep connection with the land through the seasons. Any mistakes made or hasty-doings to the land in the summer months are brought to bear in winter months. We have learned the hard way that there can be no short-cuts with respect to road work (construction and maintenance), building site preparation, drainage work, etc. These experiences on the land have fostered a nurturing attitude toward this earthwork at Berry Glen, preventing insensitive workmanship.

Physically, the work was not easy and often required working under conditions of continuous torrential rain. We directed our energy, thoughts and feelings towards the earth. Spiritually, the rewards were great. As work progressed, we could feel the reasons for our efforts and a closer spirit of comraderie evolved.

There were, as mentioned previously, several factors which did negatively affect worker morale. Not being able to camp in close proximity (within walking distance) to the worksite notably dissipated some enthusiasm. Often on other projects individuals work until dark, enjoying watching twilight set in and having a nice hike back to camp. Sometimes people will go out to work earlier in the morning also, watching dawn break over the watershed. (Even at Berry Glen, our chain-saw operator volunteered without compensation to go to work each morning an hour or more earlier than the rest of the crew. That way the noisy work with the saw could be done before the rest of the crew arrived.) These experiences further link the worker to his/her work, fostering more of a nurturing, care-taking attitude. These occasions also provide time for closer observations of the dynamics of drainage, wind currents and life throughout the watershed. In dollar values, separation from the worksite cost us $568.90 (80 hours @ $5.08/hr plus $162.50 in expenses).

The fact that we were unable to work on stabilizing the scarps above the landslide face made some workers question the value of our work wattling below. It was difficult to rationalize to ourselves that the purpose of demonstrating a single technique (wattling) was important enough in itself, whether or not it was buried by cave-ins from the top at some later date.

Recommendations

We feel it is important to create conscientious work habits among field workers. Some ways this might be accomplished are:

1. Work Performance Bonds. Contract demands for such bonds would certainly encourage contractors who hire field workers to provide close supervision. Legal questions in determining responsibility for negligence would require very detailed work specifications (i.e., for the implementation of in-channel structures, etc.). But this might discourage the flexibility and innovation required for "custom" work. Although contractor bonding may be desirable to cover costs of repairing mistakes/failures (and the "letting" of repair contracts), let us not forget that responsibility works on an individual, personal basis, not just for contract bosses.

2. Legal Structures (Cooperatives, General Partnerships). Such legal structures spread responsibility for work performance and safety among the general membership. For example, in NGFS each partner is liable for the work and safety of all other NGFS partners, a situation which further encourages concern for the well-being and workmanship of each other. In many cases, if a partner is not feeling well, he or she is encouraged not to come to work on the site that day (they may stay in camp at a half-day's wage). Another incentive for worker integrity in the coop or partnership is the individual member's concern for their company's reputation (for the quality of work performed on contract). Reputed sloppy work means no new work.

3. On-site Worker Education. On-site education may be especially helpful for those workers who are new to the field of earthwork. Leaving some structure failures in the field unrepaired can serve not only as a control for monitoring, but also as a lesson in work performance standards.

Ideally, the work force on any given project will possess a wide range of skills. Individuals need to be able (or disposed) to work cooperatively with others, assessing "on the job" the logistics of specific work tasks. This is because many decisions have to be made in the field as to the approach and ordering of work activities.

Often, the factors which determine the logic of carrying out a specific work task are recognizable only as work progresses (i.e., transportation of materials around the work site; integration of slash dispersal with trail-treading reinforcement or wattle-staking; removal of massive old-growth logs from creek channels; contingency planning in the event of periodic equipment breakdowns, etc.).

Preplanning, Monitoring and Repair Work

Under ideal circumstances, contractors could obtain detailed (1:2500) maps and aerial photos. This would afford better site orientation (i.e., locating material source areas, access routes, etc.). Such pre-planning would also facilitate the co-ordination of various tasks: trail clippings become wattle bundles, unstable debris is transformed into split products, etc.

It is reassuring to note that some of the heaviest rains since the slide occurred have fallen this winter. (As of January 20, 1978, the rainfall total at the RNP Prairie Creek Trailers was 44.38 inches.) The slide surfaces appear stable. There was some creekbank sloughing, but the structures built in the fall are working as anticipated, with some minor modifications. Sediment is being collected, revegetation is occurring, and soil erosion is being reduced.

It is readily apparent that "some of the rehabilitation measures (for instance, check-dams on gullies) may only succeed to the optimum extent if follow-up measures are completed in the years after initial installation of dams or other engineering structures."[10] Maintenance and repair efforts, especially during and after rainstorms, may be great in those initial years, tapering off as revegetation occurs.

As noted before, gully heads, scarp faces and the creekside banks have not received what we felt to be adequate treatment. This applies to construction of a low impact trail as well.

We recommend that work contracts in the expanded park be on a long-term, tributary watershed basis. This would encourage contracting groups to develop a responsibility to the land. RNP would help the work crews as much as possible, especially in the areas of pre-planning, documentation of work failures, repairs and improvement of techniques.

We enjoyed the contact and communication with the RNP staff. Our experience is still quite limited; we all have a lot to learn about taking care of the land.

Notes

1. From an Open File Report, dated 10/75, by Dr. Richard J. Janda, and entitled Recent Man-Induced Modifications of the Physical Resources of the Redwood Creek Unit of Redwood National Park, California, and the Processes Responsible for Those Modifications.

2. Conversation with Harvey Kelsey, RNP staff hydrologist.

3. ibid.

4. Meca Wawona, from "A Labor-Intensive Approach to Watershed Repair," 1977.

5. Dr. Richard J. Janda, letter to Cathy Files (Department of the Interior), dated 8/9/77.

6. From the forward of "Erosion Control in Mountain Meadows," by Charles J. Krabel and Arthur F. Pillsbury, April, 1934.

7. Forestry Network, A Labor-Intensive Approach to Watershed Repair/Earthwork in the Redwood Region, June, 1977. Forestry Network, Redwood Creek Basin Land Rehabilitation Program, August, 1977 and Addendum Report.

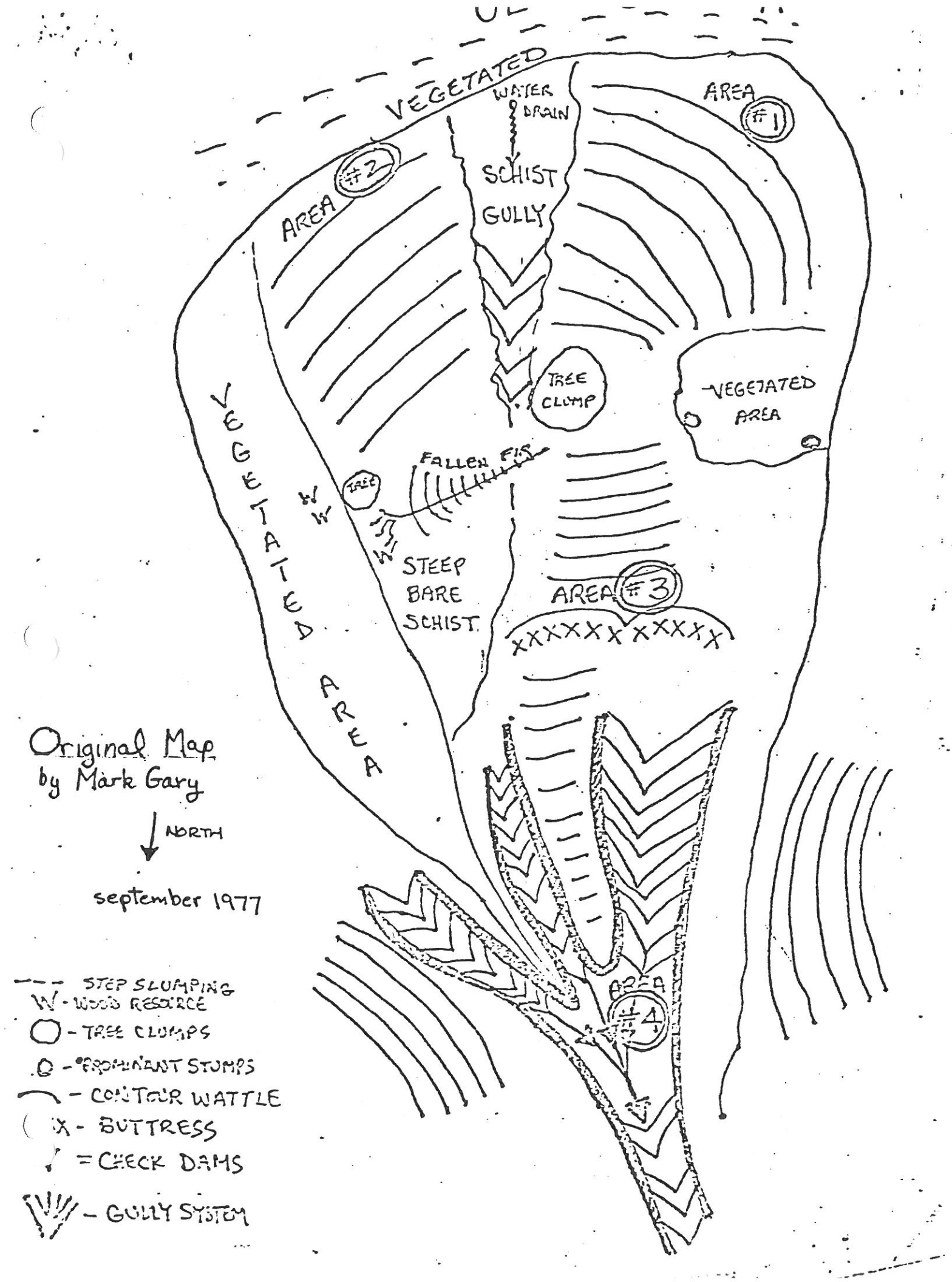
8. Letter of transmittal approving project plans from Steve Viers, September 20, 1977.

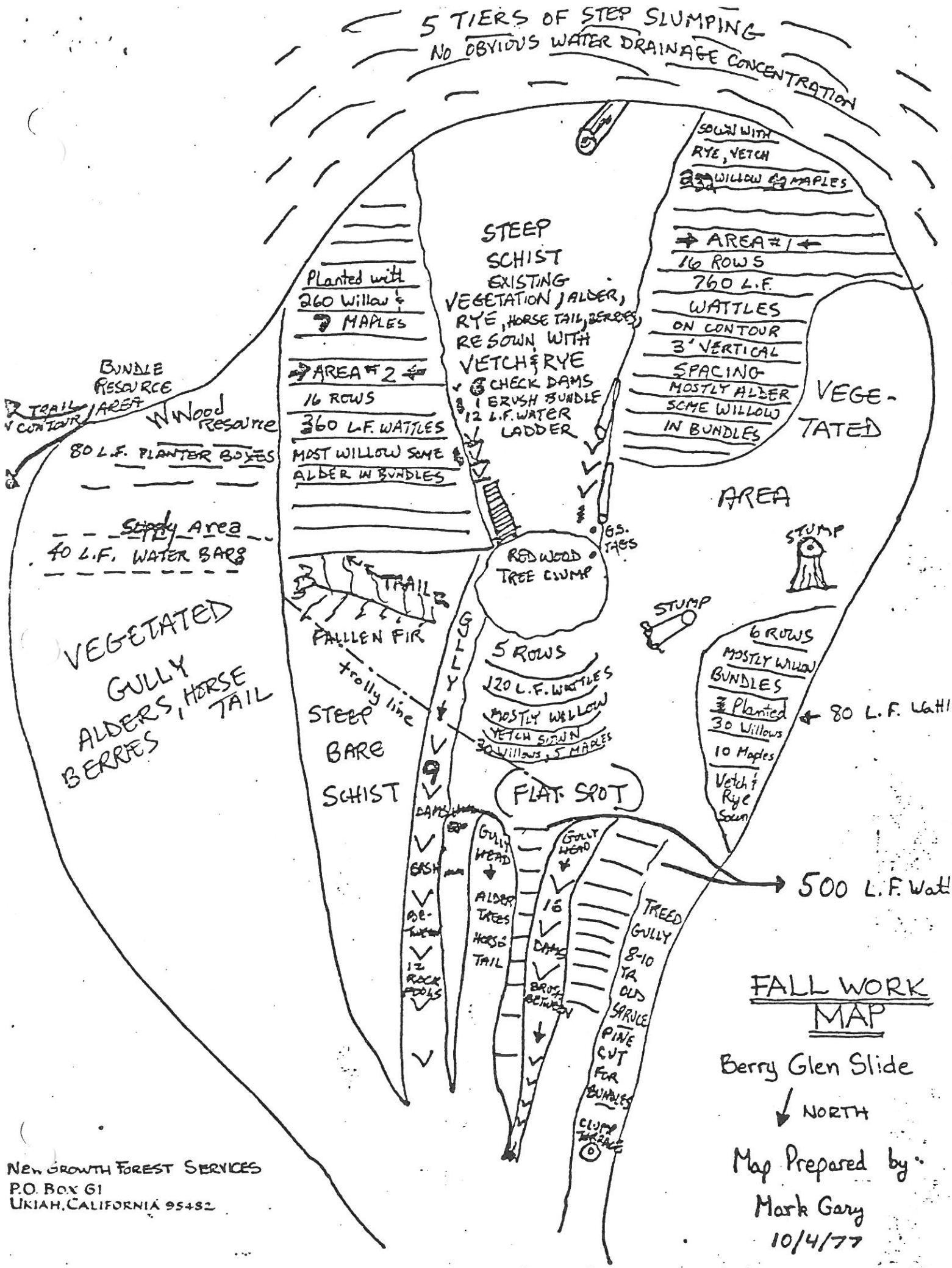
9. Krabel and Pillsbury, op. cit.

10. Harvey M. Kelsey (RNP hydrologist), Planning Options and Suggested Approaches to the Rehabilitation of the Expanded Redwood Park, November 4, 1977.

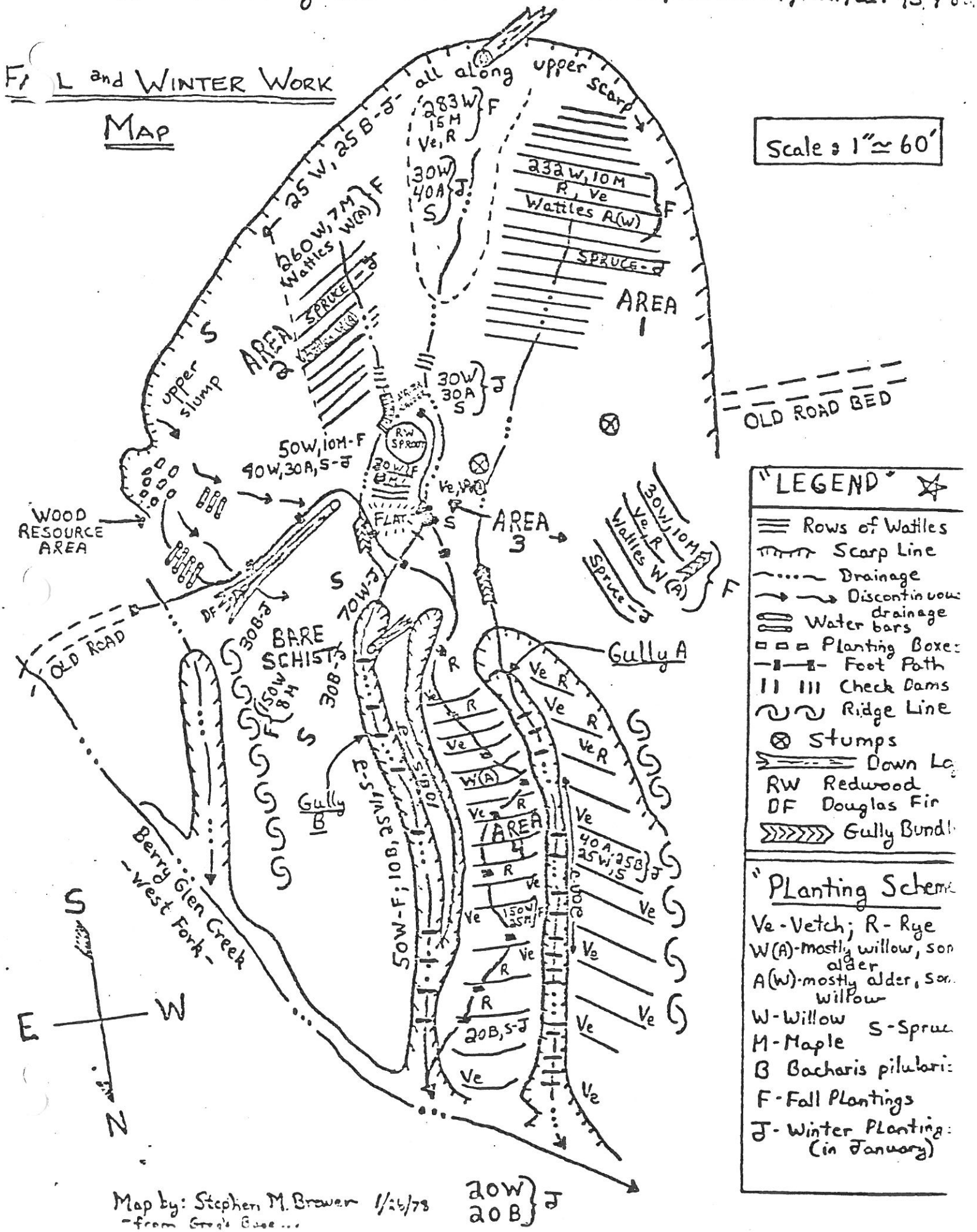
APPENDICES

APPENDIX A: MAPS


VEGETATED
WATER DRAIN
AREA #1
AREA #2
SCHIST GULLY
TREE CLUMP
VEGETATED AREA
FALLEN FIR TREE
VEGETATED AREA
STEEP BARE SCHIST
AREA #3
XXXXXXXXXX
AREA #4
Original Map by Mark Gary
NORTH
september 1977
STEP SLUMPING
W - WOOD RESOURCE
- TREE CLUMPS
- PROMINENT STUMPS
- CONTOUR WATTLE
X - BUTTRESS
= CHECK DAMS
- GULLY SYSTEM


5 TIERS OF STEP SLUMPING
NO OBVIOUS WATER DRAINAGE CONCENTRATION
SOWN WITH RYE, VETCH & WILLOW & MAPLES
AREA #1
16 ROWS
760 L.F. WATTLES
ON CONTOUR
3' VERTICAL SPACING
MOSTLY ALDER SOME WILLOW IN BUNDLES
VEGE-TATED AREA
STEEP SCHIST EXISTING VEGETATION ALDER, RYE, HORSE TAIL, BERRIES RESOWN WITH VETCH & RYE
6 CHECK DAMS
1 BRUSH BUNDLE
12 L.F. WATER LADDER
Planted with 260 Willow & 7 MAPLES
AREA #2
16 ROWS
360 L.F. WATTLES
MOST WILLOW SOME ALDER IN BUNDLES
BUNDLE RESOURCE AREA
TRAIL & CONTOUR
Wood Resource
80 L.F. PLANTER BOXES
Steep Area
40 L.F. WATER BARS
VEGETATED GULLY ALDERS, HORSE TAIL BERRIES
REDWOOD TREE CLUMP
G.S. TAGS
STUMP
STUMP
TRAIL
FALLEN FIR
trolly line
STEEP BARE SCHIST
GULLY
5 ROWS
120 L.F. WATTLES
MOSTLY WILLOW
VETCH SOWN
30 Willows, 5 MAPLES
6 ROWS
MOSTLY WILLOW BUNDLES
Planted 30 Willows
10 Maples
Vetch & Rye Sown
80 L.F. Wattles
FLAT SPOT
DAMS
BRUSH
BE-TWEEN
12 ROCK POOLS
GULLY HEAD
ALDER TREES
HORSE TAIL
GULLY HEAD
16 DAMS
BRUSH BETWEEN
TREED GULLY 8-10 YR OLD SPRUCE PINE CUT FOR BUNDLES
CLUMP TO SAVE
500 L.F. Wattles
FALL WORK MAP
Berry Glen Slide
NORTH
Map Prepared by:
Mark Gary
10/4/77
NEW GROWTH FOREST SERVICES
P.O. BOX 61
UKIAH, CALIFORNIA 95482

Site # 5 Rehabilitation Project, Berry Glen Slide
Work done by New Growth Forest services, P.O. Box 61, Ukiah, Ca. 95482



Map by: Stephen M. Brower 1/26/78
-from Grid's Base...

APPENDIX B

FIELD NOTES/WORK SCHEDULE
BERRY GLEN SLIDE REPAIR PROJECT

Work Crew

Lorie Leaf, Steve Brewer, Mark Brucker, Bob Currier, Mark Gary, Rocky Gulledge, John Hensley, Dahinda Meda, P. L. Ojeda, Liz Perkins, Randy Stemler, Ross Walker, Meca Wawona.

Duration: September 23 through October 4, 1977.

* * * * * * *

Day #1 Date: Friday, September 23, 1977
Crew: 8 (M. G., D. M., L. P., B. C., M. G., S. B., P. O., L. L.)
Weather: Heavy mists and light rain all day; cool; light wind.

Schedule	Work
9:00 a.m. to 6:00 p.m.	Final purchase of tools, food, and other supplies. Check-in at Orick. Camp setup and work orientation meeting. Tool preparation.

Day #2 Date: Saturday, September 24
Crew: 8
Weather: Early morning fog; sunny; no wind.

Schedule	Work
8:00 a.m.	Final equipment preparation
9:00 a.m.	Arrive at trail head and notch log step
9:15 a.m.	-2 went up trail, marking it and making initial cuts. "Before" pictures and notes were taken of trail and the slide for photographic documentation.

-6 worked their way up the trail, clearing thoroughly and stacking alder cuttings to the side. Two small bridges built for creek crossing, and about 18 treads cut into trail for footing stabilization. Care was taken to minimize introduction of sediment into creek.

-Note: S. B. explored upper reaches of slide mass and could find no active drainage problems. Kinetic energy of earthen scarp pads was evident.

1:15 p. m. Lunch meeting on level landing central area slide crater. Work observations discussed.

1:45 p. m. -2 climbed to top of slide in area #1 and laid out contour wattle lines on a 100% slope.

-3 made a trek back to the crummy (truck) parked at the trail head, and packed in more work tools.

-3 went down trail and bundled alder boughs for wattling materials and packed them up to the slide area.

5:00 p. m. Discussions of wattle construction, and then the entire crew headed down to the crummy, doing more trail work on the way.

5:30 p. m. Arrive at camp.

Day #3 Date: Sunday, September 25
Crew: 9 (M. G., D. M., L. P., B. C., S. B., M B., P. O., M. W., L. L)
Weather: Sunny; warm; no wind.

Schedule:	Work:
9:00 a.m.	Begin work. M. G. headed up trail with packsack full of tools and crew lunch. P.O. went to Orick for more film and then headed up trail.
	-6 others carried a large timber (bridge-piece) up the trail, always attempting an alternative out-of-creek trail route. After further scouting and subsequent discussion, it was decided that blazing this route upslope would involve more time and labor than was affordable under the present contract limitations. This route and creek-crossing was abandoned. This group then began bundling alder and willow left along the trail side and hauled these upcreek to the slide area. More alders were cut for bundle material. Up top, work was underway organizing bundle preparation and wattle construction.
11:30-11:45	Break and discussion. Bundling and organizing continued.
12:30 p.m.	Lunch and orientation meeting
1:00 p.m.	Wattle literature discussed and then:
	-2 cut, bundled and hauled alders and willow to the slide.
	-3 worked up top left (north) of slide area, bucking and splitting old-growth redwood logs (debris from logging 15 years before).
	-2 worked on wattle construction.
	These activities continued all afternoon.
4:45 p.m.	Head down trail to crummy.
5:15 p.m.	Arrive at camp.

Note: 3 members of an Arcata-based group called G.O.A.T.S. (Group for Organic Alternatives to Toxic Sprays) came up to the slide area in the afternoon. This group is involved with manual conifer-release and related research. They helped with some of the work while learning about methods of erosion control and wattle construction.

Day #4 Date: Monday, September 26
Crew: 9
Weather: Sunny day with fog burning off; muggy.

Schedule:	Work:
8:45 a.m.	Head up trail; begin work.
	-4 tied and hauled wattle bundles all morning.
	-2 built wattles
	-2 bucked redwood logs and worked on stake production.
	-1 was utility for an hour. "Utility" means helping where needed, i.e., running tools and drinking water back and forth, tool and equipment repair, messenger, etc.
1:00 p.m.	Lunch time. M.W. returned from supply run to Arcata--10 on crew now.
1:30 p.m.	-3 hauled bundles
	-2 on wattle construction
	-3 split and sharpened stakes
	-P.O. continued photographing the work as it progressed

4:45 p.m. Headed down trail, doing some minor improvements and erosion control along trail and creek.

5:15 p.m. Camp

Note: Steve Veirs (NPS) showed up this afternoon and looked everything over. M. G. and Veirs hiked all around the work areas discussing in more detail the proposed erosion control measures.

Day #5 Date: Tuesday, September 27
Crew: 8 (M. B., L. L., D. M., R. G., L. P., M. G., S. B., B. C.)
Weather: Morning clouds, then heavy rain most of day.

Note: D. M. went to Arcata for tools and supplies this morning. He returned after lunch.

Schedule:	Work:
8:45 a.m.	Begin work, head uptrail to slide area. Bundles were hauled and seed carried up to the slide area.
	-3 cut a new trail on an old cat road (which used to continue across the mid-section of the slide) and thinned alder and willow for bundles, possibly releasing the spruce, fir and redwoods.
	-2 continued splitting and sharpening stakes.
	-2 continued wattle construction.
12:15	Lunch, eaten during first heavy downpour
1:00 p.m.	Rye seed (annual) was sown (broadcast) by M. G. and R. G. all around areas 1 and 2.
	-A trolley-like shuttle was fashioned (see section on work tasks). 6 of the crew

worked shuttling stakes and bundles from production areas to wattle construction sites. Bundling continued on the old skid road to the north.

3:30 p.m. Quitting time; headed down trail.

Note: 3 members of NPS multi-disciplinary team came up to the slide area. They looked over our work, discussed their observations and went above the slide to determine any drainage problems; they found none.

Day #6 Date: Wednesday, September 28
Crew: 8
Weather: Rained heavily all night; rained during morning; misty day.

Schedule:	Work:
8:30 a.m.	Discussions in camp on project work.
9:30 a.m.	Begin up trail to slide

Observations: Hard rains fell all night in the area. The first gullies were now flowing (just up the trail from the parking area/trail-head). Lots of water flowed from uphill springs, but did not appear very erosive. At the 1st bridge crossing the water was up noticeably, but it was not very muddy. The next creek we came to on the trail (which originates in the slide area and elsewhere) was muddier and had risen considerably.

-6 worked all morning on trail clearing, chopping, clipping and sawing alder and willow, making their way down the old skid trail to the north.

-2 were bundling all morning

-later, D.M. spent 3 hours exploring the sources of the large flow of water (now coming across the old skid road to the east which was a small trickle before the storm. He returned for a shovel in an attempt to de-concentrate the drainage, but later decided that it would cause more problems than at present; he left it as is.

1:30 p.m. Lunch. Gary Lester (NPS) visited.

2:15 p.m. Back to work bundling on the old skid skid trail.

-L.L. sowed annual rye seed all around Area 3.

2:30 p.m. S.B. went to Arcata for rain gear, doing rock work on his way downtrail.

4:00 p.m. Rest of crew finished and headed for camp.

Day #7 Thursday, September 29
Crew: 8
Weather: Cloudy morning, clearing later; cool.

Schedule:	Work:
9:00 a.m.	S.B., B.C., L.P. arrived at trail head and began uptrail. Notes updated.
10:00 a.m.	Rest of crew arrived; worked reinforcing creek banks on way up to slide.
10:30 a.m.	Everyone arrived at slide area.
	-M.G., R.G., M.B. began wattle construction, moving from Area 1 to Area 2.

-B. C. and L. P. sowed vetch seed all around Area 2 (6 pounds).

-D. M., S. B., L. L., L. P., B. C. then hauled all of the bundles from the skid road production area to the edge of Area 2 for wattling.

11:30 a. m. -3 continued wattle construction

-2 bundled on skid trail

-3 rigged the shuttle cable to carry bundles and then moved bundles to the top middle of Area 2.

12:30 p. m. Lunch time

1:15 p. m. Back to work

-2 continued to bundle up on old skid trail

-3 continued wattle construction, moving up Area 2.

-3 relocated bundle shuttle (loading end on shelf at southwest end of down fir log, receiving end at level lunch area). They they worked all afternoon hauling bundles from the old skid trail out to the shuttle loading area, trolleying bunches of bundles at a time. D. M. hauled some of these over to an Area 3 wattle zone.

3:00 p. m. -5 worked together to finish clipping and bundling on the old skid road. These bundles were shuttled to Area 3.

Note: willow branches and twigs were laid in a ponded area that had formed on the uphill edge of the skid road.

5:20 p.m.	Tools were stored and covered, field notes taken, and then everyone headed down the trail.
6:00 p.m.	Camp arrival

Day #8

Date: Friday, September 30
Crew: 8, plus Randy Stemler, who volunteered to help while learning about wattle construction.
Weather: Clear, sunny and warm all day

Schedule:	Work:
9:00 a.m.	Begin work. Headed up trail doing rock rip-rap along creek in eroding areas.
9:30 a.m.	Crew arrived at slide area:
	-3 built wattles into the upper part of Area 2.
	-2 measured the linear feet of wattle contours that had been constructed.
	-3 began constructing wattles in Area 3.
10:00 a.m.	S. B. arrived (making 9 person work crew) and joined the crew at Area 3. S. B. relieved M. G. as utility person. M. G. and S. B. updated map and notes.
11:30 a.m.	-2 shuttled split planks downhill to lunch area for use in check dams.
12:45 p.m.	Lunch time and project discussion
1:30 p.m.	Begin work:
	-3 continued wattling Area 3
	-1 split stakes
	-5 moved down to Area 4 (below lunch area where gullies begin):
	-3 began building wattles in lower reaches of Area 4

-2 built wattles into a steep face across the gully (south of stepped path in Area 4).

4:30 p.m. -1 began building a treaded path up the ridge line between the gullies.

-1 bundled willow stakes on the trail below

-2 began building check dams in the south gully of Area 4.

Note: wattle bundles were tied and staked into upper face of Area 3, where 2 small gullies were seeping. These bundles were staked vertically rather than horizontally, with upper ends buried. This was done to dissipate water flowing from the seepages.

5:30 p.m. Head down trail doing rock rip-rap.

6:00 p.m. Arrive at camp.

Day #9 Date: Saturday, October 1.
Crew: 11 NGFS and 1 volunteer (J.H., R.W., M.W., and P.O. joined crew today).
Weather: Sunny, no wind.

Schedule:	Work:
8:00 a.m.	-B.C. left; M.B. and L.P. headed up the trail to the slide, carrying tools and doing creek work. Above, at "Stake City", M.B. cut off another section of the fallen redwood tree and cut it into bolts for splitting.
	-S.B. updated field notes for an hour.

8:45 a.m. Rest of the crew arrived and headed up the trail.

9:30 a.m. Work began with:

-3 bundling on old skid trail
-3 building check dams in Area 4
-2 splitting planks
-3 cutting willow canes and planting them from the top down in Area 1.

1:00 p.m. Lunch, discussion and notations made

1:45 p.m. -3 continued planting willows (cut from the top apicals from trees below along the creek) every 3-4 feet on radius, and between the wattle rows (especially in wet areas). Three small rocks were embedded around the base of every cane: (1) for protection against splash erosion; (2) to provided a nitch for energy transfer; (3) as a control indicator. Note: willow and maple canes planted later this winter will not have 3 rocks.

-7 put in more wattle contours on the south face of Area 4.

-2 were building check dams

-2 were splitting planks and stakes

-P.O. was taking pictures most of day

4:00 p.m. -4 splitting and shuttling materials from stake area to lunch area to below

-1 was utility

-3 went below to gather willow canes, bunching them end-down in creek pool to soak overnight. Note: canes which drew water overnight appeared to stay more pliable and fresh than those cut and planted same day.

5:30 p.m. Quit work

6:00 p.m. Arrived at camp

Day #10 Date: Sunday, October 2
Crew: 11 persons and 1 volunteer
Weather: Sunny day and warm, no wind

Schedule:	Work:
9:15 a.m.	Crew arrived and headed up trail. M. B. went to Orick to pick up a hand-drill and axe handle (1 hr.)
9:30 a.m.	-2 cut, split and shuttled materials to lunch area from "Stake City".
	-3 cut, prepared and planted willow canes in Area 2 and between there and Area 1.
	-4 constructed rock and wood check dams in Area 4.
	-2 spent 1 hour on sledge repair and then helped check dam crew
	-M. W. was below cutting fresh willow canes. Half were planted later than day in Area 3 and on steep schist slope by lunch area, and half were set to soak overnight.
	Note: L. L. was not feeling well so she went back to camp after a half day of work
1:00 p.m.	Lunch time
1:30 p.m.	-4 worked on check dams (rock and wood)
	-2 splitting and shuttling

-3 planting (between Areas 1 and 2 and on steep schist slopes)

-1 photographing

-1 on water ladder construction

4:30 p.m. Quit work and headed down trail

Day #11 Date: Monday, October 3
Crew: 10 and 1 volunteer
Weather: Sunny and warm

Schedule:	Work:
8:00 a.m.	S. B. went to town and bought 20 lbs. more vetch for slopes and then headed to slide area.
9:00 a.m.	M. G., M. B., R. W., D. M., L. L., R. G., and L. P. drove up Bald Hills Road to inspect the 40 acre NPS contract with Harvey Kelsey (NPS). All but D. M. met S. B. at Lady Bird Johnson Grove and hiked the L. B. J. Trail down towards Berry Glen. Finding the Blue-Flag Trail (10:30 a.m.), they crested the ridge-divide between virgin forest and cutover area, and dropped down into the upper slide area from the scarp zone (good trail, needs clipping). D. M. returned to Berry Glen in crummy and hiked up to slide area, arriving approximately same time as those hiking over L. B. J. Trail.
	-M. W., R. S., J. H. headed up trail:
	-2 cut and prepared more willow canes -1 finished water ladders
	All members arrived at upper slide area approximately the same time (10:50 a.m.)

11:00 a.m.	-3 split and shuttled shakes
	-3 worked on water ladder and small check dams between Area 1 and 2
	-3 planted Area 3 and Area 4.
	Note: The willow collected today was of the non-budding variety and it took half as long as buds to prepare.
	-2 bundled fir boughs in a small "conifer release" area to south of lunch meeting area.
	-2 others began tying and staking bundles to the lower side of wood check dams for energy dissipation.
1:30 p.m.	Lunch time and discussions
2:15 p.m.	Begin work
	-3 planting -2 making stakes -2 building check dams -2 bundling -2 water ladder building
4:45 p.m.	Quit work and headed down trail

Day #12 Date: Tuesday, October 4
Crew: 9 and 1 volunteer
Weather: Sunny and warm

Schedule:	Work:
8:30 a.m.	S. B. updated and organized notes.
	Note: Goerge Von der Lippe and Steve Veirs arrived at parking area at 9:00 a.m.

R.S. and S.B. met them at trail head. They headed up trail alone while R.S. and S.B. organized tools. R.S. and S.B. joined Von der Lippe and Veirs at slide and toured around the area discussing:

1. The wattles
2. Seeds and quail
3. Willow and alder planting
4. Water ladders
5. Bare vs. vegetated areas--work done
6. Scarps above slide
7. Stake resource area
8. Year-round programs and efficiency ideas
9. Petons used to stabilize footing for planting steep-schist-slopes
10. Shuttle-system
11. Drainage problems above
12. Pruning shears and saws vs. machetes
13. Number of workers and volunteers
14. Hope for more work of this nature to be done

-P.O., J.H., and R.W. left for Ukiah last night. M.W. met the two from NPS on their way down trail. Check-dams and planting were discussed.

-Back at camp L.L. was cleaning up and packing trailer all morning.

11:00 a.m. -M.B., D.M., L.P., M.G., and R.G. showed up and also talked with the NPS folks on their way up.

-Work discussions and organization of cleanup activities

-1 continued bundling; 4 on utility (worksite cleanup, tool round up, etc.)

-2 planted; 1 worked on map; 1 on check-dams

1:00 p.m.	Lunch
1:30 p.m.	Work as before lunch
3:00 p.m.	Quit and headed down trail
6:00 p.m.	Camp cleanup and breakdown

Note: M.W. remained at work site sowing vetch and rye around Area 4 (see map). Others sowed vetch earlier in the day around stake production area and between Areas 1 and 2 by the water ladder.

APPENDIX C

FIELD NOTES/FOLLOW-UP SURVEY

Follow-up Survey #1

Approximately one inch of rain fell Thursday, Oct. 6, 1977. Mornings during this last week have been foggy; clearing and sunny in the afternoons. Last seeding and cane planting occurred 6 days ago (October 4).

Monday, October 10, 1977: Randy Stemler and Mike Coble went to slide.

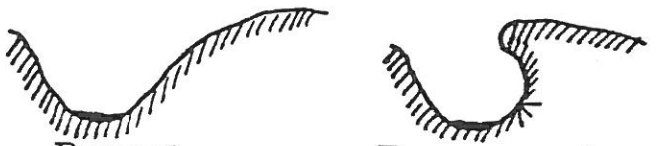
Observations:

1. Vetch rootlets had germinated profusely and were screwing themselves into ground (all over slide Areas #1, 2, 3, and 4).

2. Vetch seedlings seemed most abundant in Area 4 around the steps.

3. Rye had not yet germinated noticably. (Quail covey was not sighted.)

4. An overhanging bank had sloughed off into creekbed (bank above the area where the creekbed gets steep and rocky, approximately 3/5 of way up creek trail). The angle appears more stable than before (see illustration). Sediment was deposited in creekbed.



5. Sediment had begun forming terraces behind planks of check-dams.

6. Water was pooling and sediment filtering out behind check-dam planks, forming uniform terraces in the gully channels.

7. Willow and maple canes (on slopes and in wattles) were still alive.

8. No other significant changes were noted (2 hours spent in field).

Follow-Up Survey #2

Monday, October 17, 1977: Field survey and photographic documentation. Randy Stemler, Bob Rohde (camera), Steve Brewer (notes)

Observations:

1. The "sloughed bank" appeared the same as last observed. No significant changes were noticed on the creek profile.

2. Vetch sprouts had been devastated (eaten) by something (a covey of quail was sighted in the lunch area later on). Dried out, leafless, munched rootlets lay everywhere.

3. The rye seed was now sprouting all over and some slopes were turning green. The willow and maple canes seemed alive on the slopes and in the wattles in areas 1, 2, 3, and 4.

4. Survey crew inspected entire slide area, taking pictures of minor changes (sprouting willow, etc.). No significant changes were noticed, other than those mentioned above.

5. The water ladders had performed well, with sediment and small gravel having filtered out on the steps.

6. No other significant changes were noted (2 hours spend in field).

Follow-Up Survey #3

Friday, December 9, 1977: Follow-up survey to determine the functionality of structures, survival of plantings, drainage patterns, etc. Also to assess follow-up activities: repairs, modifications, and planting needs. Mark Gary, Dahinda Meda, Steve Brewer. Weather was clear to partly cloudy, with cool temperatures in the 50° range.

Observations: (Note: Day spent completing interim field documentation and making necessary repairs on structural failures. Repairs consisted of plugging side bank washouts with rocks and redirecting the water channel to the spillway, plus moving surplus sediment to the sides of the terraces (see Gully Report, Appendix D).

1. Wildlife observation: A medium-sized porcupine was seen burrowed into a small hole in the cliff by the first bridge up from the trail head.

2. Area 1 observations:

-small conifers in Area 1 were being grazed
-willow stakes in this area were sprouting; about 15 out of 40 stakes. A few had 9" sprouts and 2 dozen shoots. The willow stakes that were very beaten and pounded into the ground to stake wattles sprouted first and most profusely. Further observations will tell if rooting occurs as well.
-alder stakes were not yet sprouting
-approximately 5-10% of the alder bundles were beginning to sprout, especially towards the top
-heavy rye grass cover has come into the upper areas of Area 1, as seeded
-vetch seedlings were found coming up out of wattles where they were protected from browsing
-No repairs were needed in this area

3. Area between Areas 1 and 2:

-between Areas 1 and 2 grass was growing and some of the pussy-willow plantings were beginning to bud.
-no repair work was done in this area

4. Area 2:

-approximately 10% of the wattle bundles in this area were beginning to sprout.
-no repair work was needed in this area

5. Area 3:

-some alder and willow bundles were beginning to sprout. The planted willow canes seemed alive
-some grass sprouted on the flats, and lots on the upper side slope
-the plantings of willow, on the bare schist slopes to the east of the flat were still green and some appeared to be budding
-no repair work was needed in this area

6. Skid Trail Resource Area:

-it was noticed that even small branches of willow and a few alder that had been lying on the ground were sprouting
-up the old skid road, by the main creek crossing, a large log had dislodged from upslope and rolled down on the road against some large alders

7. Stake and Plank Resource Area:

-a small amount of cliff slough had occurred and silled in behind the planter boxes
-on the trail next to the fallen fir tree to Area 3, a small wood check-dam had undercut its center (not pounded in).

8. Area 4:

-we found that all check-dams had collected sediment behind them and 3 of them had then undercut around the side banks
-the northeastern gully's volume of runoff carried from the slide above is higher than the westerly one.
-rye grass had sprouted all around area 4
-there was some sprouting of willow bundles all around
-many check dams, both rock and wood, seemed to have been very effective at sediment collection.

9. Creek Between Glen and Slide:

-along the creek many of the rock rip-rap seemed to be functioning quite well; some minor erosion had occurred and a few overhanging banks had sloughed into the creek and were settling.

Future Project Plans (January):

1. Planting of conifers.
2. Possible further seeding with annual rye.
3. Planting of terminal maple canes, alder, coyote bushes, and willow.
4. Reinforcing and rebuilding check dams and other structures where necessary.
5. Final documentation

Final notes:

1. Some minor trail work was done, cleaning out waterbars and other maintenance, on the way back to the crummy
2. Following this, we drove to the Prairie Creek Trailers and discussed the work project with NPS personnel.

Follow-Up Survey #4

Thursday, January 5, 1978: Dahinda Meda, Laurie Leaf, Steve Brewer, and Steve Baranger (volunteer). Weather was cloudy and mild with short showers.

8:30 a.m. Arrived at Prairie Creek Trailers and discussed final phase of project with Harvey Kelsey, specifically:

-planting 500' elevation spruce from LP's Crannel Nursery--OK; would be good to plant some appropriate redwood but none are available

-cutting deeper spillways into check-dams and discussing things learned in the process of construction, etc.

-re-emphasized need to keep control areas for experimental purposes

9:30 a.m. Arrived at Berry Glen and headed up trail to the slide area.

-L. L. stopped off by the 1st bridge crossing and bundled 100 alders (main leaders of small trees), and 100 maples from the ends of the lower branches. These were planted in the areas between Area 1 and Area 2, and below Area 2 by the redwood clump.

-L. L. and S. B. planted for 2 hours

-D. M. and S. B. gathered stake and plank materials around the area and began repairing retaining walls by the fallen fir trail

11:30 a.m. Planting continued between Areas 1 and 2; D. M. cut notches (deeper V's) into the check-dams in the gully area, above the redwood clump. S. B. took notes and organized report information and data.

-the water ladder is catching some sediment

-7 check dams are in this area, with 2 completely full and the rest half or more full

12:00 noon Area 4 was surveyed. All the check-dams were functioning well, developing ponds and catching sediment behind them. The conifer bundles were all still very green and working well as buffer pads. Most of the bundles (80%) on the west face were sprouting. Rye grass was quite profuse on this upper west face. The willow plantings seemed healthy and perhaps 10% were pushing buds out.

-notches were cut deeper in 7 of the check-dams and the top check-dam had breached one side. This was plugged with rocks and earth. Plantings were made in the edges.

-other check dams were repaired and this information is on the Check-Dam and Gully Survey Map (Appendix D).

-more willows were clipped and set in the stream to soak water overnight

2:00 p.m. Finish working on the slide area and heading down the trail, doing more streamwork on the way.

2:30 p.m. Drove to LP's Crannel Nursery and picked up about 500 spruce trees (092-05, zone and elevation)

4:00 p.m. Arrive back at camp in Trinidad

5-7 p.m. L. L. and D. M. went to Arcata to purchase food supplies

Follow-Up Survey #5

Friday, January 6, 1978: Dahinda Meda, Laurie Leaf, Randy Stemler, and Steve Brewer. Weather was cool and mostly cloudy; little rain; it rained 1-2" inches last night.

8:00 a.m. Leave Trinidad for morning discussion

8:30 a.m. With Harvey Kelsey at Prairie Creek.

9:45 a.m. Spruce trees were checked by NPS

10:00 a.m. Head for trail head at Berry Glen

10:15 a.m. "Trail survey" on way up trail

-The small drainages that cross the road, before the first bridge crossing were all flowing. One freshet was flowing down the road and eroding a gully. R.S. and D.M. help reroute with a water bar.

-At the first place on the creek where rockwork had been done originally, some reinforcement work was done by gathering and piling large available rocks and boulders (3" to 2' diameter) as bank protection.

-This first section of rock reinforcing has held fairly well. One cutbank of exposed soil (about 50 ft. upstream from the first rock work) has collapsed in a mudflow with a scarp of 4 meters (12 ft.) in length.

-Another 40 ft. above here there is an area where a small meander was straightened out, and filled with rocks and a large (18" diameter) log 6 ft. long as bank protection. The creek appears to be cutting deeper into the channels.

-There were several small bank slumps on the way up the creek. Also, a huge Douglas fir stump (with small hemlocks growing on it, at the 2nd bridge crossing) appears to be moving or scouring its way down the creek.

-A large mass (20' across and 15' high) has started liquifying as mud and sliding down the north bank, just above #2 bridge.

-then up a rocky stretch (the trail up the middle of the creek). A bank had slumped here earlier in the season, as reported in an earlier field report. Some cut branches had gotten into the creek and lodged on a snag above the slump, creating a small dam which sent the creek against the bank and caused the slump. The channel was cleared and some rocks piled along the bare banks.

-Some minor clearance of woody debris was done within the stream channel. A small trail waterbar was also cleaned out.

-Just upon entering the older slide mass area where the bare schist slopes begin, there is a new spring of 2-3 gallons per minute that emerges some 20 ft. up the slope and is eroding a gully into this slope.

-The check-dams up the main gully have all filled, and the bank repair that was made on a lower dam (in December) has also held.

-On the slopes where the steps go up, the terraces are collecting sediment.

1:00 p.m. Lunch time

1:30 p.m. We tied blue ribbons on all the winter hardwood and brush plantings. The spruce seedlings were planted all around Area 3 and Area 1 at about 10 ft. spacings. Several cuttings were pulled, red-flagged, and replaced--the willows had sprouts and roots, the alder had catkin sprouts and occasional root nodules, and the maple had terminal bud swelling and root nodules.

-Area 3 has sprouting in all the wattle bundles and budding from the willow plantings; even the plug bundles are sprouting. The rye grass is growing in thick patches. Vetch was growing up out of bundles on slopes and in gullies.

2:30 p.m. Continued planting spruce between Areas 1 and 2 and 30 willows in the area to the west of the large redwood clump and around it.

-2 went below and marked the check-dams with numbered stakes with red flags and recorded information about past repair work done and the condition of the dams.

-I planted another 70 willows down the gully area below Area 3 heading toward gully B.

3:00 p.m. -planted spruce in Area 2, between Areas 1 and 2, in Lower Area 3, and on the bare schist slope.

-planted 40 alders on the west side of Gully A in Area 4.

4:00 p.m. -Finished planting spruce in Area 4

-L. L. went down the trail to clip more willow plantings for Saturday's plantings

4:30 p.m. Head down trail doing minor rock work on creek where necessary.

Follow-Up Survey #6

Saturday, January 7, 1978: Dahinda Meda, Steve Brewer, Randy Stemler, Laurie Leaf. Weather was cloudy and cool, but dry. Site: Berry Glen Repair Site, NPS Project Area #3.

10:00 a.m. Head north on Hwy 101 for Berry Glen

10:30 a.m. Head up trail with gear and lunch. We clipped up a wind-felled coyote bush and gathered more willow for plantings.

11:00 a.m. More minor rock work was done at the area of major rip-rapping on the creek. The area where the concentration of rock work in the creek was done, also corresponds with the area where the major concentration of downcutting and bank erosion is occurring.

11:30 a.m. Began planting willow and alder and bacharis clippings in the check-dams.

12:30 p.m. 40 willows and coyote bush were planted in the eroding slopes immediately below the slide proper (along the creek). Springs have emerged with this winter's rains and fresh gullies are being formed.

-Planted 50 coyote bush along the top scarp heads (above Area 1 and Area 2). Another 50 coyote bush and willow (mix) were planted around the control face (west side of Gully A) in Area 4. Thirty coyote bush were planted along the top of the bare schist slope below and to the northwest of the shuttle take-off point.

-R.S. clipped out fir branches in an over-crowded area and wired 14 fir bundles.

2:00 p.m. Lunch break and work discussions

2:30 p.m. Resume work. As we worked a group of coyotes barked joyously across the canyon.

-Continued planting coyote bush and willows around area 4, on the slopes and in the gullies. We staked conifer bundles into Gully B, side armoring, sediment collectors, gully plugs. Two bundles lengthwise were staked into gullies just above check-dam B.3.

-We clipped a few more terminal alder branches for planting around Gully A in the check-dam sediment.

4:00 p.m. Final clean-up work began and materials were gathered together.

4:15 p.m. Down the trail we went and stopped at the recent slump area along the creek. We gathered the willow branches that had been clipped earlier and bundled these for a wattle row. We then dug the contour ditch, placed the bundles in it, and staked these in with split redwood. These were then halfway buried on the top and packed into the hill. Willow clippings were planted on the remainder.

4:45 p. m. Finish work and head down trail.

5:00 p. m. It began to rain as we reached the trail head. End of field work on Berry Glen.

APPENDIX D

GULLY SURVEY
(1/6/78)

Gully No.	Observation
A-1	This check-dam had a west bank washout. The water flow had cut around and under the side; this breach was plugged with loose rock and a hunk of redwood and then restaked and replugged. The spillway notch was also cut deeper into the top board. -Appeared stable, but minor reconstruction may be still needed if it is to work properly. -All fir bundles between check-dams had collected a lot of sediment by this time.
A-2	Solid; was half-full with sediment, water seeping slightly between the boards.
A-3	Solid and about half-full of sediment with minor leaks.
A-4	Stable with spillway groove deepened. Filling slightly (20%).
A-5	Stable with spillway groove deepened. Filling slightly (20%). -Fir bundles between A-5 and A-6 have webbed over the bare soil so as to appear very stable with little erosion.
A-6	Stable with spillway deepened.
A-7	Stable with spillway deepened. Bundles and large rocks acting as buffers.

A-8 Ponding well with it half-full of sediment. Stable with some notch cutting done.

A-9 Stable--no repair.

-Note: willow bundle between A-9 and A-10 is sprouting profusely.

A-10 Stable with ponding flowing over and through "V" in top board.

A-11 Stable with some notching done.

A-12 Reconstruction necessary. Top board was positioned poorly, at an oblique angle to the uphill center line of the creek. The lower board was working fine and left in. The upper board was cut and refit at a better angle and restaked and fitted into the bank.

A-13 Stable, ponding slightly, with no repair needed.

A-14 Stable, little ponding, some notch cutting

A-15 Stable, with some notching and some ponding.

A-16 Very small check-dam, working well but not too significant

Gully B (northeast)

Note: Large amounts of soil have sloughed off the western bank at the head of this gully. These materials are no doubt filling the check dams below. A long log (15 ft) has also moved down on top of the first check dam.

B-1 This first small check-dam was functioning well with sediment caught behind it. No repair. The bundle just below it also acts as an energy dissipator. It was completely filled and almost covered by the log and debris from above.

B-2 Functioning well with no repair and a good conifer bundle buffer below.

B-3 There was a failure on its west bank that breached between October and December, was repaired in December and has held since. Was stable and full.

-Note: Occasionally the metal NPS stakes were found to be acting as debris catchers.

B-4 Some side breaching occurred on this one between October and December, was repaired in December and has held since. Some minor channel work was done. The dams in this gully are all full.

-Note: Gully B flows a much higher volume of water and is currently more erosive than Gully A.

-Conifer bundles appear extremely effective splash buffers.

-In the areas between B-4 and B-5 there used to be a rock check-dam that had failed, so these rocks were used as support for the banks on the other dams.

-The bank guards of wood were also working well in this area.

B-5 Was stable and filled all the way. No repair.

B-6 A rock check-dam that has held rather well. Some minor repair was done.

B-7 Stable and full with minor repair in dredging of channel.

B-8 Full and flowing through notch. Boards were at an angle downstream. Dam appears to be holding lots of weight from fill.

B-9 Had a large failure, cutting around east side of dam. This was filled with rock and mud debris and directed back through the notch in December. It appears to be holding now. Notch was cut deeper and wider.

B-10 This last check-dam appears to be holding also and no repairs were made.

-Note: the last 3 check dams (B-8, B-9, and B-10) are currently holding lots of sediment behind them.

APPENDIX E
WORK HOURS PER WORK TASK

DATE	8/20-9/23	9/23	9/24	9/25	9/26	9/27	9/28	9/29	9/30	10/1	10/2	10/3	10/4	10/5-10/17	12/9	1/4	1/5	1/6	1/7	1/8	1/9-1/23	TOTAL
Preparation and supply	3	32				4	2				1	2				4	8					56
Camp work		32											21				2	3	2	2		62
Project Discuss.		8	1	1	1		4	1		1		3	8		6		6	8	1	8		57
Tool maintenance and transport	12	1	18	1						1	2		2			4						41
Photos			4	2	3.5					6	3			2	4							24.5
Maps and notes; final report	2		3	2	1.5	2.5	1.5	2	8	3	1	2	4	24	4		3	6	6	8	110	193.5
Trail work			26	8	4.5				1			2			2							43.5
Split products				14	18	7			6	15	13	13	4									90
Check-dams									2	18	26	22	8		4		4	6				90
Water ladder											3	12	2									17
Planting, seeding						5	2	2	1	22	24	12	8		2		8	8	6			100
Debris & rockwork in creek					4	1	1	12	8	1			4				1	10	3			45
Drainage control			1	1			3															5
Wattle construct.			8.5	19.5	15	7		18	36	11									1			116
Wattle bundles			10	18.5	27	22	36	29	4	11		5	1						1			164.5
Fir bundles (conifer release)						2	2					2	1						4			11
Volunteer energy				9					8	8	8	8	8	8			8					65
RNP staff visits					3	6	1					2	4		2		1	2				21
Auto travel	16	9.5	2	2	2	2	2	2	2	2	2	2	2		10	4	2	2	2	4		71.5
Hiking on trail			3	6	6	6	5	5	5	7	7	6	6	2	1		2	2	2			71
Lunch		4	4	4	4	6	6	6	6	8	6	6	4		1	2	2	2	1			72
Planning, recon.	80															8						88

APPENDIX F

BERRY GLEN PLANTING INFORMATION
TEST AREA #3

Key: A = alder
A(W) = alder with some willow
M = maple
R = rye
S = spruce
Ve = vetch
W = willow
W(A) = willow with some alder

Area	Planting Information	Season
1	Wattles A(W), 232 W, 10 M, R, Ve	Fall
	S	Winter
2	Wattles W(A), 260 W, 7 M	Fall
	S	Winter
Between 1 & 2	283 W, 15 M, Ve, R	Fall
	30 W, 40 A, S	Winter
Along Upper Scarp	25 W, 25 C, S	Winter
Between Area 2 and Fallen DF	50 W, 10 M	Fall
	40 W, 30 A, S	Winter

Area 3 (Flat)	Wattles W(A), 30 W, 5 M, Ve !	Fall
	S	Winter
Area 3 (West Face)	Wattles W(A), 30 W, 10 M, Ve, R	Fall
	S	Winter
Between Areas 1 & 3	30 W, 30 A, S	Winter
Bare Schist Slope	150 W, 8 M	Fall
	30 C, S	Winter
Upper Gully B (Just Below Flat)	70 W, 30 C, S	Winter
Lower Gully B	50 W	Fall
	25 W, 10 C, S	Winter
Between Gully B & Step Path	10 C, S	Winter
Step Path Face and Gully A	150 W, 25 M, Ve, R, Wattles W(A)	Fall
	20 C, 20 A, S	Winter

Gully A (West Face)	Ve, R	Fall
	40 A, 25 W, 25 C, S	Winter
Downstream from Slide	20 W, 20 C	Winter

APPENDIX G

PROJECT SCHEDULE

August 17, 1977	Experimental Repair Study and Report Request for Quotations issued by Redwood National Park.
August 25-26, 1977	Field examination of the proposed test areas prior to contract bidding
September 20, 1977	Final negotiations and purchase order issued for Test Area 3 Rehabilitation Project
September 23 through October 4, 1977	First and major part of work completed on Test Area 3, Berry Glen
October 10, 1977	Interim report completed and mailed to Crescent City
October 10, 1977	Follow-up Field Survey #1
October 17, 1977	Follow-up Field Survey #2 and photographic documentation
December 9, 1977	Follow-up Survey #3 and further photographic documentation and repair work
January 5-7, 1978	Final work and winter plantings completed. Follow-up Survey #4.
January 8-21, 1978	Completion of Final Report

APPENDIX H
FINANCIAL STATEMENT

Financial Summary

Labor ($111\frac{1}{2}$ days @ $50/day)	5,775.00
Reconnaissance, negotiations, planning, documentation (25 days @ $50/day)	1,250.00
Expenses (breakdown below)	1,931.57
Overhead	943.43
TOTAL CONTRACT	9,900.00

Expense breakdown

Groceries	519.57 (about $40 left over)
Tools, equipment	663.72
Slides and photos	228.59
Seeds	13.50
Trees	41.22
Gas, oil, etc.	134.62
Campground rental	70.00
Trailer expenses	85.00
Stamps	8.10
Restaurants	75.90
Entertainment (steam bath or movie)	41.75
Reproduction (final report)--estimate	50.00
TOTAL EXPENSES	1931.57

Work Task Breakdown (lunch and volunteers not included)

1.	Documentation, planning, discussions, reconnaissance	31.1%
2.	Wattling	24.2%
3.	Equipment, travel, hike to slide	13.7%
4.	Check-dams, water ladder, fir bundles	12.2%
5.	Planting and seeding	7.4%
6.	Camp work	4.6%
7.	Creek work (rock armoring, debris removal)	3.3%
8.	Trail work	3.2%
9.	Drainage control	0.3%
	TOTAL	100.0%

Work Task Breakdown (lunch and volunteers not included)

1. Documentation, planning, discussions, reconnaissance	31.1%
2. Wattling	24.2%
3. Equipment, travel, hike to slide	13.7%
4. Check-dams, water ladder, fir bundles	12.2%
5. Planting and seeding	7.4%
6. Camp work	4.6%
7. Creek work (rock armoring, debris removal)	3.3%
8. Trail work	3.2%
9. Drainage control	0.3%
TOTAL	100.0%

APPENDIX I
CREDITS

Work Crew

Steve Brewer. Field work, field notes, mapping, follow-up surveys, final report.

Mark Brucker. Field work, chain-saw operator.

Bob Currier. Field work.

Mark Gary. Pre-inspection, work planning, project coordination, field work, mapping, follow-up survey.

Rocky Gulledge. Field work.

Lorie Leaf. Field work, camp coordinator, follow-up survey, photo book.

John Lease-Hensley. Pre-inspection, field work.

Karen Lease-Hensley. Pre-inspection.

Dahinda Meda. Pre-inspection, work planning, project coordination, field work, follow-up surveys, final report.

Don Newton. Organization of report and typing.

P. L. Ojeda. Field work, photo documentation.

Liz Perkins. Field work.

Randy Stemler. Field work, follow-up survey.

Ross Walker. Field work.

Meca Wawona. Field work, photo book, final report.

Volunteers

Steve Baranger, G.O.A.T.S. (Group for Organic Alternatives to Toxic Sprays); field work.

Mike Coble, follow-up survey.

Andy Colonna, G.O.A.T.S.; field work.

P.L. Ojeda. Forestry Network; photography.

Bob Rohde, G.O.A.T.S.; follow-up survey and photography.

Randy Stemler, Emerald Creek Committee; field work and follow-up survey.

INTRODUCTION

The Berry Glen watershed, a basin of approximately 104 hectare (.40 mi^2), was entirely logged in 1964-1965. Yarding systems common to that time, employed the use of crawler type tractors to transport timber from the site to common loading areas (landings).

The Grogan Fault, which seperates texture zones 2 and 3 and less metamorphosed rocks[1], makes contact with the alignment of Berry Glen Creek. Sandstone can be observed to the northeast, with schist to the southwest.[2] Surficial soils are primarily of the Melbourne soil series (814).[3]

Berry Glen Creek is a second order stream with a basin relief ratio of .264. Annual precipitation ranges from 70-80 inches per year. Because of its proximity to a coastal environment, the basin is often influenced by high intensity rainfalls of 2-5 day duration.

A massive, deep seated landslide was triggered in March of 1972, in the southwesterly head region of the south fork of Berry Glen Creek. The event resulted in a slide encompassing approximately 2.5 acres. This failure was further complicated by a gullying process which exposed the underlying, highly sheared, schistoid Franciscan soils.

Figure 1 is a map of the Berry Glen basin reproduced from a 1966 aerial photograph. Included in the map are drainage locations, major haul roads and skid roads. An interesting note to observe is that major skid roads terminate at the slide location, while the upper most road circumvents the area. This, along with features observed from the aerial photographs, leads one to believe that the site could have experienced an earlier failure and the removal of vegetation, along with skid road (full bench) disturbance, could have reactivated this feature.

REDWOOD N. P.
LIBRARY
South Operations Center

As part of an ongoing pilot rehabilitation program of Redwood National Park, the Berry Glen slide was selected as a test site to explore rehabilitation techniques. A wholistic approach, that is, one addressing rotational slide processes and surficial erosion, was not to be adopted. Instead, only techniques aimed at arresting surface erosion resulting from gully, rill, and sheet erosion processes were to be explored.

In September of 1977, a contract was awarded to New Growth Forest Service to perform the Berry Glen Rehabilitation. They were to demonstrate check dam and wattle construction, along with streambank stabilization techniques. Revegetation techniques, which would consider types of vegetation as well as time of planting, were also to be demonstrated.

Initial rehabilitation efforts were completed on October 4, 1977, with follow-up maintenance completed on January 7, 1978. To date, 46 inches of rain has fallen since the completion of rehabilitation.

The following report documents the progress of the Berry Glen Rehabilitation Project as of May 1, 1978.

Fig 1

BERRY GLEN WATERSHED

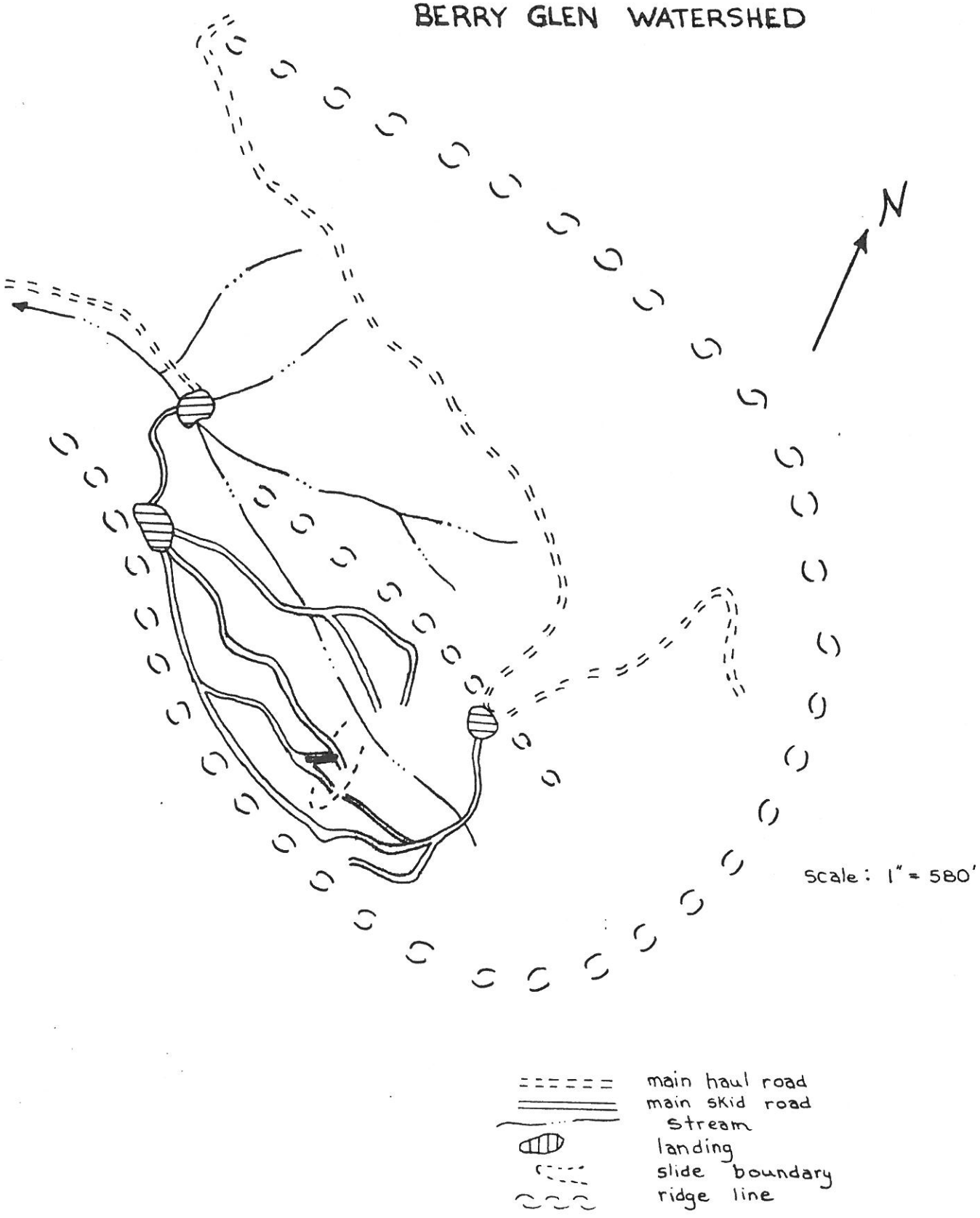


Figure 1

BERRY GLEN REHABILITATION

Gully Description

The Berry Glen Slide is a complex, rotational slide, which can be associated with shear failures along an arcuate plane. The upper toe, which defines the major break-in-slope, is still relatively intact, while the lower toe has failed and has been carried downstream. Two significant gullies have developed on the lower slide face, below the break-in-slope. Depths vary and range from 5-13 feet, with cross sectional areas ranging from 30-200 ft^2. During a year of normal precipitation, both gullies drain shallow groundwater tables and will produce winter long flows. Gully B (figure 2) is more responsive to intense rainfall and may attain flows approaching 1.5 cfs.

Gully Rehabilitation - In Channel Structures

Two types of check dams were constructed in the gullies to entrap substrates, which would later be planted with hydrophilic vegetation, in attempt to stabilize these erosional features. The first type were redwood slat check dams constructed from on-site material, while the second type were rock check dams constructed from channel bed material. A total of 16 redwood slat check dams were constructed in gully A, with 9 redwood slat check dams and 12 rock check dams constructed in gully B. In addition, fir bough dams were constructed and staked into both gully channels. Analogous to check dams, they served as energy dissipating, sediment collecting structures.

Energy dissipating structures (aprons) were installed at the outflow of each check dam to prevent localized scour and the undermining of check dams. Aprons were constructed from both redwood slats and bundled fir boughs. Both types were anchored to the gully bottom by means of redwood stakes.

A water ladder, which is used to transport water down a slope without allowing

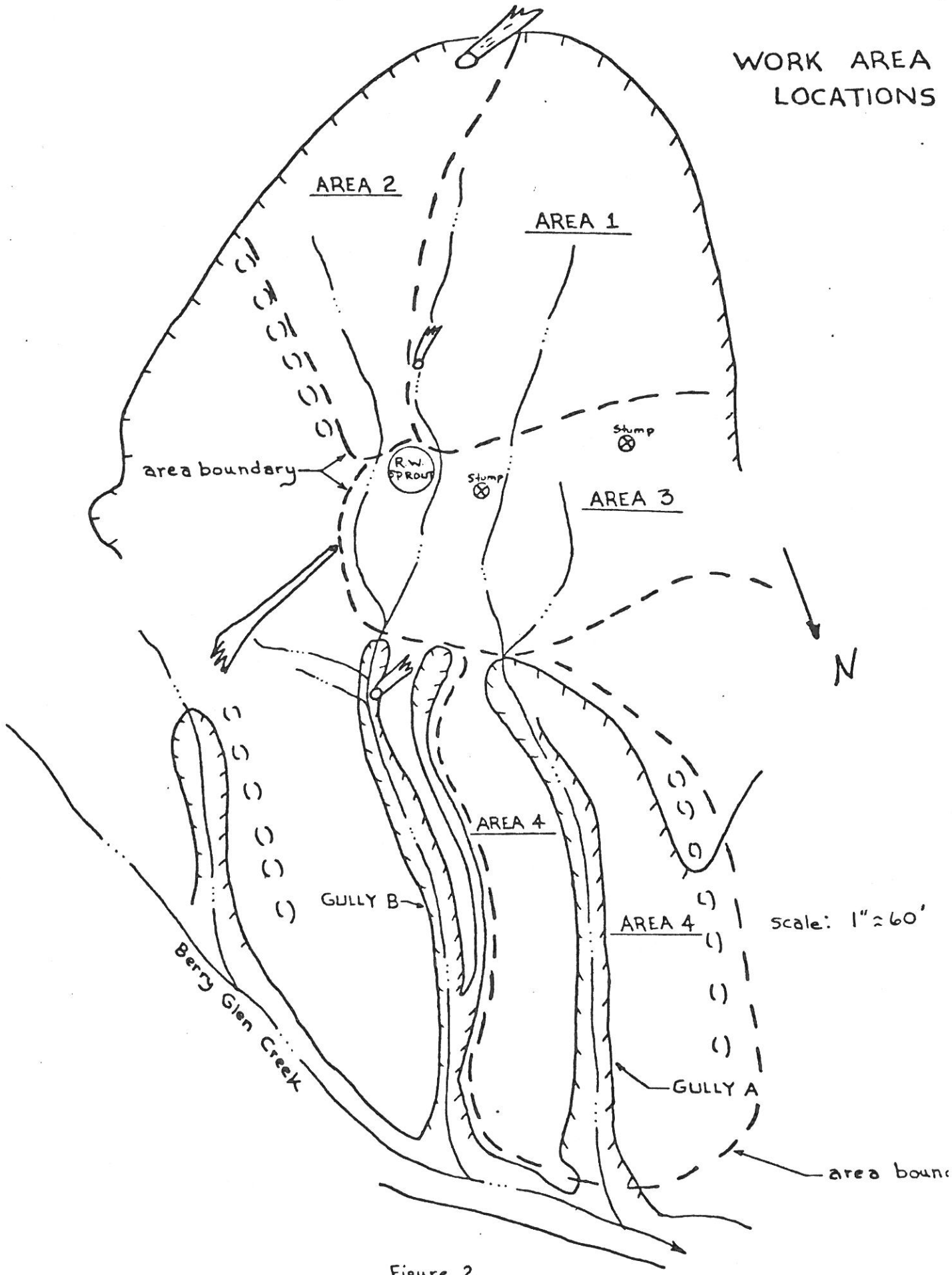

WORK AREA LOCATIONS
AREA 2
AREA 1
AREA 3
AREA 4
AREA 4
area boundary
R.W. SPROUT
Stump
Stump
N
GULLY B
GULLY A
Berry Glen Creek
scale: 1" = 60'
area boun

Figure 2

erosion, was constructed in the head of gully B. It is merely a water conveying structure and is not meant to promote aggradation.

Gully bank armoring techniques employed the use of redwood slat retaining walls. Their purpose was to prevent the undermining of gully banks and were also constructed from on-site materials.

(Slope)

Site Description

The Berry Glen Slide is a site of mixed lithology. It contains schist, sandstone and transitional rocks. As stated earlier, Melbourne soil (814) was the primary soil type and is still present in isolated areas. Specifically, this soil is found mostly along the western fringe of the slide and extends from the upper toe down along the westernmost flank. The remaining slopes are composed of highly sheared schist and extend into the gullies where exposed bedrock can be found.

Rills and gullies, although not deeply incised, have developed a fairly dense network on the uppermost slide face. Slopes range from 5-90%, with the average slope approaching 65%. Slopes along the crown and flanks often exceed 80%.

Native vegetation had established on site prior to rehabilitation, however, it was found mostly along stable scarp boundaries. Bare schist slopes were a common feature of the slide area, with vegetated slopes approximately 25% of the slide area.

Slope Rehabilitation

Planting information and wattle construction are described in detail in the New Growth Forest Service report. Briefly, however, willow and alder stems were cut on site in late September, while still in leaf. This stock was used to construct 1,820 feet of wattles on the slopes of the slide. With the exception of Area 1 and a portion of Area 3, all wattles consisted primarily of willow and contained some alder. ~~(see fig ——)~~.

The planting schedule was designed to study the success and flexibility of different species. Both planting time and stock were varied. Basically, planting was initiated during rehabilitation in October, 1977, and followed by a second planting in January, 1978. Fall planting consisted of willow and bigleaf maple, while red alder, coyote brush, Sitka spruce and willow were planted in January. The filled check dams also received willow plantings in January. Fall plantings were marked with three small rocks at their base, while blue flagging was used to identify winter plantings. Both annual rye and common vetch were broadcast seeded in October, 1977.

Both terminal and branch segments of alder, coyote brush, maple and willow were planted with most terminal segments displaying well formed terminal buds. The preparation given to these segments varied and, unfortunately, was not clearly documented. Some segments were pruned, while others were not. Alder, maple and willow received different degrees of pruning, while the coyote brush received little attention at all. Also, some were planted on the day collected, while others were held overnight in water. The depth of planting also varied with root to shoot rations of 0.20 to 1.00. The size of segments averaged approximately ¼ inch in diameter and 2 feet in length.

Berry Glen Creek

As a display of streambank protection and stabilization techniques, rock retaining walls and wattles were constructed along the toes of streambank failures. Willow wattles were also constructed along the access path where recent slope failures had developed.

REHABILITATION MONITORING

The lack of early organization precluded a thourough description of pre-rehabilitation site conditions. With the exception of earlier photographs, descriptive monitoring efforts initiated after rehabilitation had been completed.

Gully Monitoring

A longitudinal profile of the ~~main gully (gully B)~~ gully B (see appendix C) was developed from a field survey conducted on March 17, 1978. The purpose of the profile was to observe the morphological changes of the gully and, in particular, the effects of check dam construction and placement. Deposition pins were also placed behind many check dams to ascertain the depth and extent of deposition. Photo points were also established along the gullies.

Slope Monitoring

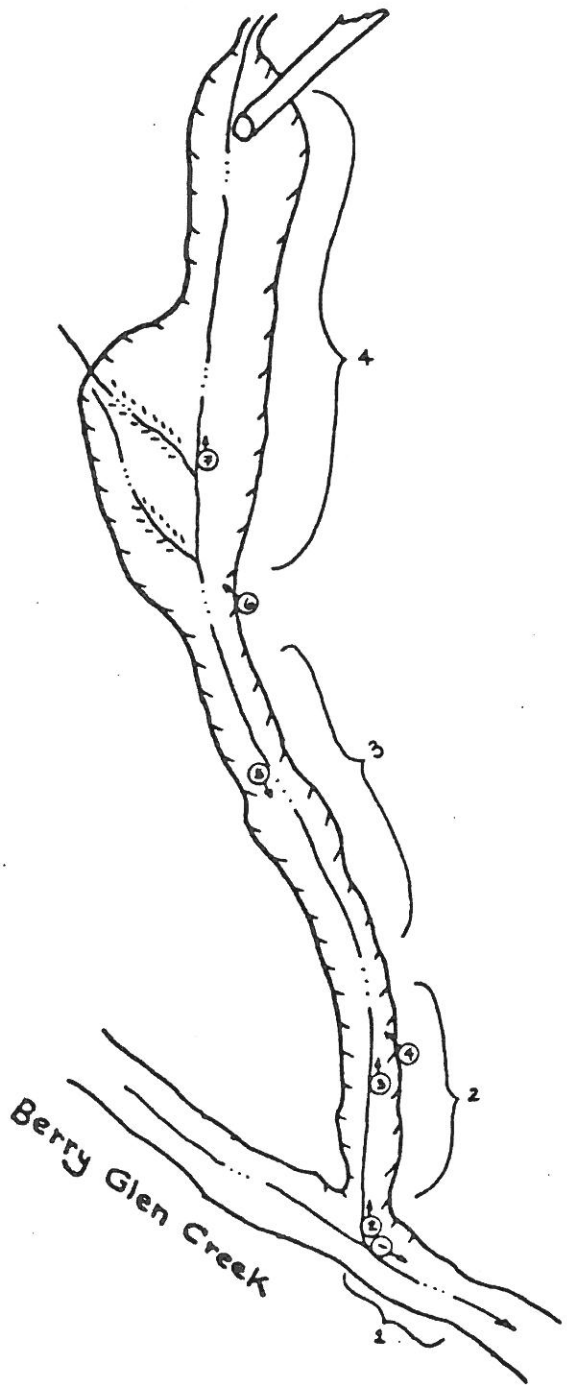
Monitoring the planted and wattled slopes employed the use of deposition pins, photography and vegetation surveys. Deposition pins provided a relative definition of the amount of sediment transported off the slopes and captured in the wattles (see Apendix A). A vegetation survey was conducted in order to identify and tally the types of surviving plantings. A wattle survey (see Appendix B) was included to describe the success of the wattles, that is, the length of sprouted wattle, per total length of wattle. Once again, photo points were established to facilitate documentation.

PHOTOGRAPHIC COMPARISON

As a visual aid, a photographic comparison will be used to depict the progress of the Berry Glen Rehabilitation Project. For most cases, comparative photos capture the same scene with similiar scales. Exceptions to this arise when a different scale is necessary inorder to display certain features eg: the sprouting of wattles.

Photographs are arranged to develop two themes; the first presenting in-channel structures, with the second concentrating on slope rehabilitation. The first page presents four photos which describe the entire reach of gully B. These photos contain lettered arrows, which help identify common points. Figure 3 defines the reach of each photo and includes locations of each comparative photo pair. A similiar map (figure 6) locates comparative photos describing slope rehabilitation. Both sections are followed by a brief discussion of the results observed.

PHOTO LOCATIONS
GULLY B



N

} = number and extent of gully photo

④ comparative photo pair location and direction of view

scale: 1" = 20'

Figure 3

DISCUSSION OF IN-CHANNEL STRUCTURES

Redwood Check Dams

Bank sloughing at the abutment of check dams was a major cause of check dam failure. By November 28, 1977, 7 of 9 check dams constructed in gully B had filled and had failed at their abutments.

Initial spillway design did not promote channelization and, in turn, did not provide protection to abutments. Spillways were notched to shallow (see pp 6). The depth of a check dam's spillway determines the height of fill stored behind the dam and if too shallow, the height of fill will too closely approximate the abutment height. The spillway, at this point, will not channelize flow and will allow it to cut laterally into gully banks. Spillways should be designed to accommodate both high and low flow regimes and should pre-determine a safe height of fill (see fig. # 4).

Rock Check Dams

Rock check dams were short lived. As can be seen from pp 5 , rocks were merely stacked in place and not anchored to the channel bottom or banks. As a result, all but one rock dam washed out by November 28, 1977. Rock dams should resemble gabions in construction. Rocks should be wrapped in a wire mesh and anchored to the channel. Another approach, which would preclude the use of only on-site material, would be to grout rocks in place, thus forming a permanent structure.

Splash Aprons

Plunge pools form at the toe of each check dam and, if not properly armored, will scour and promote bank sloughing from behind the dam's abutment. This was the cause for many check dams being undermined.

Redwood splash aprons were neither long enough nor placed properly in the channel. They were too short and did not armor the entire area of impact.

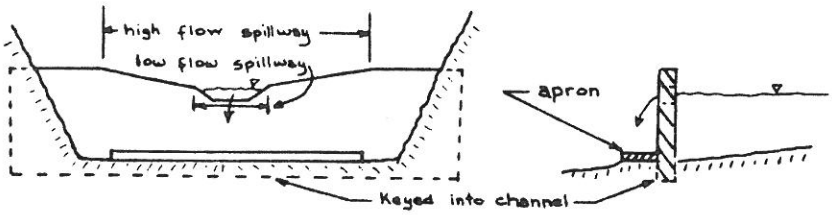


Figure 4. Check dam with double spillway and apron.

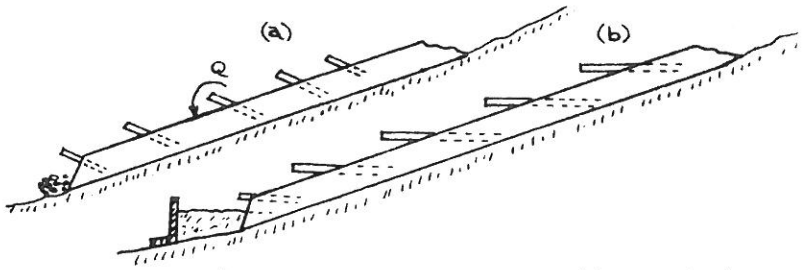


Figure 5. Water ladder: (a) present design; (b) new design

Furthermore, they were not butted securely against the base of check dams to deter infiltrating water from undermining the apron and eventually the check dam. Aprons should have a length equal to the width of high water spillways and should be butted securely in place (see fig. 4). Their placement should also closely approximate the channel gradient to prevent forming another plunge point.

Fir bough aprons were often used in place of redwood aprons and functional well at the beginning. However, they fatigued from impacting flows and eventually became ineffective. PP 6b shows an apron which resulted in a perched apron. Degradable plant tissue should not be used as a splash apron. Willow bundles, on the other hand, could prove to be effective.

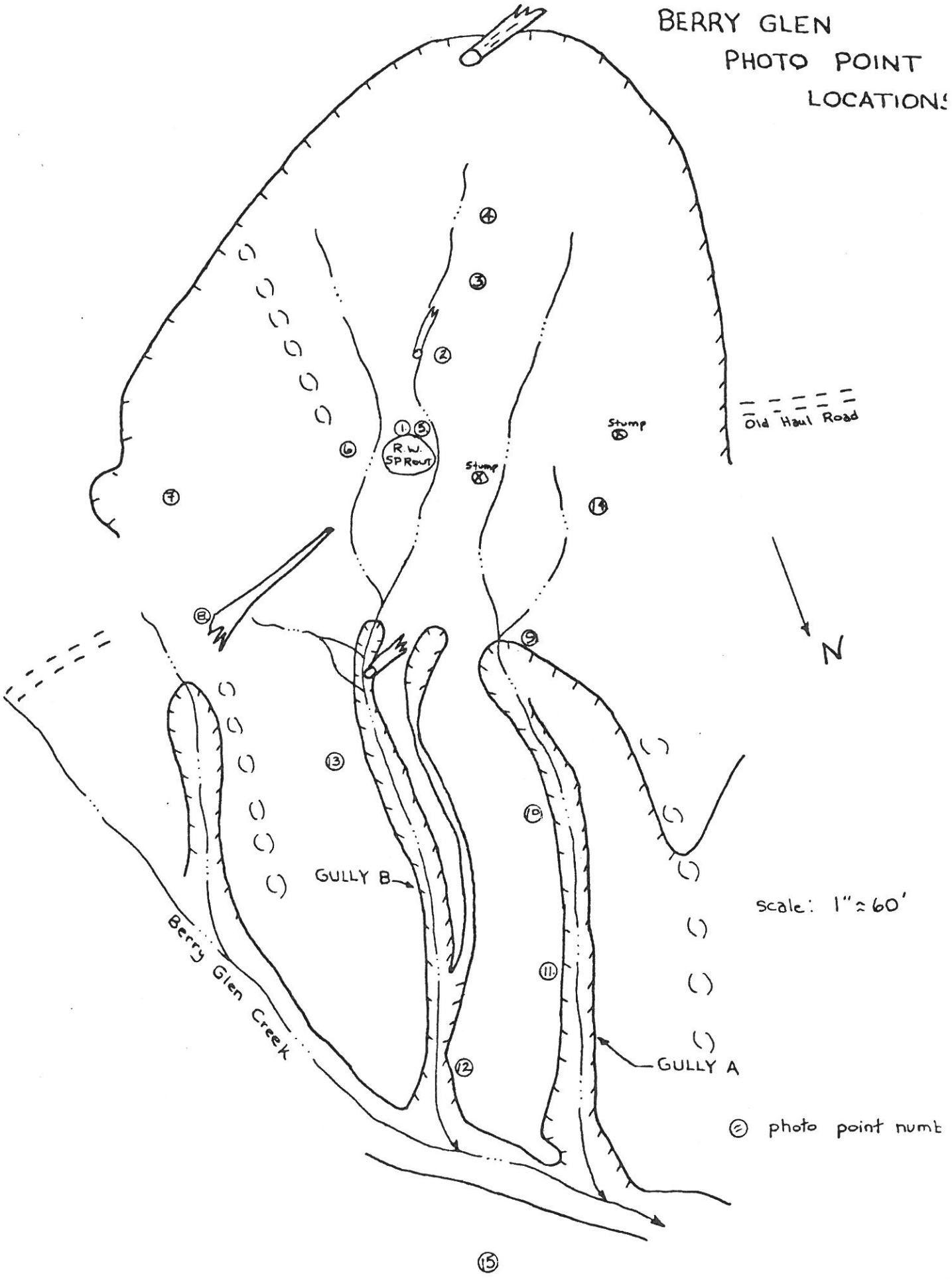
Water Ladder

Water ladders appear to be viable alternatives to culverts,, or half-culverts, when transporting water across a slope. Unfortunately, the water ladder, which was constructed, did not receive a fair test (pp 9). Its placement precluded erosive flows. It was observed in operation, however, and, with a few design alterations, should prove to be an effective conveying structure.

A number of problems existed with the tred design. They were placed too far apart, and water could not travel from one tred to the next. The angle at which they were installed also created a situation where flow would drain into the slope, rather than down the ladder and slope (see fig. 5). Finally, spillways were not cut into the treds. Should a water ladder be subjected to significant flows, channelization would be more easily maintained.

In order to establish and maintain a base level at the outflow of a water ladder, a check dam should be constructed at that point. Instead, only a fir bough dam was constructed. A check dam would be a better guarantee against upslope migration of knick points, which could possibly undermine the structure.

BERRY GLEN PHOTO POINT LOCATIONS



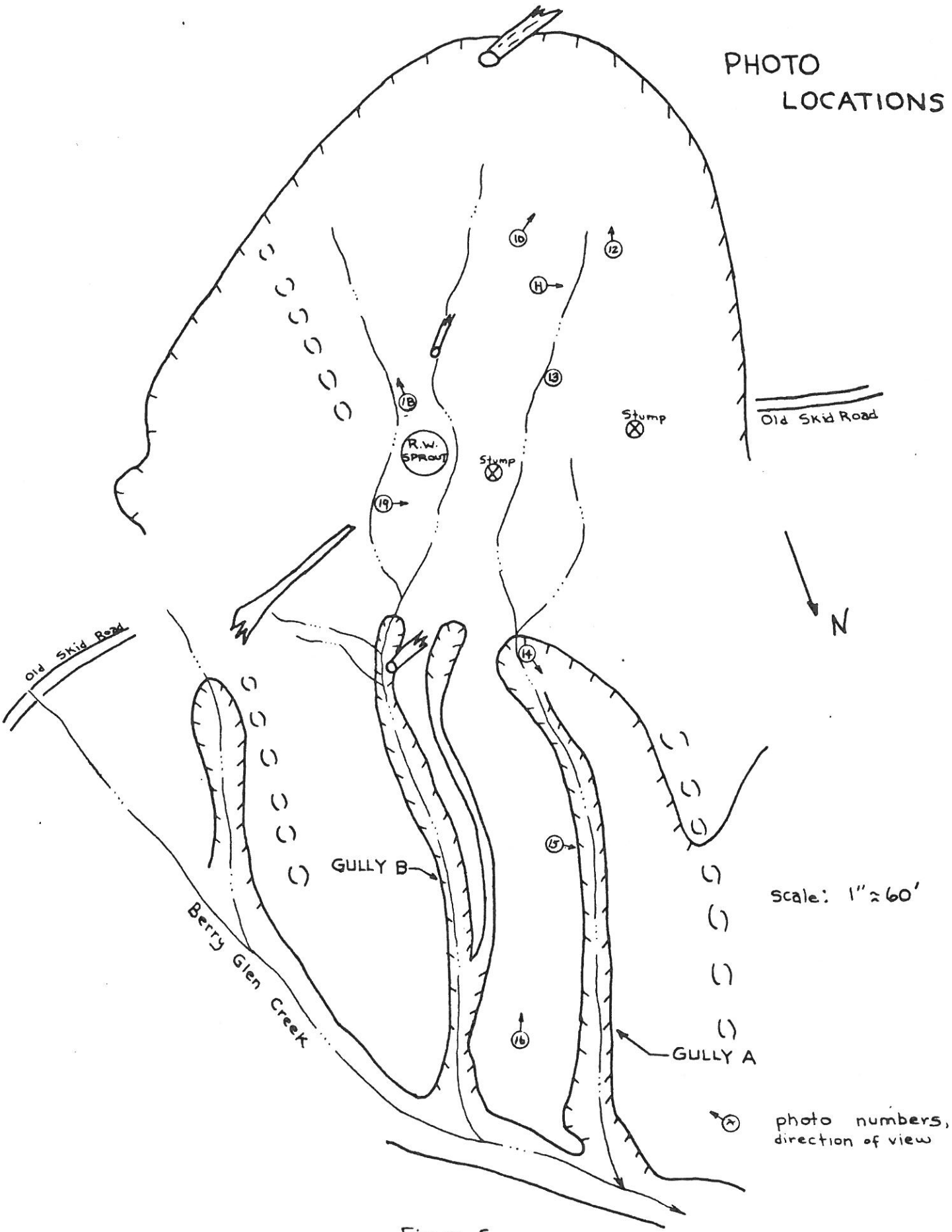

PHOTO LOCATIONS
Old Skid Road
Stump
R.W. SPROUT
Stump
N
old Skid Road
GULLY B
Berry Glen Creek
GULLY A
Scale: 1" ≈ 60'
photo numbers, direction of view

Figure 6

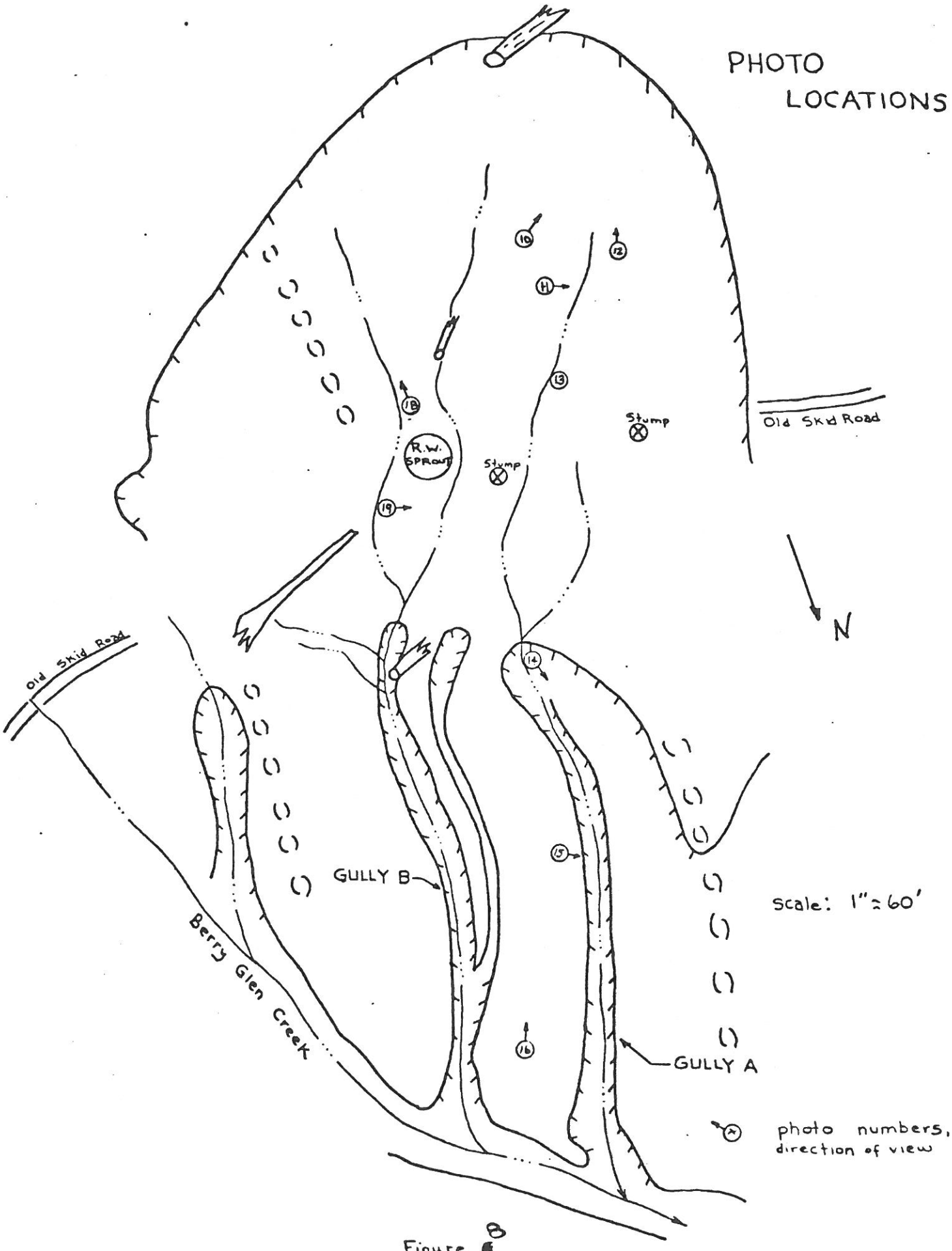

PHOTO LOCATIONS
Old Skid Road
Stump
R.W. SPROUT
Stump
Old Skid Road
N
GULLY B
Berry Glen Creek
GULLY A
scale: 1" = 60'
photo numbers, direction of view

Figure 8



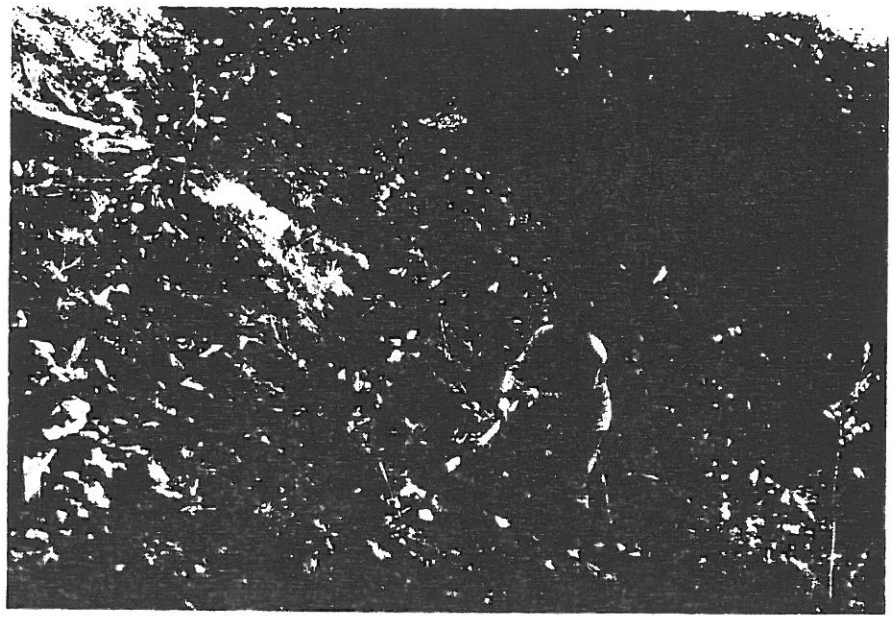
March, 1975



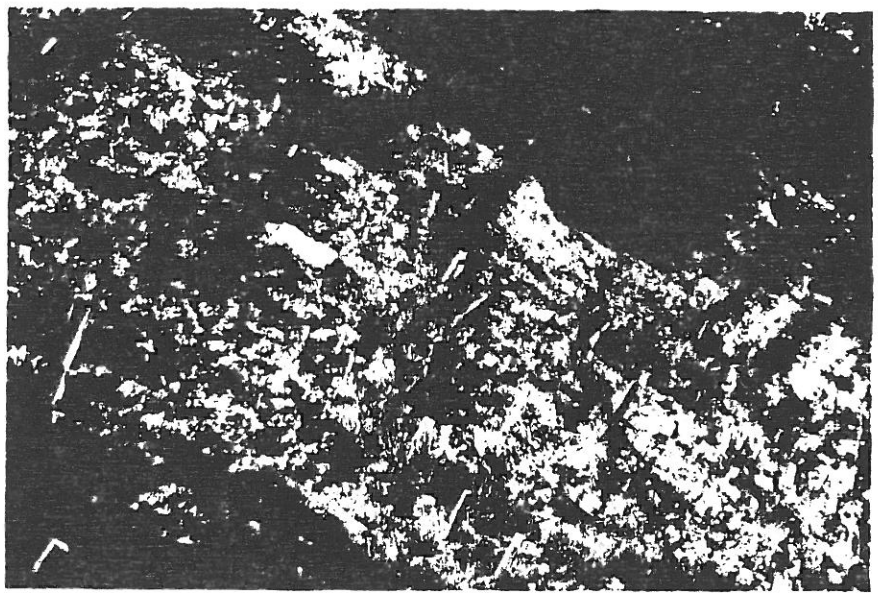
May, 1978

Photo Pair 10. Area 1.

The uppermost photo shows the site conditions in March, 1975. Three years have past since the slope failed and vegetation has yet to establish. The lower photo, taken in May, 1978, shows a very good grass cover and wattles on the slope.



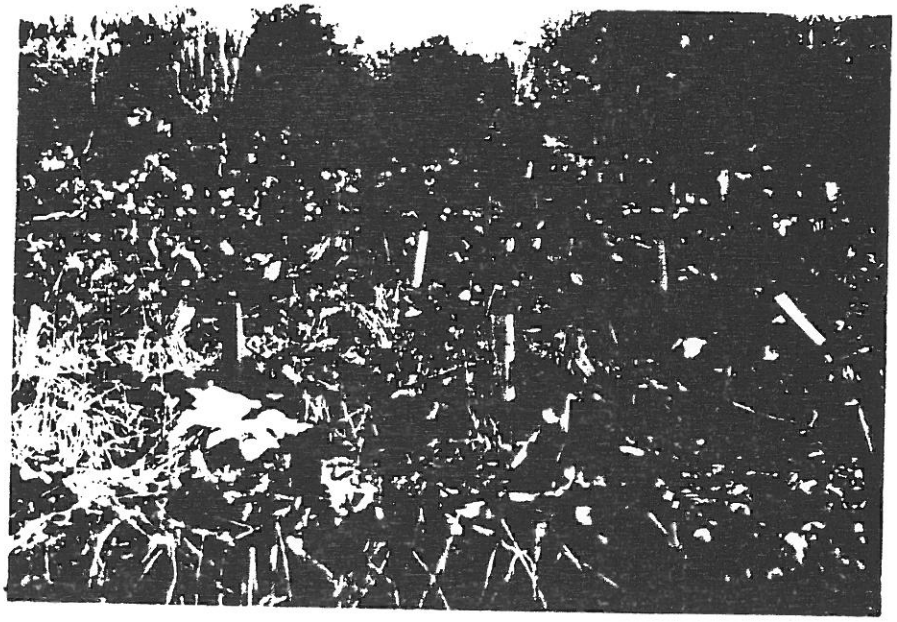
October, 1977



May, 1978

Photo Pair 11. Slope segment of Area 1.

The upper photo was taken at the time of rehabilitation and shows the un-vegetated, mineral soil conditions. The lower photo displays the distribution of grass density. Wattles were not only successful in capturing soil transported off the slope but also served as a catchment for rain swept seed.



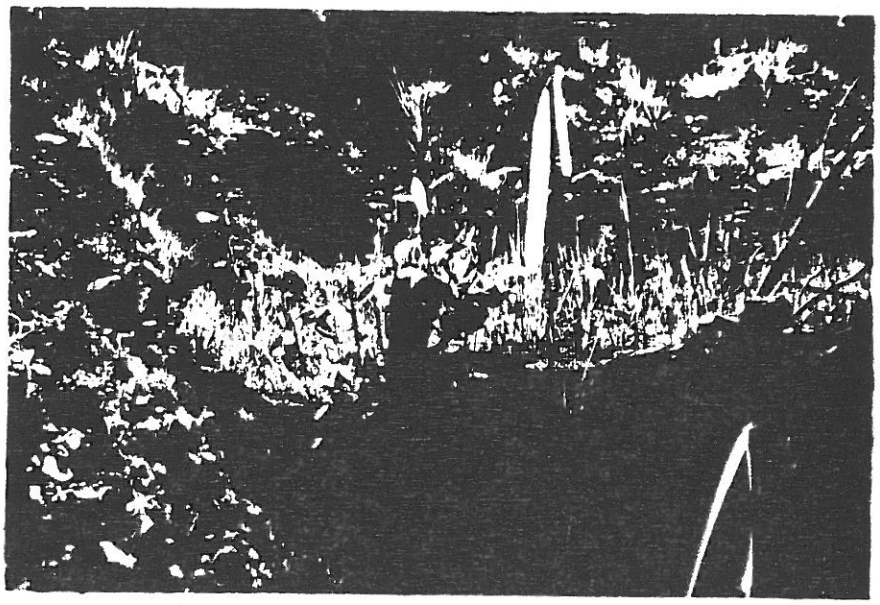
October, 1977



May, 1978

Photo Pair 12. Slope segment of Area 1.

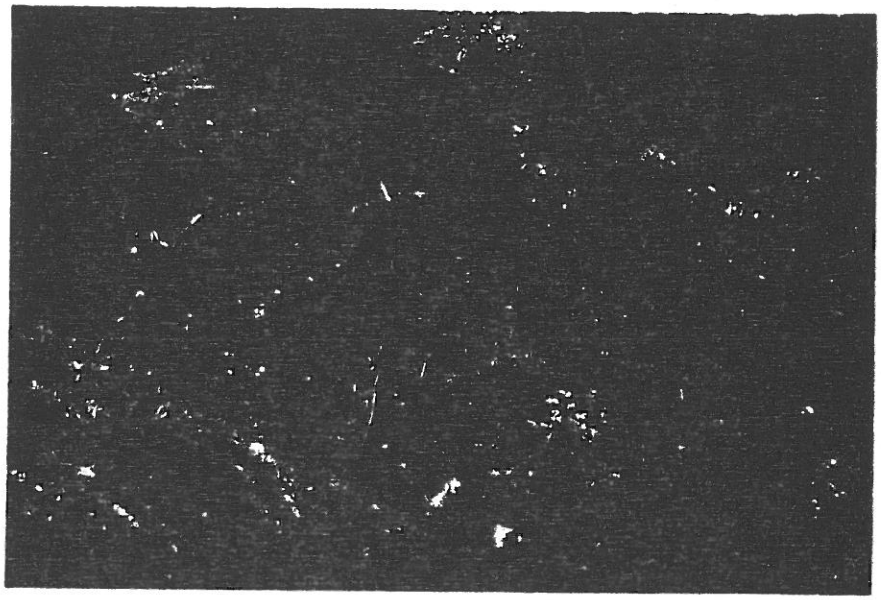
Area 1 was wattled with red alder and has not yet produced sprouting. It is perhaps the wettest site of the entire slide and only willow is producing sprouts from the wattles.



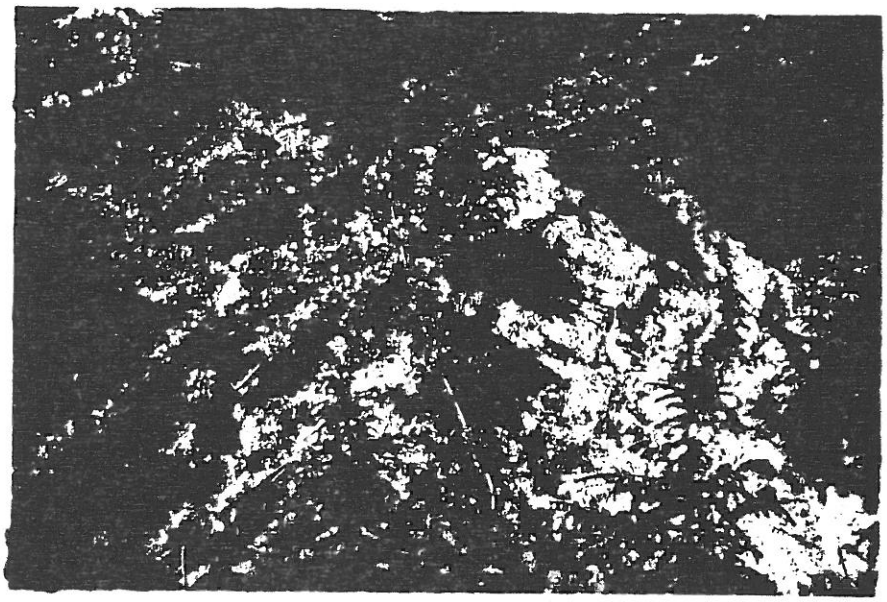
May, 1978

Photo 13. Willow cane in wattle of Area 1.

Although wattles of Area 1 contain largely red alder, some willow canes were used to anchor wattles to the slope. In most cases observed, willow canes had produced roots and sprouts. In some cases, however, canes were placed upside-down and have not sprouted.



November, 1977



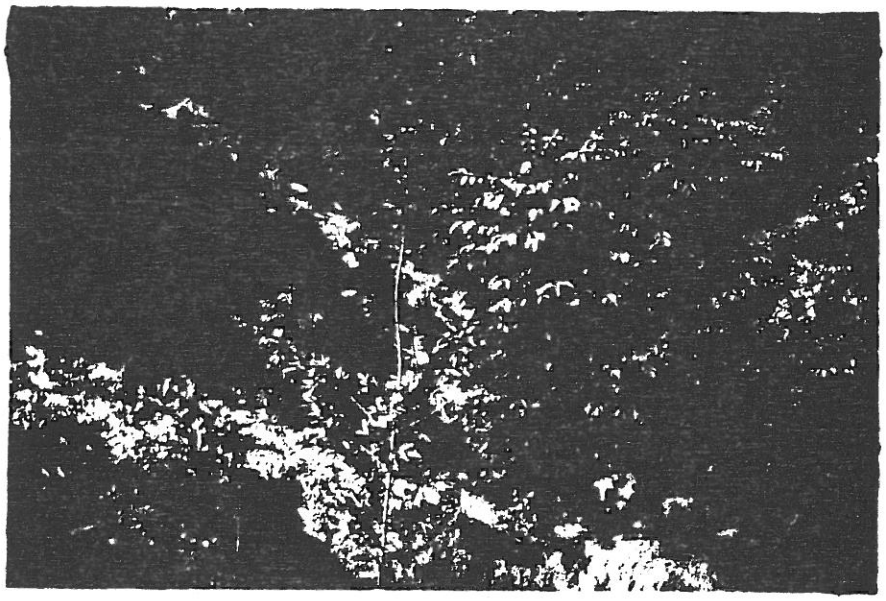
May, 1978

Photo Pair 14. Western slope of Area 4.

The upper photo shows the bare site condition which existed shortly after rehabilitation. Taken at a smaller scale, the lower photo displays the increased ground cover of annual rye and wattle growth. The wattle growth in the lower left corner of the lower photo, is representative of the wattle growth on this site.



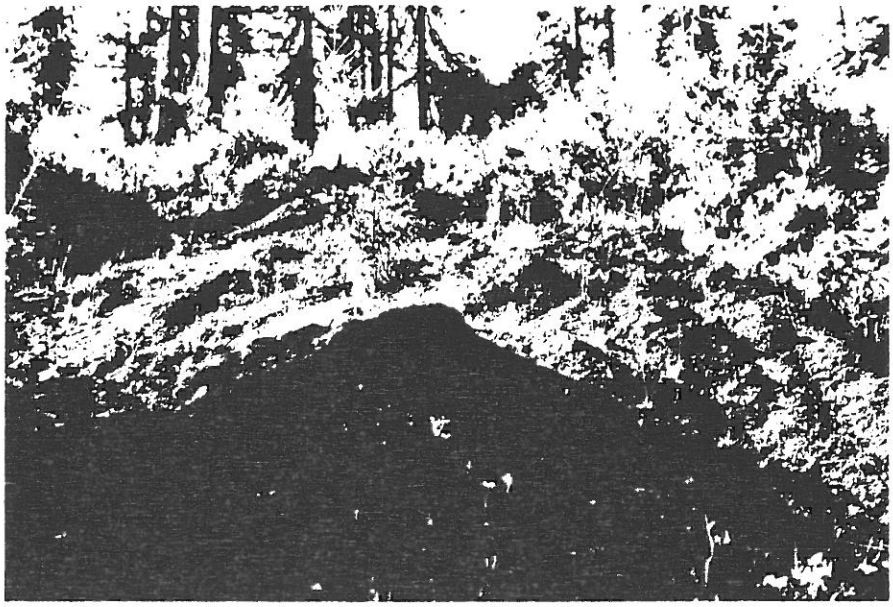
September, 1977



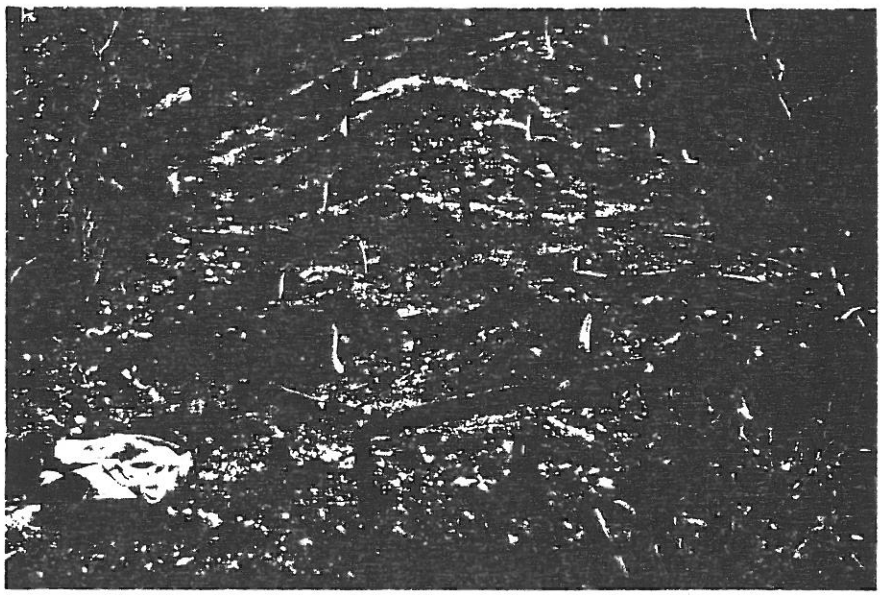
May, 1978

Photo Pair 15. Slope segment of Area 4.

Once again, the lower photo was taken at a smaller scale to show wattle and vegetation growth on the slope, which was largely bare soil.



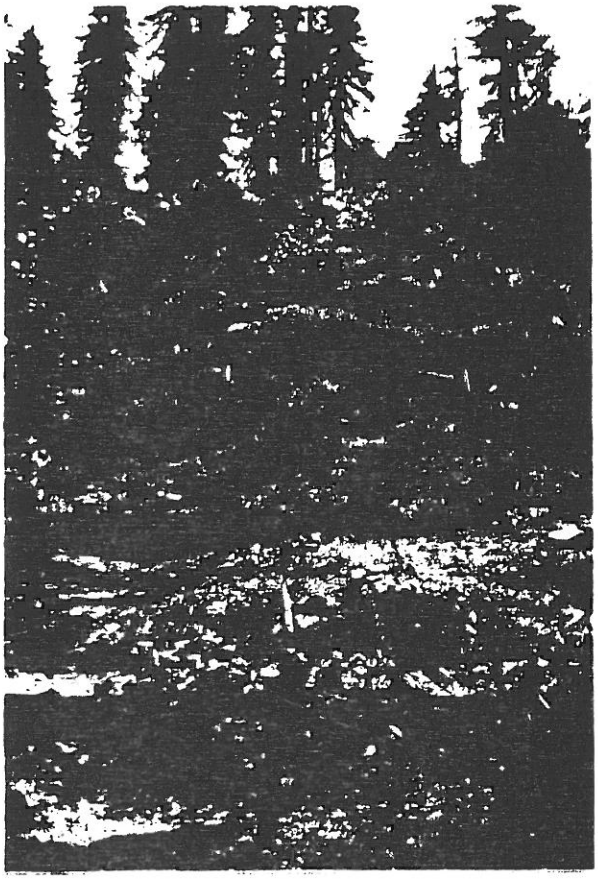
September, 1977



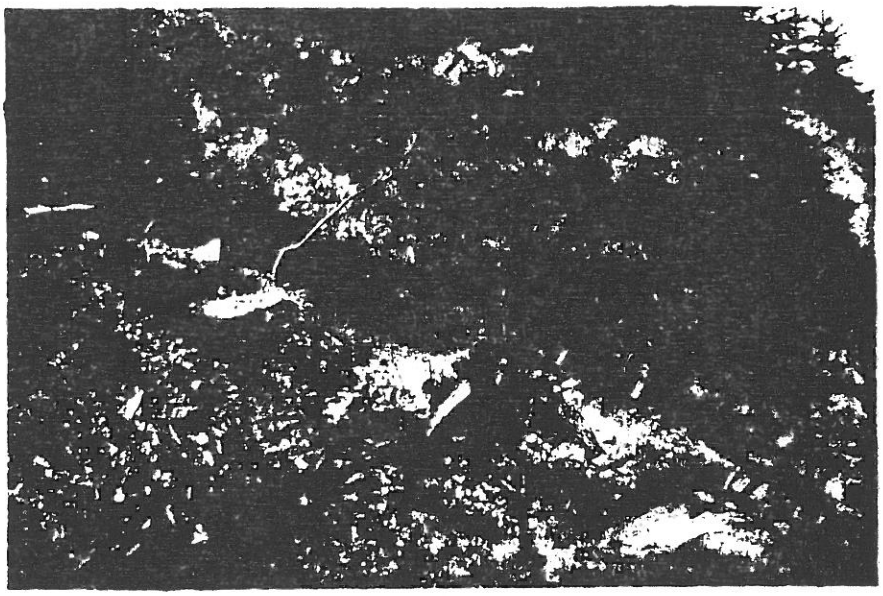
December, 1977

Photo Pair 16. Central slope of Area 4.

The upper photo shows pre-rehabilitation conditions, with the lower photo taken in early December, 1977. As can be seen, willow wattles have not yet started to sprout on this site which is dry and composed largely of schist.



May, 1978



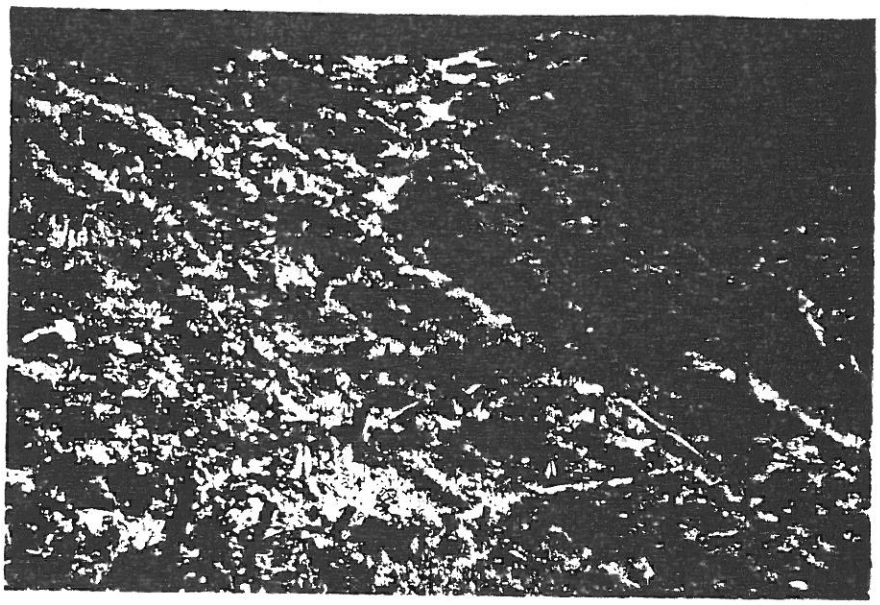
May, 1978

Photo Pair 17. Central slope of Area 4.

Taken in May, 1978, the upper photo shows the establishment of grass and wattles. The lower photo, also taken in May, 1978, displays a representative sample of wattle growth on this slope. The lower photo views western area 4 but the central slope is captured in the foreground.



December, 1977



May, 1978

Photo Pair 18. Area 2.

The upper photo shows only the lower portion of Area 2 and displays the lack of vegetation. In comparison, the lower photo captures the entire slope on which grass has established. Note the density of grass in the central gully. The upper slope was used a supply area for rye seed and apparently a fair amount was spilled. Rainfall and runoff helped desperse the seed down the gully.



October, 1977



May, 1978

Photo Pair 19. Eastern area 3.

Wattles in this site were constructed largely with alder. As can be seen from the photos, they have not yet produced significant growth. Only the willow has produced new sprouts. Rye, however, has established a moderate ground cover on this relatively dry site.

DISCUSSION OF SLOPE REHABILITATION

The success of slope rehabilitation (revegetation) efforts cannot be gaged at this time. Observations and early results will be discussed but, the success of various planting efforts must await the trial of the dry summer season.

Wattles

Wattle construction employed a mixture of alder and willow. In general, the wattles contained mostly willow with some alder or mostly alder with some willow.

A wattle survey was conducted in April, 1978, to describe the "success" of wattle sprouting (see Appendix B). The results showed a 50% sprouting success of wattles containing mostly alder as compared to 63% of those containing mostly willow. In both cases, however, the sprouting was attributed to willow and not alder. The alder displayed only leaf expansion from pre-existing buds. At the end of April, one instance of alder sprouting was observed. In all cases where sprouting willow material was examined, adventitious roots were present. In contrast, no adventitious root development has been noted in the alder material.

In general, native willow appears well suited for use in wattle construction. It will root adventitiously and develop a dense root system. It does not seem likely that native alder will produce advantitious roots spontaniously and tests with indole acetic acid (rooting compound) may be warranted. In either case, both alder and willow are deciduous and will not provide a winter ground cover.

Willow Stems

Willow stem plantings have displayed a high percentage of new growth and survivial. An estimated 90% of both winter and fall plantings, terminal and branch stems have survived thus far. Rooting on hillslopes and behind check dams has been observed.

Alder Stems

An estimated 40% of the alder stem plantings have so far survived. In most cases, the stems have only expanded their leaves and have not rooted. Included in this estimate, are those stems which appear to have only living cambium.

Once again, a rooting compound may be warranted to further test alder stem plantings under more controlled conditions.

Bigleaf Maple Stems

Terminal and branch stems did not show evidence of sprouting or rooting by March, 1978. In April, however, perhaps 30% to 50% of the stems showed nearly complete leaf expansion from pre-existing buds. Many of the leaves were broused by banana slugs and only a few of those sampled displayed any form of rooting.

Bigleaf maple results are essentially the same as for alder and 100% mortality may be expected by the end of summer. Root systems have not yet developed on a site which will soon be dry.

Coyote Brush

Coyote brush plantings appear senescent. Cambium appears to be living but plants have so far displayed very little new growth or rooting.

Coyote bursh is known for its adaptibility to dry sites and ability to root.

Elsewhere (test area #4) another contractor's plantings are sprouting and rooting. This leads one to believe that either the plant stock was of poor quality or the time of planting was not condusive to growth. It was noted that the plantings had a very large leaf area for unrooted cuttings. A lack of pruning may also have been the cause. In either case, success cannot be determined at this time. Coyote brush is an evergreen and a wide spread native shrub and should be further tested.

Annual Rye

Rye has established well on slopes and in wattles (see pp 12 and pp 18). Deposition in the wattles from soil washed off the slopes was much less in Area 1 as compared to the other wattled areas (see Appendix A). This may be a result of the dense grass, which has established on that area. Rye is an annual and does not represent a perennial grass sod.

Common Vetch

Young vetch was heavily broused by quail and only 100-200 have survived. They have reached 2-4 inches in height and remain only in protected niches - largely in the wattles.

Instead of being broadcast seeded, vetch could be planted to provide better protection against brousing.

APPENDIX A

This appendix contains deposition pin data obtained from surveys conducted on April 11-13, 1978. The data is presented in the form of site maps, which show the amount of deposition (in millimeters) and the relative location of each deposition pin. Legends accompany each map to describe characteristics peculiar to each site.

SUMMARY

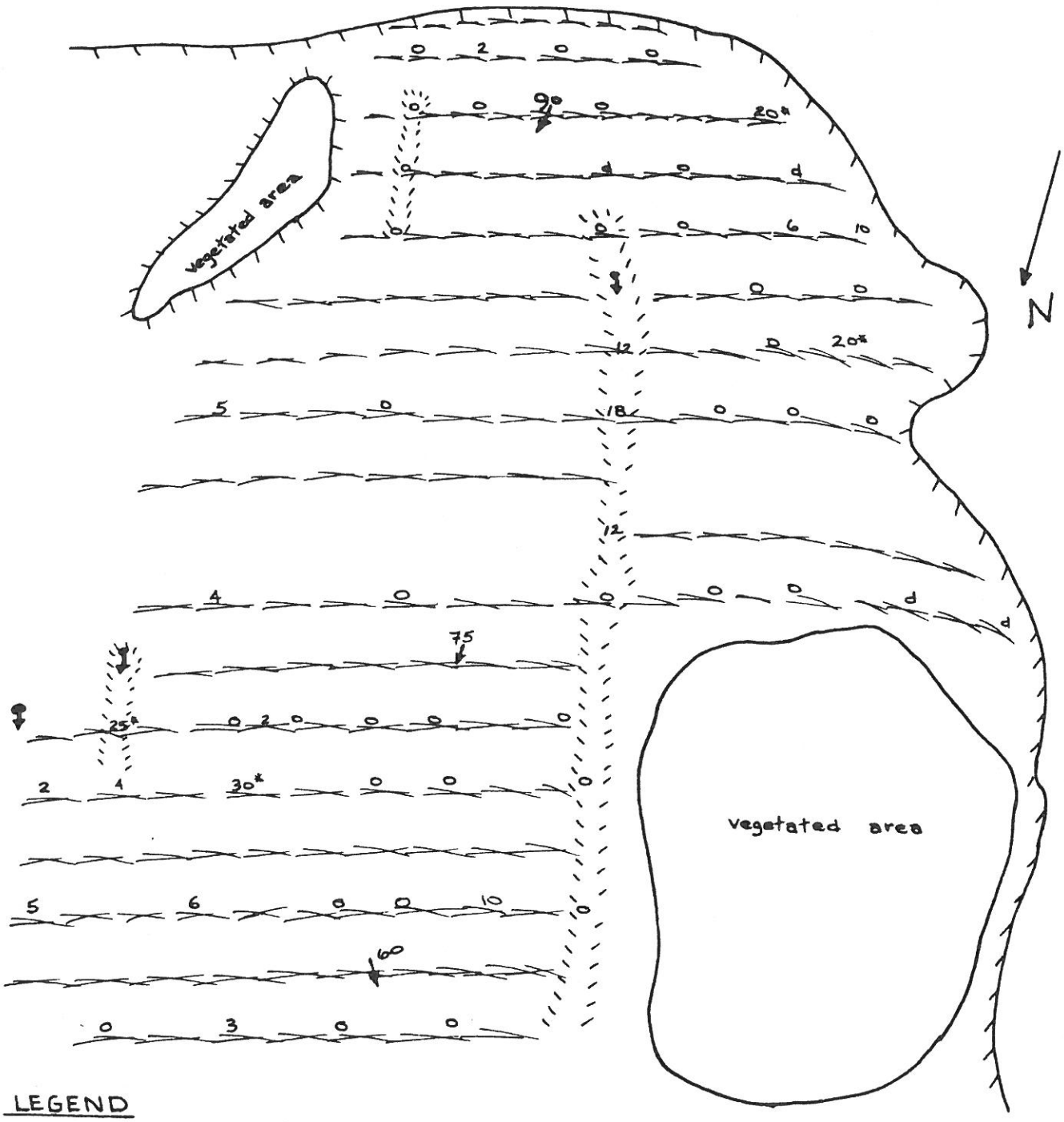
Area #1 and western area #4 displayed the least amount of deposition collected behind the wattles. A common feature to both sites is the profuse grass cover of annual rye. In contrast, area #2 and central area #4 are drier sites and have developed only moderate grass covers. These latter sites also contain less of a soil mantle than area 1 and western area 4.

APPENDIX B

This appendix contains data and results from a wattle survey conducted on April 12, 13, and 26, 1978, and describes wattle success. Success is defined as continuous and vigorous ~~growth~~ sprouting, and is presented in the form of percentages. It is the length of sprouted wattle per total length of wattle.

Data is presented in tabular form and contains a column in which the sprouting observed is described. When alder and willow growth is present in equal amounts, both are written completely. However, when a clearly dominant species exists, only it is written completely. The less dominant is abbreviated in parenthesis.

WESTERN SLOPE, AREA #1
SKETCH MAP

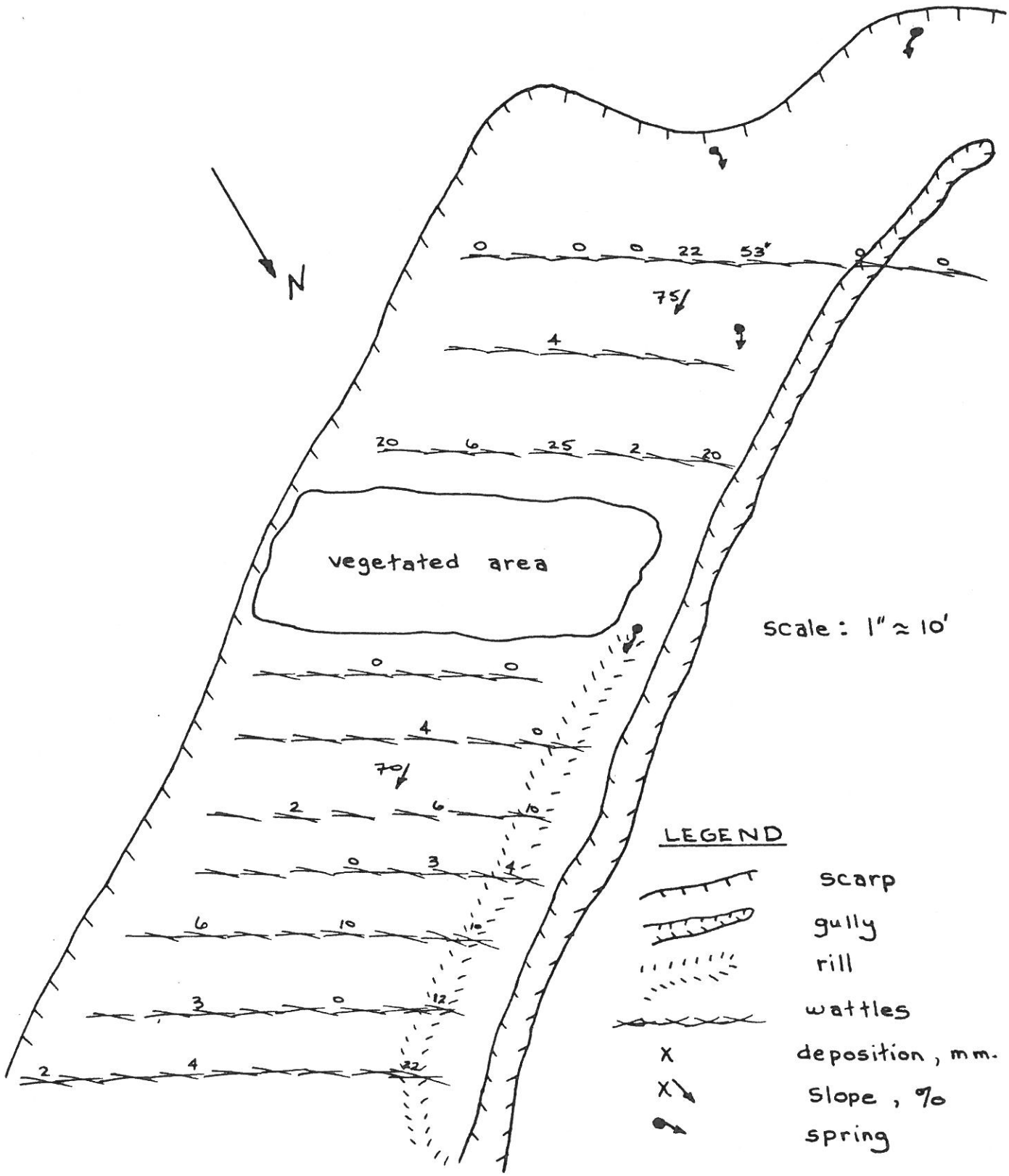


LEGEND

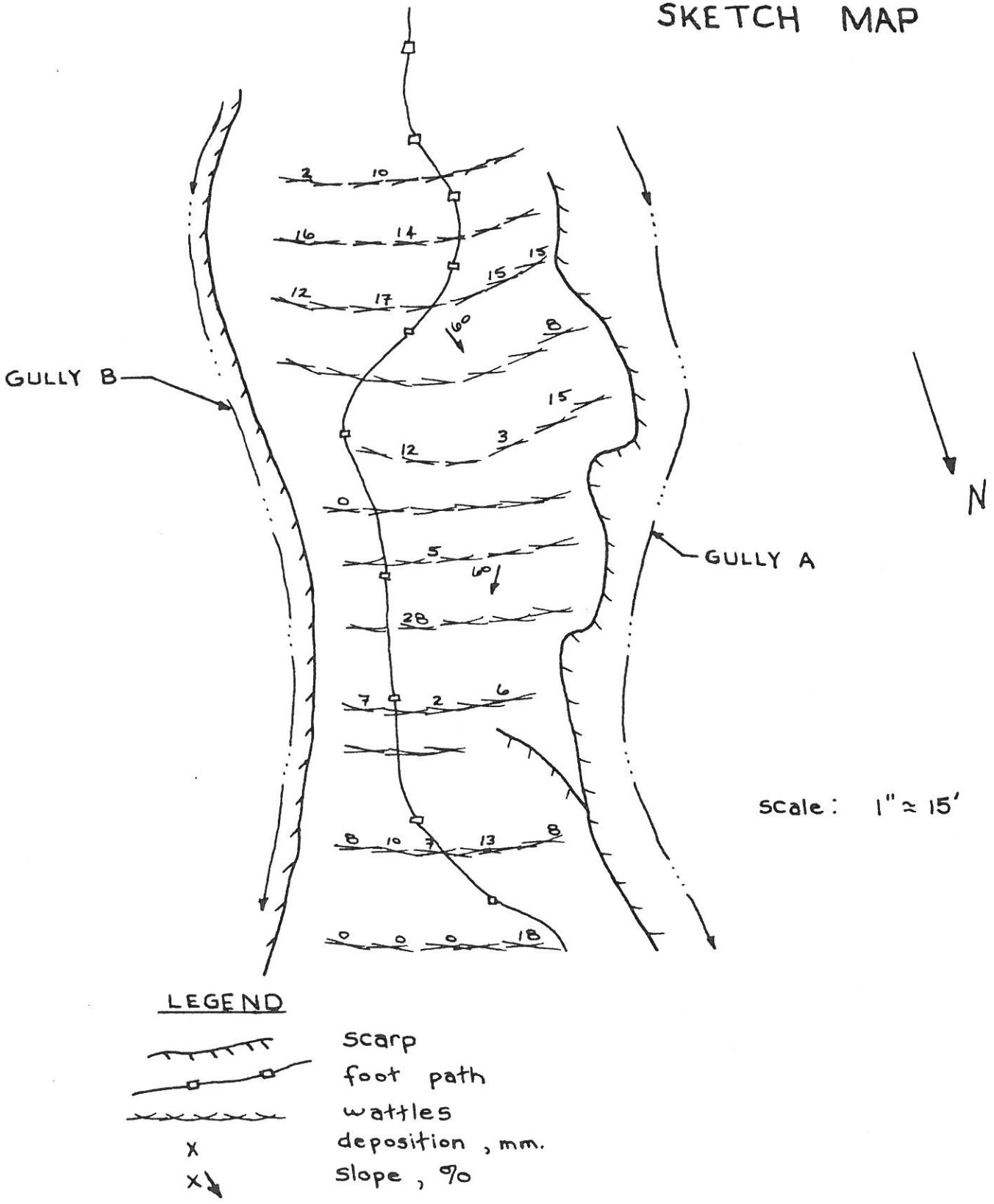
- wattles
- scarp
- rill
- X — deposition, mm.
- X↘ — slope, %
- X* — localized failure
- d — damaged by elk
- spring

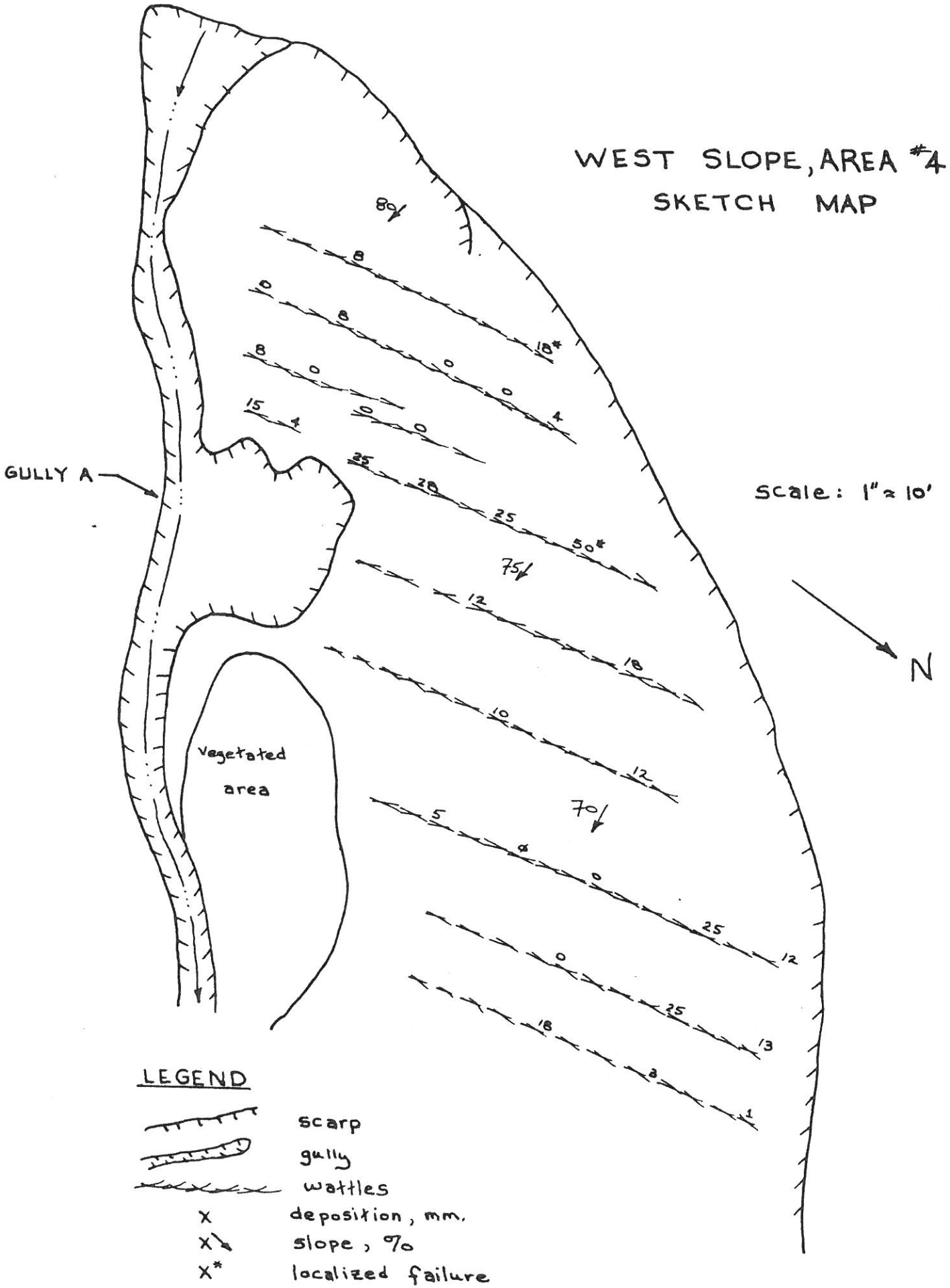
scale: 1" ≈ 10'

EASTERN SLOPE, AREA #2
SKETCH MAP



CENTRAL SLOPE, AREA #4
SKETCH MAP




WEST SLOPE, AREA #4
SKETCH MAP
GULLY A
Scale: 1" ≈ 10'
N
Vegetated area
80/
8
0
8
18*
8
0
0
4
15
4
0
0
25
20
25
50*
75/
12
18
10
12
70/
5
4
0
25
12
0
25
13
18
3
1
LEGEND
scarp
gully
wattles
X deposition, mm.
X/ slope, %
X* localized failure

Western Slope, Area #1

Row	Total Length, feet	Sprouted Length, feet	Description
1	26	4	Alder, willow
2	35	3	Alder, willow
3	35	2	Willow (A)
4	35	32	Willow
5	33	11	Willow (A)
6	35	15	Willow (A)
7	27	24	Willow (A)
8	65	24	Willow (A)
9	35	6	Willow (A)
10	45	32	Willow (A)
11	54	40	Willow (A)
12	55	63	Willow (A)
13	61	30	Alder, willow
14	40	12	Willow (A)
15	35	12	Willow (A)
16	31	30	Willow (A)
17	23	13	Willow (A)
18	18	6	Alder, willow
Total	688	359	

NO CAPS

Percent of wattles sprouted = 52%

Comments: Surveyed on April 13, 1978. ~~The~~ This is a wet site - much moisture. Soil mantle is present towards the top, but tends to schist towards the bottom of slope. Excellent grass cover has established. Alder is only expanding its leaves - not sprouting.

Eastern Slope, Area #2

Row	Total Length, feet	Sprouted Length, feet	Description
1	17	7	Willow (A)
2	15	9	Alder (W)
3	17	13	Willow (A)
4	20	15	Willow (A)
5	17	12	Willow (A)
6	11	6	Willow
7	6	0	-
8	22	14	Willow
9	16	8	Willow
10	31	15	Willow
11	32	17	Willow
Totals	204	116	

No Cane

Percent of wattles sprouted = 57%

Comments: Survey conducted on April 12, 1978. The site is relatively dry with sparse grasses in and between wattles. Slopes are mainly schist and wattles are constructed largely of willow, but does contain some alder.

Central Slope, Area #4

Row	Total Length, feet	Sprouted Length, feet	Description
1	9	5	Willow
2	7	1	Willow
3	7	2	Willow
4	12	10	Willow
5	8	6	Willow
6	8	5	Willow
7	15	10	Willow
8	21	18	Willow
9	22	20	Willow
10	22	22	Willow
11	19	17	Willow
Total	150	116	

Percent of wattles sprouted = 78%

Comments: Survey conducted on April 12, 1978. Site conditions for Row #1 - 6 described by little or no moisture on slopes, sparse grass cover and surficial material of schist. Rows 7-11 are characterized by more moisture, grass, and more of a soil mantle with less schist. Wattles contain mostly willow.

Below Redwood Sprout, Area #3

Row	Total Length, feet	Sprouted Length, feet	Description
1	21	7	Willow (A)
2	20	6	Willow
3	22	7	Willow
4	21	11	Willow
5	20	6	Willow
Total	104	37	

↑ No caps

Percent of wattles sprouted = 36%

Comments: Survey conducted on April 26, 1978. Site is dry and contains schist. A moderate ground cover of rye has established in and between the wattles. Wattles contain mostly alder.

West of Redwood Sprout, Area #3

Row	Total Length, feet	Sprouted Length, feet	Description
1	13	13	Willow
2	18	18	Willow
3	10	10	Willow
4	11	11	Willow
5	8	8	Willow
6	13	5	Willow
Total	73	65	

No caps

Percent of wattles sprouted = 89%

Comments: Survey conducted on April 26, 1978. This well protected site has a good soil mantle and little schist. A very good ground cover has established on this moist site. Wattles contain mostly willow.

Western Slope, Area #4

Row	Total Length, feet	Sprouted Length, feet	Description
1	16	9	Willow
2	14	7	Willow
3	26	9	Willow
4	24	24	Willow
5	15	11	Willow
6	27	24	Willow
7	23	23	Willow
8	25	25	Willow
9	27	23	Willow
Total	197	155	NO CAPS

Percent of Wattles sprouted = 79%

Comments: Survey conducted on April 12, 1978. More moisture and denser grass cover were observed in upper regions of slope. The upper most region receives little sunlight and remains damp. Soils tend to schist towards the bottom of slope. Wattles contain willow with some alder. Only the upper extent of this slope was seeded with annual rye.

SUMMARY

The western portion of area 3 displayed the most success with 89% of the wattles sprouted. In contrast, the eastern wattles of area 3 showed the least success with only 36% of the wattles sprouted. A gross difference exists and is due to the composition of the wattles.

The wattles constructed in western area 3 consisted primarily of willow with some alder, as compared to the wattles of eastern area 3, which were primarily alder. This was the greatest contributing factor to the results. Alder wattles, as yet, have shown little evidence of sprouting. Only leaf expansion from pre-existing buds has been observed. Therefore, the percentages of sprouting wattles describes willow sprouting and alder leaf expansion.

When comparing other willow wattled areas to western area 3, the site quality comes into play. Western area 3 is best described as a moist to wet site, with a destinctive soil mantle, and pre-existing ground cover. Being located above the toe of the slide and against the slide's western flank, the site is a well protected niche. Other sites are also wet but contain a weathered B-horizon largely of schist and are more exposed to climatic elements.

Still another possibility of varied willow wattle success, is simply the amount of bio-mass in each wattle. The probability of successful sprouting will obviously increase with the amount of material available to sprout.

OPTIONAL FORM NO. 10
JULY 1973 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

N16

TO : Research Biologist

DATE: November 1, 1978

FROM : Park Technician

SUBJECT: Berry Glen plantings

On October 3 and 4, I surveyed the survival of the vegetative cuttings and the success of sprouting of willow wattling on the Berry Glen rehabilitation site. I have reproduced Appendix B from the spring evaluation of the Berry Glen rehab and have included the fall data from each area. Wattle success over the season can be compared from the double column of numbers below the "Sprouted Length" heading. Any additional data or notes on the individual sites are added below the "Comments" paragraph.

In summary, the summer season has taken its toll with a measurable wattle dieback from a spring success of over 60% to 49% on the Berry Glen slide. Yet possibly due to the favorable northern exposure of the slide, the success of wattles are good compared to only 3% success on the wattles constructed adjacent to Berry Glen Creek at a southern exposure.

Willow cuttings appear to be fairly successful at 73% survival, although only 388 individual stems could be located. Baccharis cuttings were less successful at 26% and the surviving Baccharis cuttings did not look well-established.

In gully B where a vegetative planting of redwood was tried, six were still alive but establishment is doubtful. Maple and red alder cuttings were not successful throughout the slide. The probable cause of cutting dieback is moisture stress on the cuttings before roots were established. Possibly an application of rooting compound may aid cutting establishment, especially on less favorable or further inland sites. Experimental wattle planting should be tried on less favorable sites to determine if sprouting success can be achieved with different wattle construction.

Gary

Gary Lester

cc:
E. Johnson
Prairie Creek Office

5010-110

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Western Slope, Area #1

Row	Total Length, feet	Sprouted Length, feet		Description
		Apr. 13, 1978	Oct. 3-4, 1978	
1	26	4	6	alder, willow
2	35	3	5	alder, willow
3	35	2	5	willow (A)
4	35	32	26	willow
5	33	11	14	willow (A)
6	35	15	16	willow (A)
7	27	24	18	willow (A)
8	65	24	20	willow (A)
9	35	6	3	willow (A)
10	45	32	31	willow (A)
11	54	40	24	willow (A)
12	55	63	28	willow (A)
13	61	30	23	alder, willow
14	40	12	8	willow (A)
15	35	12	9	willow (A)
16	31	30	19	willow (A)
17	23	13	2	willow (A)
18	18	6	0	alder, willow
TOTAL	688	359	257	
Percent of wattles sprouted =		52%	37%	

Comments: Surveyed on April 13, 1978. This is a wet site - much moisture. Soil mantle is present towards the top, but tends to schist towards the bottom of slope. Excellent grass cover has established. Alder is only expanding its leaves - not sprouting.

Comments: Surveyed on October 3-4, 1978. Considerable die back was observed on this site due to exposed wattle bundles, especially on row 11. Sixty-three feet of sprouted wattle on row 12 on the spring survey was probably an error. Annual Rye (Lolium sp.) and Velvet Grass (Holcus lanatus) are well-established, but mainly on wattle lines.

Cuttings:

Willow	10/24, 41%
Baccharis	9/32, 27%
Maple	4 dead
Alder	17 dead

Eastern Slope, Area #2

Row	Total Length, feet	Sprouted Length, feet		Description
		Apr. 13, 1978	Oct. 3-4, 1978	
1	17	7	9	willow (A)
2	15	9	5	alder (W)
3	17	13	10	willow (A)
4	20	15	14	willow (A)
5	17	12	10	willow (A)
6	11	6	7	willow
7	6	0	0	-
8	22	14	19	willow
9	16	8	8	willow
10	31	15	14	willow
11	32	17	22	willow
TOTAL	204	116	118	
Percent of wattles sprouted =		57%	57%	

Comments: Survey conducted on April 12, 1978. The site is relatively dry with sparse grasses in and between wattles. Slopes are mainly schist and wattles are constructed largely of willow, but does contain some alder.

An additional 38 feet of wattling was placed in 4 rows above row 11. A total of 10 feet were sprouted with willow.

Cuttings:

Willow	31/37, 83%
Baccharis	5/39, 12%
Maple	31 dead
Alder	12 dead

West of Redwood Sprout, Area #3

Row	Total Length, feet	Sprouted Length, feet		Description
		Apr. 13, 1978	Oct. 3-4, 1978	
1	13	13	11	willow
2	18	18	17	willow
3	10	10	10	willow
4	11	11	8	willow
5	8	8	6	willow
6	13	5	2	willow
TOTAL	73	65	54	
Percent of wattles sprouted =		80%	74%	

Coments: Survey conducted on April 26, 1978. This well protected site has a good soil mantle and little schist. A very good ground cover has established on this moist site. Wattles contain mostly willow.

Two 6-foot wattles were also found here and were sprouting their total length, but were placed vertically with the slope.

Below Redwood Sprout, Area #3

Row	Total Length, feet	Sprouted Length, feet		Description
		Apr. 13, 1978	Oct. 3-4, 1978	
1	21	7	20	willow (A)
2	20	6	6	willow
3	22	7	7	willow
4	21	11	10	willow
5	20	6	4	willow
TOTAL	104	37	47	
Percent of wattles sprouted =		36%	48%	

Comments: Survey conducted on April 26, 1978. Site is dry and contains schist. A moderate ground cover of rye has established in and between the wattles. Wattles contain mostly alder.

Increase in wattle success was due to substantial sprouting in row 1. Also, an additional wattle of 5 feet was sprouting its full length.

Holcus and Lolium were established along wattle lines.

Cuttings:

Willow	15/16, 93%
Baccharis	1/5 , 20%
Maple	1 dead
Alder	1 dead

Central Slope, Area #4

Row	Total Length, feet	Sprouted Length, feet		Description
		Apr. 13, 1978	Oct. 3-4, 1978	
1	9	5	5	willow
2	7	1	1	willow
3	7	2	0	willow
4	12	10	8	willow
5	8	6	4	willow
6	8	5	5	willow
7	15	10	8	willow
8	21	18	17	willow
9	22	20	20	willow
10	22	22	21	willow
11	19	17	17	willow
TOTAL	150	116	106	

Percent of wattles sprouted = 78% 71%

Comments: Survey conducted on April 12, 1978. Site conditions for Row #1 - 6 described by little or no moisture on slopes, sparse grass cover and surficial material of schist. Rows 7-11 are characterized by more moisture, grass, and more of a soil mantle with less schist. Wattles contain mostly willow.

Holcus and Lolium cover was primarily along wattle lines.

Cuttings: Willow 33/40, 82%
Baccharis 8/18, 42%
Maple 4 dead

41.2

Western Slope, Area #4

Row	Total Length, feet	Sprouted Length, feet		Description
1	16	9	9	willow
2	14	7	7	willow
3	26	9	8	willow
4	24	24	21	willow
5	15	11	11	willow
6	27	24	25	willow
7	23	23	20	willow
8	25	25	11	willow
9	27	23	20	willow
TOTAL	197	155	132	
Percent of wattles sprouted =		79%	65%	

Comments: Survey conducted on April 12, 1978. More moisture and denser grass cover were observed in upper regions of slope. The uppermost region receives little sunlight and remains damp. Soils tend to schist towards the bottom of slope. Wattles contain willow with some alder. Only the upper extent of this slope was seeded with annual rye.

One 20-foot length of red alder and willow wattles was found just off the slide north of this area; 2 feet had sprouted willow. Scattered throughout was Holcus lanatus, velvet grass.

Cuttings:

Willow	12/16, 75%
Baccharis	4/20, 20%
Maple	7 dead
Alder	30 dead

5/173

Western Slope, Area #1

Row	Total Length, feet	Sprouted Length, feet	Description
1	26	4	alder, willow
2	35	3	alder, willow
3	35	2	willow (A)
4	35	32	willow
5	33	11	willow (A)
6	35	15	willow (A)
7	27	24	willow (A)
8	65	24	willow (A)
9	35	6	willow (A)
10	45	32	willow (A)
11	54	40	willow (A)
12	55	63	willow (A)
13	61	30	alder, willow
14	40	12	willow (A)
15	35	12	willow (A)
16	31	30	willow (A)
17	23	13	willow (A)
18	18	6	alder, willow
TOTAL	688	359	

Percent of wattles sprouted = 52%

Comments: Surveyed on April 13, 1978. This is a wet site - much moisture. Soil mantle is present towards the top, but tends to schist towards the bottom of slope. Excellent grass cover has established. Alder is only expanding its leaves - not sprouting.

Eastern Slope, Area #2

Row	Total Length, feet	Sprouted Length, feet	Description
1	17	7	willow (A)
2	15	9	alder (W)
3	17	13	willow (A)
4	20	15	willow (A)
5	17	12	willow (A)
6	11	6	willow
7	6	0	-
8	22	14	willow
9	16	8	willow
10	31	15	willow
11	32	17	willow
TOTAL	204	116	

Percent of wattles sprouted = 57%

Comments: Survey conducted on April 12, 1978. The site is relatively dry with sparse grasses in and between wattles. Slopes are mainly schist and wattles are constructed largely of willow, but does contain some alder.

Below Redwood Sprout, Area #3

Row	Total Length, feet	Sprouted Length, feet	Description
1	21	7	willow (A)
2	20	6	willow
3	22	7	willow
4	21	11	willow
5	20	6	willow
TOTAL	104	37	

Percent of wattles sprouted = 36%

Comments: Survey conducted on April 26, 1978. Site is dry and contains schist. A moderate ground cover of rye has established in and between the wattles. Wattles contain mostly alder.

Central Slope, Area #4

Row	Total Length, feet	Sprouted Length, feet	Description
1	9	5	willow
2	7	1	willow
3	7	2	willow
4	12	10	willow
5	8	6	willow
6	8	5	willow
7	15	10	willow
8	21	18	willow
9	22	20	willow
10	22	22	willow
11	19	17	willow
TOTAL	150	116	

Percent of wattles sprouted = 78%

Comments: Survey conducted on April 12, 1978. Site conditions for Row 1-6 described by little or no moisture on slopes, sparse grass cover and surficial material of schist. Rows 7-11 are characterized by more moisture, grass, and more of a soil mantle with less schist. Wattles contain mostly willow.

MISCELLANEOUS DATA ON OTHER AREAS

Area below slide adjacent to Berry Glen Creek:

Wattle success - 3%

(59 feet total length in 7 rows, 2 feet sprouted)

Cutting establishment - Willow 11/16, 68%
Alder, 3 dead

Cutting establishment:

Adjacent to Access Trail

Willow 20/35, 57%

In Gully A

Willow 31/41, 75%
Alder, 9 dead

In Gully B

Willow 77/99, 76%
Redwood 6/20, 30%

17 stakes for sandbag reinforcement have sprouted.

Upper Gully B

Willow 42/54, 78%
Baccharis 9/25, 26%
Maple, 29 dead
Seder, 8 dead