LONG TERM IMPROVEMENT OF THE JACOBY CREEK WATERSHED

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Introduction

I have watched the Jacoby Creek watershed 20 years while working on various projects: salmon and steelhead habitat improvement, stream bank revegetation, road and log landing removal; water quality testing; and comments on timber harvest plans. I have seen several citizen groups form and dissolve around issues of zoning, water quality, herbicide spraying, timber harvest and land use. My observations lead me to present these suggestions and a discussion of improvements that I believe are essential for long term healthy biological processes.

This is my own compilation; it represents no group or organization. The alternatives I offer are intended to foster reestablishment of natural habitats and preserve important heritage landmarks without more intrusive government. I believe the democratic accomplishment of these alternatives would benefit our personal and community identity, and our regional and national economy.

I have a bias that past, present and future generations have been taken advantage of for short term economic gain. My evidence is that despite the efforts of local, state, and federal agencies designed to protect it, the use of watershed for housing development, and timber and pulp harvest is degradative when viewed from impacts to the complexity of native ecosystems or resource loss, such as soil. The storm season of 1995-96 has proved false the conclusion of cumulative effects analyses that the watershed is recovering from past abuses.

Below are suggestions for improvement followed by a discussion of conditions which have brought them about. Washington Gulch is included in Jacoby Creek watershed as I believe it was separated from Jacoby Creek delta for purposes of the Washington Gulch railroad to serve the Dolbeer and Carson Mill at Bayside Cutoff in 1874.

Ten Suggestions For Long Term Improvement

1. The once productive wildlife areas in the lower stream and estuary need to be returned to natural conditions. Levees need to be removed or relocated. Off-stream water sources and stream zone fencing are needed for Livestock

2. A greenway from Humboldt Bay along Jacoby Creek to headwater springs, seeps, and bogs is needed. This corridor, where homes are not compromised, would incorporate stands of native vegetation and would be managed with little human disturbance toward a goal of allowing a complex natural system to develop.

3. A minimal instream flow defined in cubic feet per second needs to be set aside for fish and wildlife in Jacoby Creek.

4. The Humboldt County Planning Commission and Department and the Regional Water Quality Control Board Northcoast Region have allowed increased housing development without meaningful evaluation of effects or consequences, especially those of human health related to viruses and other pathogens from septic systems along Fickle Hill, Greenwood Heights, Kneeland Ridge, and the Jacoby Creek Bottoms. There needs to be a credible planning document to limit growth in the watershed rather than one which facilitates it.

5. Parcel splits, without a comprehensive land use plan which considers cumulative effects, are a major cause of habitat loss. Humboldt County needs to define parcel splits as projects and subject them to CEQA and the Subdivision Map Act requirements.

6. The environmental assessments of THPs are developed, sustained, and promoted by organizational systems which tend to selectively produce and sustain information favorable to harvesting. Favorable assessments are encouraged; they do not disrupt organizational systems. Contrary assessments

tend to be systematically filtered out. The cumulative outcome is systematic distortion (Bella, 1992). Reorganization of the forest oversight agency is needed.

7. A timberland ethic is needed which acknowledges a responsibility to protect and to pass on improved priceless forest legacy to future generations. As we improve for the future we improve our own present as well.

8. Arcata needs another Forest Initiative to determine whether timber harvest or natural watershed function without further logging is best for long-term interests.

9. An exotic plant control program (Target species: English ivy, broom, holly, and victorian box) needs to be implemented. Exotic control in riparian canopy should be a first priority.

10. The Humboldt County Public Works Department needs to replace road culverts with bridges where culverts block or hinder fish migration at S. Quarry Road (Cascade Creek) and on Steep Creek.

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Geomorphology Governs Watershed Processes

Especially heavy rainfall during late 1995 and the continuation of above normal precipitation during 1996, have caused major erosion features and raised the concerns of many residents in the Jacoby Creek area. During the 24 hour period of the major storm (Dec. 29, 1995) some residents of Fickle Hill area reported 12" of rain; in Jacoby Creek valley 6 inches were recorded. A notable geomorphological event occurred during this storm when the left bank tributary downstream from the headwater forks inner gorge avalanched into Jacoby Creek. This massive debris load was propelled into Jacoby Creek damming the stream which was in flood flow, the avalanche volume displaced an equal volume of water sending a large wave down the stream channel. Estimate of the avalanche volume is approximated by considering that material related to the avalanche was ±400 yards downstream from the entry point. Large boles of western red cedar, hemlock, and alder and sediments load the channel.

Many other sediment sources were aggravated by this wet season. Across a spectrum of ownerships old log road crossings and culverted ones at many stream intersections plugged and overflowed resulting in eroded road fill and sediment contributions downstream. Downstream of the debris avalanche a new large log jam appeared where a bridge had crossed Jacoby Creek about 75 yards upstream of the rock falls barrier to fish migration. Formation of this jam could have been associated with the avalanche.

The stream removed riprap at the Blue Slide on a project executed to reduce sediment and stabilize the road bank at this Franciscan Melange. The lower Rebel Creek culvert was reported to be only a few inches from overflowing at the Blue Slide.

Downstream of the Blue Slide to the end of S. Quarry Rd. the stream channel has, in many locations, been shorn of vegetation. At Snag Creek/ Jacoby Creek Junction road culverts plugged seriously eroding the road prism. Noteworthy sediment deposition occurred in the Brookwood area and

downstream. On parcels where owners had intact riparian vegetation and in low lying areas where sediment laden water stilled, sedimentation of up to two feet occurred.

Timber Harvesting

Timber harvesting is the dominant land use in this watershed. Since the establishment of the California Forest Practices Act in 1974, timber harvest plans (THPs) are required for most harvests in excess of 3 acres. Theoretically the public can participate in the THP process by commenting in writing to the California Division of Forestry (CDF). However, most comments have no effect on CDF actions and are routinely dismissed.

The public has expressed concerns over biological and social impacts on many Jacoby Creek THPs ranging from clearcutting steep slopes and the last mixed old and second growth forest patches to burning and the noise of road building and timber operations.

In the 1990's some of those writing THPs concluded that Jacoby Creek is no longer significantly impacted and is "in fact improving." Reasons given were: the California Forest Practices Act, stream rehabilitation work, and community education. It is true that rehabilitation work has lessened the contributions of sediment from a few sources in the drainage and harvest rules are better than they used to be. However from the standpoint of a healthy forest ecosystem, species diversity, habitat quality, and viewshed there is no improvement.

Only a few old growth snags remain on ridgetop skylines to remind us that the former forest canopy reached two or three times higher then the present one. Streamside cover can still be removed in a shell game of percentage take and leave. Two hundred old growth redwood have been taken by Eel River Sawmills in 1995 on a "state of the art" Jacoby Creek THP!

In other stands THP activities take place where logging occurred less than 30 years ago and where adverse impacts from logging roads on stream channels are still visible. Large clearcuts still occur in 1995 and appear likely to continue under present management regimes. Roads are still being located and built on unstable soils without special design or provision for seasonal removal of

erodible fill material. The response time during 1995-96 storm season showed that large timberland owners such as Simpson could not clear road culverts even on an easily accessible road during the storm season until weeks after the event (Cascade Creek--Morrison Gulch--the tributary most used by spawning coho). Salmon spawned downstream of a reach which was diverted down the road because of plugged culverts.

Why is there no provision or realistic enforcement of road maintenance, especially at road/ stream crossings? Why not remove all road crossings during the wet season? Why is the cumulative impacts of using Appertenant Road during wet periods not realistically evaluated? In 1996 road repair consists of pushing new road fill into eroded areas with no provision for the same event occurring during the next erosion cycle.

Forest management ideally attempts to control timber stand structure and dynamics through stand manipulation so that high quality gene pools and microenvironments lead to differential growth and desired stand structure. Most forest management of today does not result in the accomplishment of this goal. Present management boils down to cutting stump sprout redwood and Douglas fir plantations at around 50 years. Few timber landowners have written objectives for stand structure with goals for desired elements of the vegetation such as regeneration, shrubs, poles, mature, over mature timber and down logs. It is a rare THP that clearly presents the desired canopy, gives an ecological description of the vegetation or discusses how a stand will function within the larger landscape. The change in the structure of the stand over time in any given location is important to objectify. On what basis are early mid and later seral stage decisions being made?

In 1991 the Society of American Foresters described stand diversity as "variety and abundance of species, their genetic composition, and the communities, ecosystems, and landscapes in which they occur. Stand diversity refers to ecological structures, functions and processes at all of these levels." Few THPs serve these aspects of the ecosystem. Forest management theory is still learning about how forest vegetation responds to low, partial shade, and high

light intensity and duration; and how the forest environment is affected by sun flecks versus continuous light.

Short-term economic needs of individual landowners and the biological needs for optimum stand structure are not the same, but in the long run greater production of quality wood will result from incorporating healthy stand structure into forest practice. A look at the Jacoby Creek watershed from various vistas reveals a landscape where little attention is given to how a stand of one ownership affects the biology of a neighboring one; a cumulative effect not adequately addressed in the THP process.

On the contrary, large effort goes into denying any cumulative effect on any facet of watershed dynamics. Timber companies pay for "expert" witnesses to testify that there are no problems, or that problems are thoroughly mitigated. In recent years some plans propose on or off site mitigations which are rationalized as leading to zero net sediment discharge. Commonly the "mitigations" are simply compliance with Forest Practice Rules or actions such as road reconstruction needed for access.

CDF often relies on the company's Registered Professional Forester (RPF) and company "experts" in developing the Official Response (OR). On a 1993 THP OR when RPF testimony interpretation differed as to whether the watershed was "improving" the OR states, "It is expected that disagreement over interpretation of data will exist even among environmental resource professionals."

CDF claims to mitigate potential cumulative impacts to a level of insignificance on a THP'. And that "improvement in large and complex systems such as the Jacoby Creek watershed do not occur in brief time frames" (THP 1-91-065). Yet, at the same time, CDF approves harvest plans for areas that have been cut twice in the last 40 years. Since three rotations are generally considered minimum to determining sustainability in any agricultural system, where does evidence come from that cumulative impacts are insignificant?

Ruling on the above referenced THP, Humboldt County Superior Court Judge William Ferroggiaro maintained that CDF in approving the plan did not act according to law and that their decision was not supported by substantial evidence. The Judge's review of pertinent case law showed that California

Environmental Quality Act requires meaningful and studied consideration to all manifestations of a project, and to other past, present, and future projects in an area which might combine to create significant negative environmental effects. The Court found that both sides agreed that cumulative effects exist from past operations. Ferroggiaro noted that CDF and a Barnum consultant deprecated demonstrable effects of continuing sedimentation. The Judge found no analysis of future harvests despite CDF's acknowledgement of its need, thus their decision of no substantial impact on the environment by cumulative activities was not supported by substantial evidence.

To cover this point in future situations, a CDF staff forester Marc Jameson and CDF forester Jose Medina toured the watershed on December 2, 1992. Jameson wrote a one page memo on cumulative impacts. He concluded: "Most current timber operations appear to be allowing the aquatic habitat to recover." If the foresters had toured the watershed during the 1996 storm season they would have paused over this prediction. They would have seen that stream turbidity and soil movement showed an unhealthy situation; that the vegetation was not capable of the function of safe capture, storage and release of precipitation; that watershed and ecological processes and productive capacity were not being sustained by management practice (Bushby and Cox, 1994).

As people living in the Jacoby Creek area know THP's have social effects and costs. An early 1980's THP in Jacoby Creek canyon illustrates this concern. Road building began in the late winter before the THP was announced. At first the proposed harvest was to include the unstable steep inner gorge, across Jacoby Creek from the mouths of Snag and Steep Creek tributaries; fortunately the plan was changed to delete most of the unstable inner gorge area, but streamside canopy was cut. In the fall after logging the area was burned, but the fire got out of control and CDF fire crews, including bentonite tanker planes, were needed. Fall atmospheric inversion caused smoke to hang in the canyon for days. Many residents moved to motels in town. Some suffered from breathing difficulties, others from stress related to the noise of the many months of road building equipment, chainsaws, falling trees, and yarder whistles echoing in the canyon.

During the subsequent rainy season, a debris avalanche developed from a harvested area down the steep face of the bluff upstream of Steep Creek and a slurry of material flowed into Jacoby Creek. Under direction from the Regional Water Quality Control Board, Barnum Timber Company salvaged a few large logs from the creek, but nothing was done to revegetate the avalanche chute or to reclaim the new material available for sediment transport.

Timber harvests which clearcut trees at relatively young ages are called short rotations. Short rotation management is usually for pulp and fiber products, as juvenile vegetation, while producing high-growth yields, does not produce high quality wood. Short rotation practice has eliminated vital components of ecosystem processes such as large, old, broken top trees that serve as nests for marbled murrelets, flying squirrels and voles; substrate for nitrogen fixing old growth lichens important in the food chains of many animal species; and large down logs. These vital components are important not only to the species directly associated but also to processes linked with other species distributed across the landscape.

Rotation rates need to be based on appropriate ecosystem disturbance routines which often differ from one vegetation type or ecosystem to another (Henderson, 1994). For instance a rotation for Sitka spruce and western hemlock vegetation consistent with wind disturbance would be different from a redwood forest where climate or fire is limiting.

All species in a community or ecosystem are connected with the others with which they share space. Properties of certain ecosystem functions and processes are passed on through species gene pools. Ecosystems are adapted to recycle organic matter and nutrients from their principal disturbance elements. Ecosystems have emergent properties beyond the simple characteristics of their component species' properties. Nutrient and carbon cycling and fire, and many mutalistic interactions are critical parts of ecosystems. Interaction of food chain and habitat requirements of species have evolved along with species.

An example of such an ecosystem interaction receiving very little protection in THPs are Carex obnupta stands. Sedge swamps indicate important watershed standing pool areas. An ecological function of the sedge

swamps is to process organic material and elements into humic materials. The chelating action of humic substances is a kind of biologic conditioning that has influence on aquatic productivity. Sedge swamps increase the residence time of nutrients in the water column. More strictly physical effects of humic materials are related to their ability to rapidly absorb solar radiation storing heat in bodies of water. Little thought in THP planning is given to how roading impacts these areas.

Lichens, organisms which contain an association of fungus and algae, illustrate another important component of forest health not considered in management. In most northwestern forests, the species and biomass of lichens change markedly from early to late successional stages. Two important groups are the nitrogen fixing lichens (e.g. Lobaria spp.) and the forage lichens (Alectoria spp.). In Pacific Northwest Douglas fir/ western hemlock forests, the habitat for important nitrogen fixing lichens takes 200 years to develop. Lobaria oregona thrives in moist forest at low to moderate elevations reaching maximum abundance by about 500 years. Lobaria pulmonaria may become abundant at an earlier age, but this species is more limited in distribution and occurs most commonly on hardwood trees. Other nitrogen-fixing epiphytic lichens, Pseudocyphellaria spp., usually occur in very old forests. Management schemes with rotation rates of less than 100 years virtually exclude these important organisms, the source of much of the nitrogen that has accumulated over the millennia.

In the Pacific northwest, a dry site would lose nitrogen under a fire cycle of less than 151 years, while a moist site would accumulate nitrogen under cycles of any length as long as red alder is a component of the site. If alder is eliminated, the moist site would lose nitrogen under fire or harvest cycles of less than 200 years. It seems that the aim of current forest practices to eliminate alder (and Ceanothus spp.) from cut sites to speed conifer growth is another source of nitrogen loss.

If the forest resource is not sustained, it is being exploited. The old growth component of northcoast forests has been exploited in the same manner

as the buffalo and tall-grass prairie. Our goal should be to establish a management practice that ensures the viability of the ecosystem in perpetuity. There should be no timber harvest activities on Franciscan Melange (Atwell soil) or seismic fault areas. Removing vegetation from erodible Franciscan terranes contributes to increased mobility of earthflow features and usually results in streambank erosion which is difficult to control and costly. An example of such an area is the former quarry about 1/8 mile up Snag Creek, at the end of Eric Lane; another is at the lower Rebel Creek/Jacoby Creek confluence (the Blue Slide).

Exotic Plants

In the natural system, small disturbance areas, for instance along streambanks, occur and are colonized by native opportunistic species such as Sitka spruce, western red cedar, red alder or Sitka, arroyo, or shining willow. In contrast, today, disturbance of the forest by road construction and logging have created large swaths of habitat for aggressive non native species. Control efforts are not focused on non-native species.

The absence of effort to eradicate pampas grass (Cortaderia jubata), is justified on the basis of its vulnerability to canopy closure. Eradication is said to be not needed because pampas grass lasts only 10 to 20 years. This is a substantial amount of the rotation time. During this time Pampas grass effects energy transfers and resource allocation on many levels. What are the effects of Pampas grass on soil moisture and nutrient sequestration on the recovering ecosystem? If manual control was undertaken another real cost of short term management would emerge. Would the expense bring about a reevaluation of forest practices?

Other aggressive non native species are beginning to have a profound effect on Jacoby Creek vegetation. Among these are Australian fireweed, (Erectites prenanthoides), Himalaya berry (Rubus procerus), cotoneaster (Cotoneaster pannosa and C. franchetti), English holly (Ilex aquifolium), victorian box (Pittosporum undulatum) and ivy (Hedra helix). These species change light and ecological relationships through litter fall and nutrient uptake.

Ivy is of special concern. At the canopy level, the evergreen ivy twines up alders and conifers, displacing native plants such as honeysuckle and poison-oak. At the ground level, where ivy runners grow to cover the forest floor, nutrient sources and storage areas are diminished. Ivy impacts the forest system at the soil forming level. Photosynthesis is diminished or eliminated. Fungi, lichens, mosses, club mosses, liverworts and understory herbs such as, trillium (Trillium ovatum), wild ginger (Asarum caudatum), salal (Gaultheria shallon), and redwood sorrel (Oxalis oregona) are shaded out along with native vines, man root (Marah oreganus), honeysuckle (Lonicera hispidula) and poison oak (Toxicodendron diversilobum). Eventually ivy covers both forest floor and canopy, greatly impacting the forest and stream. Ivy removal needs to have a high priority for riparian restoration. I have noted the increase of ivy in several areas of Jacoby Creek, for example at the Eric Lane/ Jacoby Creek Road Junction.

Another feature of non native vegetation is an ability to influence the structure of the ecosystem creating favorable habitat. For example, non native grasslands are commonly composed of orchard grass (Dactylis glomerata), velvet grass (Holcus lanatus), and sweet vernal grass (Anthoxanthum odoratum). These species carry fire leading to a continuation of the grassland.

Wildlife

Fundamental changes in wildlife populations are being caused by current timber harvest practices. CDF argues complexity of wildlife habitat is ensured by retention of desirable stand components, such as large trees and woody debris. The effect of keeping the watershed landscape at an early stage of vegetation succession and the impact on biotic guilds is rarely discussed. Biological organisms are inextricably interrelated and affect one another in an ecosystem. The stability and resilience of the biological community are affected by short term rotations as the diversity of energy exchange pathways within the community is reduced.

Species of concern or species that have left the Jacoby Creek watershed are those whose habitat requirements require wetlands or the maintenance of

late seral stage habitat components beyond current rotations for populations to remain viable. Examples are waterfowl, spotted owl, marbled murrelet and fisher.

Humboldt Bay's waterfowl habitat has been impacted by the installation of levees which restrict the area of the lower Jacoby Creek floodplain between Old Arcata Road and U.S. 101. Tidal influence (except during major storm events) has been eliminated in favor of livestock grazing. "The most important factor influencing populations of most species of waterfowl in the West has been the modification or loss of suitable wetland habitat as a result of human settlement and land use" (Banks and Springer, 1994).

Throughout its entire range, the spotted owl has declined over the past century correlated with logging and urbanization of mature and old growth forest habitat. Where owls are found in previously logged forests, those forests almost always contain residual elements of the original forests (Gutierrez, 1994). A similar reduction in population size and the Endangered status of the marbled murrelet is attributed to the removal of old growth nesting habitat and high predation (Ralph, 1994).

Likewise, clearcut logging has affected the fisher. By removing all the trees in an area and following with a slash burn, the composition of prey species is affected. It seems that "forest type is not as important to fishers as the vegetational and structural aspects of the forest that lead to high prey populations and high prey vulnerability. This structure is not found in the second growth forests in the Pacific Northwest, where structural complexity and the species and age diversity characteristics of the centuries old old growth forest appear necessary for healthy fisher populations" (Powell, 1993).

As exemplified by the spotted owl, marbled murrelet, and fisher, forest practices aimed at maximizing tree production while minimizing rotation times are of no more value to wildlife than is any other type of industrial farming.

Conversion of Forestlands

The previously discussed poor management practices, which impair timber and other forest resources are on one end of a spectrum of forest

conversion. On the other end of impending harms to Jacoby Creek forestlands and wildlife is the increase in the conversion of forestlands to residential subdivisions. The net result of such conversions is the reduction of long-term timber supplies, fragmented and damaged wildlife habitats, increased erosion, and lessened water quality.

The overriding variable affecting a landowner's decision to convert forest property is the relative profitability of converting the land (Anon. 1994). Development markets are becoming increasingly lucrative in forested areas as people seek more attractive places to build their homes. This increased demand for housing and building materials is likely to reinforce conversion pressures by keeping stumpage prices strong and enhancing the attractiveness of liquidating merchantable timber inventories in conjunction with divesture of forestland parcels. Further parcelization, the process of creating new parcels and reducing average parcel size, generally carries with it increased roading, fencing, vegetation changes, and human and domestic animals, reducing forest values.

Agricultural Water Use

Water appropriation occurs from headwaters springs, tributary channels, and along the main stem. The impact of diversions can be serious to aquatic ecosystems. The flow of Jacoby Creek has sometimes ceased when adjacent agricultural fields were being irrigated between Old Arcata Road and Highway 101. Important fish and wildlife conservation issues are: How much of Jacoby Creek flow needs to be reserved for instream and Humboldt Bay uses? At what flow levels should irrigation be curtailed? How can agreements be made to serve interested parties?

Domestic Water

Most well water in Jacoby Creek has a high mineral content often with sulfur smell and staining plumbing an orange red. Those who can in lower Jacoby Creek get water from the Mad River via the City of Arcata. While the extension of this line is limited costly hookups can be purchased to those living along the creek on South Quarry road. Households on Greenwood Heights and

Kneeland take water from headwater springs. Others must rely on wells or instream catchments.

During the fall of 1993, I counted household and irrigation water intakes along the main stem of Jacoby Creek from Old Arcata Road Bridge to about 100 yards upstream of the rock falls barrier to fish migration 5 miles upstream; and up the Snag and Rebel creek tributaries to the first currently used road crossing. I found 26 water intakes. Flexible black plastic pipe between 1 and 2" diameter composed 70% of the intakes. Two intakes were streamside wells. The number of intakes does not portray the number of households using the water as some intakes connect to water tanks used by several households. There are many more water intakes than the ones listed; for instance, further up Snag, Rebel, and Steep Creeks, and on Fickle Hill.

Human Related Biochemical Impacts To Water Quality

A large volume of water is imported to the Jacoby Creek area, but no provision is made for the treatment of waste water discharged. I believe there is cause for concern for users of Jacoby Creek water and effects on biological systems. I have witnessed a landowner along Lindholm Lane spraying herbicide on streamside vegetation so his garden plants can grow. There have also been unconfirmed reports of the dumping of toxic materials in the Garden Lane area. A source not quantified is pesticide and fertilizer runoff from the Baywood Golf Course. Perhaps as gross indicators of molecular substances, golf balls from this tributary system can be found in Jacoby Creek downstream of the Golf course tributary (downstream end of Brookwood) to Humboldt Bay. The kind and quantity of herbicides used on the Golf Course, times of application, and amounts reaching Jacoby and Grotzman Creeks and Humboldt Bay need to be evaluated. If pesticides are known, then the US EPA Pesticide Root Zone Model which evaluates the environmental mobility and persistence of various pesticides could be calculated (cf. Horsley and Witten, 1995).

Similarly the amounts, kinds, and application procedures of fertilizer compounds needs to be known. Fertilizers can be "fast release" water soluble

compounds--calcium nitrate, sodium nitrate, ammonium sulfate and urea; or "slow release," less prone to leaching--ureaformaldehyde, methylene urea, isobutylidene diurea, and sulfur-coated urea. The amounts, kinds, and application procedures of these fertilizers influence the leaching rate. Fertilizers, which add nitrogen, phosphorus, and potassium, carried by rain and runoff, can greatly affect the aquatic ecosystem by influencing the species dynamics of stream algae and phytoplankton.

Septic systems influence water quality. As the number of residents living on Fickle Hill, Greenwood Heights, and along Jacoby Creek continues to grow, most of whom depend on septic systems, one has to wonder how long it will be until public health problems are detected. Septic systems are short-lived solutions to sewage treatment that are known to predictably fail and at best only provide minimal treatment of wastewater. There is no testing or periodic (3 years) pumping required of watershed septic tanks to protect the leaching facility from solids, plugging and dysfunction, nor is there a requirement for the facility's costly replacement.

Of concern is the dispersion of contaminant plumes into surface water runoff. The standard test for water quality uses fecal coliform bacteria as an indicator for healthy or unhealthy drinking water conditions, as it remains viable for over two months. The coliform indicator is not always applicable to other kinds of bacteria and is even less predictable for virus pathogens. Principal reasons for not providing sewer services are the expense of a system and the growth inducing effects. Alternative sewage treatment and limitations on growth need to be separated in conservation strategy.

Furthermore, a nitrogen loading analysis based on saturation buildout is needed to predict nitrate-nitrogen concentrations in groundwater. The analysis tabulates annual nitrogen loading from various sources and divides this loading by the annual dilution due to natural and artificial groundwater recharge to give an idea of the impact on stream and estuary waters. An important question in regard to human health is: What is the effect of man made organic compounds and minerals, such as asbestos from serpentinite, on domestic water sources downstream of quarry operations?

Roads and Road Associated Impacts

The Jacoby Creek road cuts through a Franciscan melange earthflow near the Eric Lane junction. Eric Lane, an extremely steep road, was constructed through a natural drainage in the 1970's for logging and then to access lot splits. Constant work is needed to keep this road functional during the storm season. An abandoned quarry at the top of Eric Lane contributes to slope instability, earthflow movement, and turbidity of Snag Creek. Eric and Garden Lane (also in this area) are poorly conceived in terms of grade, slope and culverting. Culvert intakes and discharge areas are rarely protected to prevent erosion. These sources contribute sediments with almost every rain.

Barnum Section 24 Quarry

The effects of the Barnum Timber Company Section 24 quarry and its access road on watershed landscape and biology are considerable. The road prism blocks anadromous fish migration at the Snag/Jacoby Creek confluence at the beginning of the private road, partially owned by Barnum (3.2 miles from the Bayside Grange).

Four miles from the Grange the Jacoby Creek road crosses an earthflow into Jacoby Creek, the Blue Slide. Logging and roading of this area and subsequent efforts to stabilize it has cost approximately $200,000 to date. Large rock riprap placed to stabilize the road and streambank of Jacoby Creek were washed away during the 1995-6 storm season. A major relocation of this road farther up the streambank is planned.

Activities in and around the Section 24 quarry influence a large area adjacent and downstream. Large areas around the quarry have been logged in the last 20 years; there is very little forest canopy. The absence of canopy combined with the compacted ground in the quarry result in an increase in the amount and speed of runoff. The climate near the ground is hotter in summer and more often frozen in winter. Without the stratified forest canopy, heat from the denuded area contributes to thermals that diminish fog persistence, thereby

losing about 10 inches of summer fog drip. The wasteland of the quarry provides considerable habitat for pampas grass. Another rotational slide in the quarry on the lower quarry road to which upper quarry runoff is channeled has never been treated.

Former Tributaries

The drainage from Washington Gulch runs on the south side of Lindholm Lane and Graham Road. It is confined to a ditch along about 250 yards along Lindholm Lane. At the end of this reach Seven salmon, chinook, according to Gary Friedrichsen, a local biologist and commercial fisherman, were observed spawning in a gravel pocket under the bridge at the junction of Lindholm and McMahan Lanes during high water of January 1995. While I have heard of spawning in this tributary previously, it is rare in the last 17 years. The gravel substrate these fish chose to spawn in was artificially placed--under a bridge--one of the few places where the highly mobile sand load does not accumulate. The rarity of spawning habitat underlines improvements needed.

Amends for the channelization of the Washington Gulch tributary by the present road need to be made. If the Old Arcata Road and the Bayside Cutoff have diverted Washington Creek the stream needs to be connected back into the Jacoby Creek estuary. Furthermore, the headwaters of Washington Gulch (which runs through one of the oldest land title tracts on Humboldt Bay, the Washington Claim) is greatly in need of work to remove failing road/stream crossings and landings.

Land Use (See Johnston and Madison 1991)

There are several ways citizens can influence private land use decisions and open space development. The most effective, and the most expensive control, is Full Fee Acquisition. Another alternative is for the landowner to donate a conservation easement to a land trust. This option may significantly reduce a landowners and/or their inheritors income and the estate taxes. Also, conservation easements may reduce taxes on the underlying parcel. Scenarios where development rights are purchased but the private owner still retains title are desirable.

Many open space protection studies have found that property tax increases are a major reason for the conversion of rural lands to urban uses. Scheduling growth on the urban fringe can be accomplished by interim zoning, conditional zoning, planned unit developments and phased zoning. It has been found on a statewide basis that local zoning is inadequate due to campaign contributions from landowners and the mistaken belief that growth is fiscally beneficial. Interim zoning freezes development to allow the completion of studies on proposed new zoning measures or subdivision controls. In conditional zoning, a property owner promises to fulfill special conditions in exchange for allowing specific uses. Planned unit developments, which allow greater densities in some parts of the development in exchange for the preservation of other areas of the tract as open space can be good for preserving small wildlife areas, but this often results in piecemeal preservation unless carefully pre-planned. Thus consideration of the large scale is important.

Conclusion

In summary, there is ample evidence that the long term result of human activities in the Jacoby Creek watershed has been to reduce biological productivity. We have many examples of how the ultimate cause of extinction and jeopardy is an increasing human population whose demands are greater than the ecosystem can sustain. Short-term boom followed by long periods of bust have characterized human use of the watershed from 1850 to the present. Today, increase in population, parcelization, mining, short rotation timber harvests, and grazing continue to degrade watershed soil and water. The challenge of our time is to demonstrate how taking care of the watershed and regional prosperity are related.

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