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IMPACT OF THE SKI INDUSTRY ON THE RIO HONDO WATERSHED

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Abstract: This essay examines the ecological impact of the ski industry upon the Rio Hondo watershed, located near Taos, New Mexico. Focus is on the primary impact of ski resort development upon river water quality and biota, and upon water quantity in the downstream system of irrigation agriculture. Secondary impact of resort development is analyzed insofar as it affects long-standing patterns of land and water rights ownership and use within the watershed. The watershed is considered as an ecosystem that includes the village-based agro-pastoral economy established during the early nineteenth century. It concludes that while the long-range impact of ski resort development upon river biology is uncertain, the increasing demand that expansion places upon surface water quantity threatens downstream community resource domains and irrigation agriculture. **Keywords:** ski industry, river pollution, water scarcity, irrigation agriculture, competition for natural resources.

Résumé: L'impact de l'industrie du ski sur le bassin du Rio Hondo. Cet essai examine l'impact écologique de l'industrie du ski sur le bassin hydrographique du Rio Hondo, qui se trouve près de Taos, au Nouveau-Mexique. Le centre d'intérêt est l'impact primaine du développement des stations de ski sur la qualité de l'eau et sur la flore et faune de la rivière aussi bien que sur la qualité de l'eau en aval dans le système de l'agriculture par irrigation. On analyse l'impact secondaire du développement des lieux de vacances dans la mesure où il affecte les anciens droits de propriété de la terre et de l'eau et l'utilisation de ces dernières près du bassin hydrographique. Ce bassin est considéré comme un écosystème qui comprend l'économie agro-pastorale, basée dans des villages, qui s'est établie au début du dix-neuvième siècle. On tire la conclusion que, bien que l'impact à long terme du développement des stations de ski sur la biologie de la rivière soit incertain, la demande due à l'expansion pour des quantités de plus en plus importantes d'eau de surface menace les domaines de ressources communautaires en aval aussi bien que l'agriculture par irrigation. **Mots clef:** industrie du ski, pollution des rivières, manque d'eau, agriculture par irrigation, compétition pour les ressources naturelles.

INTRODUCTION

This essay examines the impact of the ski industry on the Rio Hondo watershed of north central New Mexico. The paper describes the establishment of a ski resort at the head of Hondo canyon, subsequent pollution

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of the river, and state findings on biophysical impact. Next it analyzes the effect of resort development on the downstream system of irrigation agriculture. The secondary impact of resort development, accelerated real estate activity, affects the amount of water as well as membership in the ditch system. Also examined in terms of its impact on the ditch system is the State Engineer's policy with respect to water rights transfers.

The approach treats the watershed as an ecosystem that includes the village-based agro-pastoral adaptation *Mexicano* or Hispano settlers established there in the early nineteenth century. This conceptual framework of cultural ecology becomes explicit in reference to the ditch system, the hydraulic and organizational backbone of agricultural practice in the Rio Arriba or Upper Rio Grande region. Even though the agro-pastoral subsistence economy that prevailed into this century is now displaced by a wage economy, the pattern of land and water ownership and use persists. Each village occupies a resource domain more or less coextensive with its ditches, which in turn link it with other such resource domains within a given watershed. Today the reduced resource domains of land grant villages in the Rio Hondo basin are threatened by the expansion of the ski resort in the upper watershed and by secondary real estate development throughout and adjacent to the drainage. Sewage pollution is, therefore, only one aspect of the ski industry's impact on the watershed ecosystem. The larger ecological change this impact engenders is accelerated transition from a rural, community-based system of irrigation agriculture to an urban, recreational system involving different demographic patterns and different patterns of land and water ownership and use.

The discussion begins with a physiographic description of the watershed and river, followed by an overview of watershed settlement and the regional economy. This essay is based on review of the available information on river quality, watershed hydrology, and the ski resort, in addition to 24 months of ethnographic research on social change, tourism, and ethnic relations in contemporary Taos.

RIVER AND WATERSHED PHYSIOGRAPHY

The Rio Hondo is a high-quality coldwater stream that originates in the Sangre de Cristo mountains and descends westward for about 18 miles to the Rio Grande. Its headwaters lie a mile upstream from, and another thousand feet above, the confluence, at 9,300 feet, of two small tributaries. Its mouth, at 6,500 feet, empties in the Rio Grande gorge. The river passes through three of the five life zones found in north central New Mexico (as classified by Baily 1913). It begins in the Canadian zone, which includes the steep canyon known as Hondo or Twining, part of Carson National Forest. This upper portion of the watershed is forested by spruce, fir, white pine, and aspen. Below the mouth (at 7,650 feet) of this eight-mile mountain canyon the land opens up into a deep, narrow valley that extends roughly four miles and lies mostly within the Transition life zone. The valley bottom consists of flood-irrigated agricultural lands. It is surrounded by piedmont whose typical vegetation includes piñon, ponderosa pine, juniper, scrub oak, willow, and various other shrubs and grasses.

Below the bluffs at Cañoncito, where the upper (Valdez) valley closes, the lower (Arroyo Hondo) valley opens onto a longer, broader floor also surrounded by more arid uplands. To the east the piedmont rises into mountains, while to the west the land sweeps down to the precipitous edge of the gorge. Between the upper and lower valleys the Rio Hondo grades into the Upper Sonoran zone. Here are sage brush, salt brush, yucca, some juniper and piñon, and various species of shrubs, grasses, and cactus.

The river channel itself is about 15 feet wide, with a gradient of about 3%. Its depth is less than one foot when average flows prevail (NMEIA 1975:2–3). The riverbed consists mostly of one-foot diameter boulders and a fill of cobble and pebble-sized rubble (NMEID 1975). Its current is swiftest and most turbulent in the canyon, particularly during the early spring runoff. Water volume is greatest in May–June and least in deep winter. Various species of trout inhabit the Rio Hondo: cutthroat and brook reproduce in its uppermost reaches; rainbow are stocked annually in the canyon, and brown are found in the valley (NMEID 1975).

WATERSHED SETTLEMENT

The Rio Hondo is one of eight mountain streams that drain into the Taos basin. Human habitation in the Hondo watershed probably dates from 1100–1200 AD, when Anasazi cultivators were dispersed at the peripheries of the basin. Taos Pueblo lies nine miles southeast of the mouth of Hondo canyon, in the upper Rio Pueblo watershed.

Permanent settlement of the Hondo watershed did not take root until the early 19th century, when grants were made to Hispanic settlers north of the town Don Fernando de Taos. In 1815 the Arroyo Hondo community grant was made by the provincial Spanish governor to 43 settlers, who established their *placita* in the lower Hondo valley, roughly 6.5 miles below the canyon. In 1823 an extension of that grant was made to families who established a second *placita*, originally known as San Antonio, in the upper valley, some five miles upstream. Each village built its own chapel and *morada* (chapterhouse for the lay brotherhood known as the *Hermandad de Nuestro Padre Jesus Nazareno*), and dug its own community ditches, or *acequias*, by means of which water is diverted from the Rio Hondo to strips of individually owned cropland. The two villages are linked by this system. Arroyo Hondo, because it is older, enjoyed priority use rights to the waters by Spanish law. Sometime during this period another set of ditches was dug to carry waters to the dispersed settlement of Des Montes, along the southern rim of the Hondo valley. Mountain and river villages throughout the Rio Arriba region subsisted by means of an agro-pastoral and trade economy. In addition to individually owned farmland extending across the valley floor, each community land grant, or *merced*, contained common lands that ran from the edge of the wetlands up into the mountain wilderness. Their uses included private extractions for subsistence and construction purposes and extensive livestock grazing, mostly of sheep.

Throughout the Mexican period and the Territorial period after American incorporation, the villages sustained by the Rio Hondo remained agriculturally vital. Both the upper and lower valleys contained mills for grinding wheat and corn. San Antonio, called Valdez after 1894, was

known for its abundant fruit. Sheep remained an important part of Arroyo Hondo's economy up to World War II.

Land losses suffered by *Mexicanos* after Americanization undermined the traditional village economy. The common lands were appropriated into the public domain and finally, in 1906, declared national forest. This curtailed use of the wilderness, particularly livestock grazing. Seasonal outmigration, originally for agricultural and pastoral wage labor (crop picking and sheep herding in nearby states), became almost universally necessary for most families to make ends meet. By the time of statehood, most of the Anglo-controlled extractive and land speculation booms that characterized the Territorial period had subsided, and the region slipped into a condition of economic stagnation and underdevelopment from which it has never emerged. Sixty-two percent of the county land mass, containing every mountain watershed, ended up under government ownership and management, including Indian lands. Small-scale ranching and irrigation agriculture nevertheless continue to be a significant part of the domestic economy and way of life of most native families. At the same time, the majority are today primarily dependent upon unskilled wage labor (see Figure 1).

TOURISM

The modern economic history of the greater Taos area is the history of tourism development. Taos has undergone two periods of accelerated tourism development or boom in this century. The first, between World Wars I and II, followed the establishment of the Taos–Santa Fe "art colonies," regional centers for the marketing of a peculiar combination of art, ethnicity, and the natural environment. The second began in the late 1960s and has continued into the early 1980s. It centers around the ski industry and associated real estate development. Between these two boom phases Taos underwent two decades of population decline, tentative economic growth, and slow modernization.

Like the rest of the Rio Arriba, by the late 1950s the town was desperate to escape from the annual feast–famine cycle of summer tourism and winter stagnation. In 1956 a small resort was established at the head of Hondo canyon, near the site of an old mining camp named Twining that had flourished briefly early in the century. The resort grew steadily in size and reputation, and by 1970 it had become a hub in the local economy.

IMPACT ON WATER QUALITY

The Rio Hondo is classified by state water quality standards for use as a high-quality coldwater fishery. Other designated uses are domestic water supply, fish culture, livestock and wildlife watering, and secondary contact recreation. Water quality studies of the river date only from 1974, after pollution from the ski resort's sewage treatment plant had become a heated public issue. The plant was constructed in 1967, just below the ski area. It discharged treated sewage directly into the river. Prior to that,

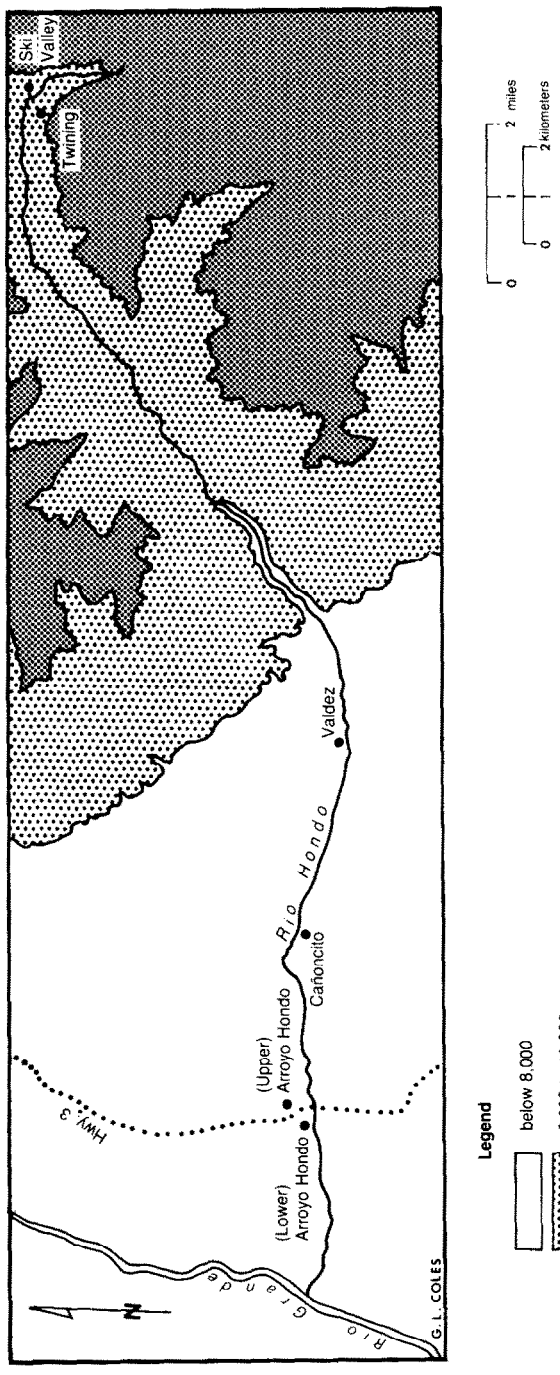

Figure 1. Rio Hondo Watershed

sewage had gone into individual on-site systems such as septic tanks, or else directly into the river.

In 1974 the EPA (Environmental Protection Agency) issued the resort, then in the process of forming a sanitation district, an NPDES (National Pollutant Discharge Elimination System) permit, pursuant to the 1972 Federal Clean Water Act. This required periodic monitoring of the effluent from the plant to test for compliance with federal standards. Monitoring has been carried out by EID (Environmental Improvement Division) personnel working under contract with EPA. In addition to compliance monitoring that samples only the effluent channel between the plant and the river, EID scientists have also conducted periodic intensive surveys of the river. These involve frequent sampling at representative points along the river over a period of time (usually two to four days) in order to determine water quality characteristics under specific conditions. This type of testing is designed to determine cause and effect relations (Tague 1986). The water quality data for the river collected through these two types of study form the basis for this discussion.

By the late 1960s downstream water users had begun to complain about sewage pollution of the river. The resort had grown beyond the 32,000 gallon per day capacity of the treatment plant. Private residences associated with the ski industry comprised addition, "nonpoint" sources of river pollution. Anecdotal accounts from this period describe fecal matter floating in the ditches in Valdez, in addition to odor, scum, foam, slime, and algae. There were also occasional complaints that people and livestock got sick from drinking the water, that the water percolated through the soil more sluggishly than before during irrigation, and that the fish smelled or tasted bad, or even turned black.

Isolated complaints coalesced into organized protest in 1974, when downstream users opposed a proposed expansion of the ski area that would add a 4,500 "pillow" resort complex. The maximum number of skiers using the slopes in one year was then about 95,000, with an overnight lodge capacity at the resort of 702 people (Beardsley, Davis Associates, Inc. 1973:1–3, 47). The protest dissuaded the Forest Service, which owns roughly 90% of the land used by the ski valley corporation, from improving access across public land to private property where the new complex was planned. The Forest Service denied the request for improved access, at least until a bigger and better sewage treatment plant could be built to accommodate further expansion.

The EID Studies

The controversy prompted EID to undertake a 20-month survey of the river between February 1974 and September 1975, following federal guidelines. Originally, 12 variables were measured: temperature, dissolved oxygen, pH, phosphorus, total nitrate nitrogen, total ammonia nitrogen, chemical oxygen demand, turbidity, total organic carbon, conductivity, fecal coliform, and total residual chlorine.

Results showed that the river water quality was high overall, although with deterioration in the six-mile reach between the sewage treatment plant and the mouth of the canyon. Multiple total phosphorus violations were reported, mostly at the mixing zone site 300 yards below the plant,

the next highest number being a few miles below that. There were numerous violations of fecal coliform standards. Most violations occurred between December and February, at the height of the ski season. In terms of more stringent numerical standards pending adoption in 1976, violations occurred also for ammonia nitrogen, total residual chlorine, and nitrate nitrogen (NMEIA 1975:6–7). EID indicated a major problem with the sewage treatment plant was due to hydraulic overloading caused by groundwater infiltration, such that the plant's 32,000 gallon-per-day (gpd) capacity was exceeded almost every month, a situation worst during the spring runoff. The system was organically overloaded as well. The report correctly predicted that the frequency and severity of violations would increase with the size of the "sewered population" at the resort.

Interestingly, this survey showed that domestic and irrigation usage of the river in Valdez and Arroyo Hondo did not significantly affect the expectably sensitive parameters (NMEIA 1975:9). Because water quality parameters were at potentially harmful levels below the plant, the report recommended that measures be taken to improve both the maintenance and operation of the system, particularly correction of chlorination procedures and reduction of groundwater infiltration. It recommended that no increase in the area serviced by the present plant be permitted (NMEIA 1975:9–10).

Compliance monitoring was done at least annually after the 1974 NPDES permit was issued. Virtually all reports showed violations. The most common were of effluent limitations for flow capacity, fecal coliform, BOD (biochemical oxygen demand), BOD loading, TSS (total suspended solids), and TSS loading. Of these parameters, fecal coliform poses the most direct health hazard to humans. It refers to the presence of animal, in this case human, fecal waste matter. High concentrations can indicate the presence of potentially pathogenic organisms (e.g., *Shigella, Salmonella*). The worst violation on record for this parameter occurred in 1976, and involved a count of 1,300,000 per 100 ml, the limit being 400/100 ml (NPDES Compliance Monitoring Report 1976: Appendix C). That year EPA issued an Administrative Order calling for a halt to the violations, which nevertheless continued.

Violations were due primarily to the inadequate capacity, inept operation, negligent maintenance, and poor condition of the sewage treatment plant. Defects in the system tended to result either in excess chlorination, as a way of killing the coliform, or else excessive coliform. Whereas fecal or other organic matter can endanger river life forms indirectly (for example, by reducing the amount of oxygen available for fish), chlorine can be directly toxic to them.

Prior to 1981 there was little change in the pattern of violations, although their severity fluctuated according to weather and the number of skiers placing demands on the system. Infiltration and hydraulic overload were attributed to people leaving their taps open to keep pipes from freezing.

In January 1980, an Assurance of Discontinuance was negotiated between the state Water Quality Control Commission and the resort sanitation district. It specified deadlines by which the district must come into compliance with standards. The EID also recommended, as it had before, voluntary measures to remedy the problem. The first deadline came and

went, and the violations continued. In January 1981, a nearly snowless Christmas ski season yielded an unprecedented clean NPDES compliance report. Violations resumed later in the year, while the ski valley undertook to upgrade the plant, improve its operation, and impose a daily limit of 4,050 on the number of skiers. Environmental impact studies were begun for resort expansion and a new sewage plant.

Another intensive survey was completed in 1981, during which time the plant was upgraded to a capacity of 80,000 gpd. The environmental impact studies were done by EPA for a new 95,000 gpd plant, and by the Forest Service for the resort's 30-year master plan for growth. Samples were taken at approximate monthly intervals between November 1979 and April 1981, from eight stations along the course of the river. Once again, violations predominated at the site 300 yards below the plant, for total phosphorus, fecal coliform, and percent saturation of dissolved oxygen (NMEID November 1981:8). Recent testing had determined that the limiting nutrient for the Rio Hondo is phosphorus. As a consequence the river became exempt from the total inorganic nitrogen standard (NMEID June 1981). High levels of total phosphorus in such a stream are associated with a degraded biotic environment, and must be controlled in order to control nuisance algal growth. Hence the new plant would have to include a system for phosphorus removal, along with other features essential for meeting water quality standards for a fragile, high altitude, high-quality coldwater stream.

It was also during this period that an ongoing series of intensive surveys of river biota was begun. Studies between March 1979 and March 1981 in the stretch below the plant showed significant degradation of the aquatic environment, through alteration of the structure of the benthic macroinvertebrate community that serves as the primary food source for trout. Here the aquatic insect community was dominated during the winter by pollution-tolerant organisms such as true flies, which replaced a more diverse group of pollution-sensitive organisms such as mayflies and stoneflies, the desirable food for trout. Occasional deterioration of the biological and chemical environment above the plant was also observed, and attributed to various nonpoint pollution sources, such as "malfunctioning on-site sewage disposal systems at one large lodge and numerous unsewered homes, runoff from parking lots and roads, and runoff from fertilized ski trails" (Jacobi 1981:31). The survey also documented that overchlorination in the winter of 1981 eliminated populations of both tolerant and sensitive organisms below the plant. This had a devastating though not permanent impact on the downstream aquatic ecosystem, since upstream populations unaffected by plant effluent could subsequently drift downstream and recolonize affected areas after the ski season (Jacobi 1981:26–30).

A macroinvertebrate survey conducted a year later, nevertheless, showed a nearly 50% reduction in the numbers of organisms as well as a 50% reduction in the numbers of taxa collected at the same site below the plant. A lowering of the biotic condition index (BCI) was also noted, as well as a loss of stoneflies and mayflies, which previously had decreased to extremely low levels. The overall quality of the river outside the damaged zone between the plant and canyon mouth remained high. Stream standard violations for total phosphorus, total inorganic nitrogen, and turbi-

dity occurred during periods of effluent discharge (Jacobi and Smolka 1983:15–16).

DOWNSTREAM PROTEST

Two mass protest demonstrations were held at the ski area in the winters of 1981 and 1982. Nearly two years of government-sponsored citizen's advisory committee (CAC) meetings over the environmental impact studies had culminated in the resort's unilateral decision to construct a new plant that would achieve maximum capacity without a hook-up policy tied to demonstrated permit compliance. This precipitated a breach in the already strained relations between upstream developers and downstream water users. It further intensified protesters' frustration with the governmental EIS process.

The first demonstration, held the day after Easter, was conducted as a mock funeral procession for the river, replete with hearse, coffin, and parish religious banners. Approximately 250 protesters picketed skiers in the parking lot. The second demonstration occurred the day after Christmas, at the height of the season, after construction was underway on the new plant. The resort's sanitation district had finally decided to build it with private instead of federal funding, probably to hasten the process and insure greater decision-making autonomy.

During this period the community of Valdez instigated a dramatic, grassroots movement against the proposed construction of two large condominium projects in the upper valley. One project involved an application for an NPDES permit to discharge sewage into the river just below the mouth of the canyon. Virtually the entire village of Valdez, which numbers about 150 people, vigorously opposed the granting of the permit. Eighteen households in Valdez and Cañoncito (a tiny settlement just below Valdez) depended on the river for domestic purposes including drinking. This information led to the denial of the permit, and now added weight to the case against the ski valley.

In the autumn of 1983 the repeatedly postponed state and federal hearings were finally held on the matter of violations. The sanitation district was fined $4,500 in state district court, payable to EID. It agreed to a $30,000 settlement out of federal court, where it might face a maximum fine of $1,000 per day; $5,000 of this went to downstream *acequias* for "improvements." The remainder went to EPA. Both sides were left with substantial legal fees, although plaintiff's attorneys, who had worked at reduced rates, were awarded some $12,000. Investigations for the 1982–83 ski season still reported no improvement in the quality of the benthic invertebrate community downstream from the discharge. Occasional NPDES violations occurred and total phosphorus limits were exceeded (Jacobi and Smolka 1984:2).

THE NEW PLANT

The first full season of operation for the new plant was 1983–84. Surveys in March showed only two stream violations for turbidity above and below the plant, attributed to spring runoff from the parking lot.

Samples from the effluent channel showed one pH and one total phosphorus violation, and erratic fluctuations in total phosphorus concentrations throughout the winter. However, biological sampling yielded a disturbing picture. This showed "some of the poorest conditions observed in the river since biological sampling was initiated," at sites above and below the plant (Jacobi and Smolka 1984:5–6). Total numbers of organisms and taxa were down as were the diversity index and BCI. At the site 50 yards above the plant but downstream from the parking and utility lots, "fine sediments covered the surfaces and filled the interstices of the normally sediment-free rubble substrate and a petroleum sheen was visible on the water surface." Furthermore, "the total number of organisms was 50% lower than the worst case situation observed in 1980 and was reduced by 67% compared to the previous year. Total taxa were reduced by almost 50% compared to the average of the preceding five years" (Jacobi and Smolka 1984:6). At the sampling site below the plant and for six miles downstream, the natural rubble substrate of the river was covered with a mat of the alga, *Hydrurus foetidus.* Here the total number of organisms was down 46% from the year before and 58% of the organisms were pollution-tolerant true flies. Sensitive species were scarce (Jacobi and Smolka 1984). The 1984 report concluded that because the plant was improperly operated it was supplying nutrients to the river that "triggered" excessive algal growth (Jacobi and Smolka 1984:7). It echoed earlier reports by identifying the parking lot-utility area as a significant source of river degradation.

If the 1984 survey revealed some of the poorest conditions observed over the past several years, the early 1985 study showed some of the best (Jacobi and Smolka 1986). Some phosphorus and residual chlorine violations were observed, but generally speaking the effluent quality was much improved over that of the old plant. The biological condition of the river above and below the plant also showed improvement. Overall numbers and diversity of organisms increased at the impacted sites above and below the plant and there was some recovery of sensitive taxa. Yet the algal growth was still present. The next NPDES reading showed violations for ammonia and phosphorus, while excessive algal presence continued (NMEID 1986; NPDES 1986). The alga appears to be caused by intermittant phosphorus excedence. In order to solve the problem the sewage treatment process will have to be upgraded.

WATER QUANTITY AND THE *ACEQUIA* SYSTEM

As important as pollution in the Rio Hondo is the impact the ski industry has on the ownership and use of surface water rights. From the point of view of *acequia* users, the ski valley represents a threat not only in terms of water quality, but also with respect to the perennial issue of how much water is available for irrigation. A universal perception exists that there is never enough water in the ditch to go around, and furthermore that there is less water in the river today than many years ago. This claim is borne out by USGS (US Geological Survey) records of annual river flow, which show a 25–40% reduction in flows between 1934 and 1979, a trend noted in other nearby watersheds as well (reported in USFS 1981:17–19).

Studies also indicate there is no longer enough water in the Rio Hondo

to accommodate all irrigation needs throughout the growing season. These needs could be met only through "some type of water storage project" (Wilson 1981:6–25). This decrease appears to represent a decline in the ratio of surface runoff to winter precipitation. While there has also been a decline in the amount of overall precipitation, the Forest Service does not consider this the major cause of flow reduction in the Rio Hondo (USFS 1981:24). They propose that in the absence of timber harvesting (or forest fires) in the canyon, the moisture has been absorbed by the increasing number and size of trees (USFS 1981:22).

The resort has cleared some 316 acres for ski trails. This is said to have increased the surface runoff by as many acre feet of water per year. So while the resort has diverted and consumed an increasing amount of surface water over the years, it is not considered to have been a significant factor in the decline of river flow. Nevertheless, it is generally agreed that for whatever reasons, there is less water in the system now than there used to be, a scarcity felt most acutely around August, by those lowest on the ditch.

While the impact of resort development on water quantity is said by state hydrologists to be negligible, a different view is held by downstream *acequia* users. From their point of view, there is less water available to the ditches not only because of less precipitation, but also as a result of rights to that water having been transferred from cropland to the ski area. This trend, particularly in the context of a real estate boom coupled with the water decline, has far-reaching implications for the Rio Hondo watershed as an ecosystem.

To grasp the full, cumulative nature of the impact of the ski industry on the watershed as a human ecosystem, some understanding of the *acequia* system and New Mexico water law as it relates to it is necessary. In the late 1960s, the landholding component of the resort purchased farmland that had rights to 10.91 acre feet of water (acfy) on a ditch in Des Montes. It then applied to the State Engineer to transfer their point of diversion to the ski valley, and to change their designated use from agricultural to "domestic and sanitary." One acre foot per year is the amount of water needed to cover an acre of land to the depth of one foot once each year. This was the water used to develop the original resort area and its sewage system. As decreed by a special district court order, it amounted to 218.2 acre feet per year of diversionary rights. This meant that the ski valley was allowed to take 218.2 acre feet of water out of the system but to consume only 10.91 of them.

As with virtually every water rights transfer since, the commissioners for the ditches affected filed a protest against the transfer application. As in most cases since, the commissioners also withdrew their protest before it reached the point of a hearing, evidently in order to avoid the cost of litigation they were likely to lose. They withdrew in the original case on condition that all sewage effluent resulting from the diversion "be disposed of in a manner approved by the NM Health and Social Services Department" or a comparably responsible agency. The State Engineer imposed this and a number of other conditions on approval of the transfer, including the requirement that the resort regularly meter and report both the amount diverted and the "return flow" to the river (NMSEO Memorandum 1970). Over the next 15 years (the original transfer was finally approved in 1970), most if not all of these terms were repeatedly violated.

This pattern elicited censure and warnings from the State Engineer, but no punitive action.

In the years that followed, other priority water rights transfers were made from downstream *acequias* to the ski valley. In each case the affected ditch users argued that their rights would be impaired, although in no instance did this prevent a transfer. In each case the State Engineer concluded that no impairment of downstream users' rights to surface waters would result. Part of the justification for this is that most ski area diversion of the water takes place in winter, whereas the greatest agricultural demand occurs during the summer. At the head of Hondo canyon the consequence of reduced quantity in winter is felt at — or rather just below — the plant, when maximum diversion, minimum flow, and maximum sewage effluent exacerbate conditions for pollution, or intensify its concentration.

Today the resort owns a minimum of 623 acre feet of diversionary rights, amounting to 41.48 acfy of consumptive rights (Molzen-Corbin & Associates 1985), with an undetermined number pending. The ski lift corporation also owns 18.94 acre feet of consumptive rights from two parcels in Des Montes still under irrigation, although the use could be transferred at any time.

In 1969, 2,945 acres were under irrigation in the Rio Hondo watershed (NMSEO 1979), whereas 2,735 were under irrigation in 1978 (Wilson 1978:VII-32-VII-33; Wilson 1981:6–25), representing a loss of 662 acfy of diversionary rights. Any piece of farmland from which the ditch rights are severed will remain forever fallow. The only water to which it can, thereafter, have legal access must come from an underground well, to be used for residential purposes. Such land has value only for residential or nonagricultural commercial development (e.g., condominiums).

Fifteen of the 41.48 consumptive feet are purchased San Juan – Chama water rights. In Taos this water is taken out of local surface or groundwater sources and "paid back" by release of water from one or another reservoir along the Rio Grande. Tied to these and other rights employed for snowmaking are explicit seasonal conditions for use. Prior to these acquisitions, snowmaking was done illegally, using the original acquired rights, which did not have that designated purpose.

The transfer of priority rights from down to upstream use reduces the quantity of water available in the lower portion of the watershed. Presumably some kind of threshold point would be reached if river and ditch flow declined to a point where it no longer recharged aquifers in the valley. This point could be hastened by proliferation of wells for residential development on previously vacant and agricultural lands within the drainage. Adverse climatological conditions might also play a role in bringing about such an eventuality. Hydrological studies do not foresee this scenario as an imminent possibility. But there is another important way in which the transfer process will affect the system of resource ownership and use.

THE *ACEQUIAS*

The institutional backbone of Hispanic village organization in the Rio Arriba was, other than the family and apart from *morada* and parish, the *acequia* system. Each landowner and *parciante* participated — and still does — through labor, fees, and the election of commissioners and a

mayordomo (ditch boss) to manage ditch maintenance and water allocation. The *acequia* also links each village with every other in a given watershed. Each community is coextensive with its ditches and constitutes a resource domain unto itself, while at the same time being part of an inclusive system or resource domain. Although the ditch system is weaker today than when agriculture was the economic mainstay, it is very much intact in all the villages that surround Taos. In the Hondo watershed, many ditch officers have protested against ski valley pollution or water rights transfers or both. Other ditch associations from the Taos area intervened on their behalf in the final violations suits against the ski valley. They have also attempted to negotiate a limit on the amount of water rights the ski valley can transfer. Indeed, it is these custodians of traditional community resource domains, along with the officers of domestic water and land grant associations, who have lent the ski valley protest its greatest legitimacy, in a tourist town (Taos) where the issue has by no means been popular with the business community.

Since a ditch must be maintained by the collective labor of its *parciantes,* each time a parcel loses its water rights, a proportional amount of labor and ditch fees is also lost, thereby increasing the burden of maintenance upon the remaining *parciantes.* This deleterious impact is maximized for those lowest on the ditch. The burden of proof of potential damage from water loss rests upon the *parciantes* rather than the other way around. The applicant for the transfer is not required to prove that the transfer will not be deleterious. Moreover, the costs of filing a protest ($250) and any ensuing litigation must be borne by the *acequia* users themselves.

Two identifiable factors conspire against the ability of the *acequias* to persist. One is the State Engineer's policies concerning water rights transfers. He considers each case as an isolated instance unrelated to other transfers that may have taken place or be pending within the same village or watershed. The rights like the land are private property owned by individuals and no community interest or ownership is recognized. This ignores the fact that every transfer has an incremental impact upon the system as a whole, not only in terms of actual water quantity, but also in terms of the overall viability of the system. Indeed, this view fails to acknowledge the existence of a "system."

Presumably there is a threshold point beyond which the maintenance of the *acequia* becomes impossible, regardless of whether the reamaining *parciantes* prefer to sustain it. It would be reached when one more transfer tipped the balance and caused the remaining *parciantes* to give up trying to maintain the system. A threshold crisis of this nature is likely to occur sooner than a hydrological one. While there is no necessary causal relation between the one and the other, it does seem possible that a threshold crisis in the *acequia* system would portend, and also increase the chances for, a threshold crisis in the hydrological system of the watershed which, as mentioned earlier, would be reached when stream and ditch flows became so low they failed to recharge the downstream aquifers. At present the latter would seem to be more a theoretical than an actual possibility. Yet the demise of the *acequia* system would signal, if not the eventual drying up of the lower watershed, at least major change throughout the entire ecosystem. The *acequias* are part of the watershed ecosystem, where change in one part signals change in others. Presumably this process would occur in perceptible stages, beginning with the gradual cessation of irrigation.

THE SIGNIFICANCE OF SECONDARY IMPACT

The other force which militates against the *acequia* system is the real estate boom associated with ski resort development. Since the late sixties, real estate development has accelerated throughout the county in proximity to ski resorts, of which there are now several. Most of the real estate development in the Taos basin, particularly second homes, condominiums, and lodges, has been concentrated around the town and along the road between the town and the ski valley. Land prices around Taos, particularly along this corridor between town and Twining, have increased exponentially over the past 20 years. An acre of irrigated land in the Hondo watershed that sold for less than $1,000 in 1965 might sell today for $25,000. In 1981 in Twining, an acre could go for between $45,000 and $75,000 (Wilson 1981:D-11).

The tax rolls for the Rio Hondo and adjacent watersheds reveal since 1960 a decrease in acreage owned by Hispanos (mostly farmer–ranchers who inherited their land) and an increase in acreage owned by Anglos (a growing proportion of whom arrived recently and live elsewhere for most of the year). A longstanding local inheritance practice, subdivision of land, is now promoted by speculators. This pattern is ubiquitous with individual variation in each community. For example, prior to 1970, more than half the land in the combined Valdez–Twining tax district belonged to Hispanos. The crossover to 50% or more Anglo ownership occurred during the 1960s. In Arroyo Hondo, however, about 65% of the land is still owned by Hispanos, although the number of Anglo landowners went from 28 in 1970 to 145 in 1980 (the estimated population of Arroyo Hondo is 600). Hispanos (about 67% of the county population) still outnumber Anglos in all nearby settlements except Las Colonias and Twining. In Des Montes, Hispanos own roughly half the land and make up nearly 75% of landowners, although they are outnumbered by Anglo residents, including renters.

The price of water rights has skyrocketed alongside land price. An acre foot of surface water can sell for $2,000 to $6,000. Often rights are transferred from a ditch to a well for multifamily dwellings (condominiums) and/or recreational uses such as swimming pools or spas. An acre of irrigated land is worth more if it is subdivided and its surface water sold separately. Each lot is entitled to one well that yields three acre feet a year for residential use. This increases the demand on ground water.

In Taos county roughly 30% of families live at a subpoverty level and the official unemployment rate seldom drops below 15%. Increasingly, native landowners cannot resist the pressure to sell their land and water to developers. Those who do hold out confront public policy that evaluates "beneficial use" of vital resources in terms of its marketable dollar value and considers the traditional agro-pastoral pattern of adaptation obsolete.

CONCLUSION

The ski industry has polluted but not yet irreversibly damaged the Rio Hondo. It has also removed a significant amount of water from the downstream *acequia* system. The impact has been intensified by economic and climatological conditions in the region, as well as by state water policy. These impacts on water quality and quantity have been further intensified

by real estate development secondary to the ski industry, proliferating throughout the Hondo and adjacent watersheds.

The biological and physical future of the river seems uncertain. The history of the issue suggests that without rigorous controls, the ski industry would degrade the high quality of the river. Regulations are in place and, for the first time since their inception in 1972, seem to have halted major pollution. Yet just as one set of problems seems to have been improved another set; algal growth has worsened.

If resort and related private development were not in continuous expansion, the achievement and maintenance of equilibrium in the system would be easier. Already EID is pressed with requests to increase the capacity of the plant and the wasteload allocation of the river. Improvements made by the new plant notwithstanding, it remains the case that no full year has passed without any violations whatsoever. Under these conditions the persistence of the river as a high-quality cold water stream seems questionable.

The impact of the ski industry on the Rio Hondo *acequia* system is deleterious. It threatens to precipitate a final crisis in a protracted transition from a rural agricultural pattern of resource use to an urban recreational one involving different demography and ownership. Where two different populations and patterns of adaptation compete for the same resources, either the two systems mutually accommodate and become increasingly interdependent, or one eventually displaces the other (Barth 1969:20). Various factors will affect the outcome of any given situation, such as the particulars of stratification and differential power, as well as specific economic and environmental conditions. While there seem to be grounds for predicting the disappearance of the traditional Hispanic agricultural adaptation, the history of the area as well as reflection upon the reactive nature of ethnicity would lead one to expect persistence of ethnic boundaries. Indeed, the grassroots protest in response to resort development may represent intensified boundary maintenance, in an environment where different groups have historically occupied distinct if somewhat overlapping *niches,* and where each village constitutes a well-guarded resource domain (Rodriguez 1987). The limiting factor to urban development will be water, as it has always been. If cultural, social, and/or economic factors do not intervene to limit growth, ultimately water scarcity will. □□

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