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August 13, 2004

Allen Robertson, Deputy Chief
California Department of Forestry and Fire Protection
P.O. Box 944246
Sacramento, CA 95814

Northern Region Headquarters
California Department of Forestry
135 Ridgeway Avenue
Santa Rosa, CA 95401

Subject: Evaluation of Potential Impacts on Hydrology and Water Supply
THP No. 1-04-055 SON and Proposed Negative Declaration TCP No.04-533
Roessler/Zapar Inc. THP/Conversion, Annapolis, California

Dear Mr. Robertson:

I am a hydrologist with over seventeen years of technical and consulting experience in the fields of geology and hydrology. I have a Master's of Science degree in Geology received from Miami University (Oxford, Ohio) in 1989 and am a California Registered Geologist and Certified Hydrogeologist. I have been providing professional hydrology services in California since 1991 and routinely manage projects in the areas of surface- and groundwater hydrology, water supply, water quality assessments, water resources management, and geomorphology. Most of my work is located in the Coast Range watersheds of Northern and Central California. I have been working professionally in the Gualala River watershed for over three years, most recently completing hydrologic investigations in support of a resource management plan for the lower Gualala River and estuary on behalf of the Sotoyome RCD and State Coastal Conservancy. My areas of expertise include: characterizing and modeling watershed-scale hydrologic and geomorphic processes; evaluating surface- and ground-water resources/quality and their interaction; assessing hydrologic, geomorphic, and water quality responses to land-use changes in watersheds and causes of stream channel instability; and designing and implementing field investigations characterizing surface and subsurface hydrologic and water quality conditions. I also teach an annual course on hydrology and geomorphology through the University of California Extension (Berkeley) and provide technical talks to community and non-profit groups. I co-own and manage a hydrology and engineering consulting firm in San Rafael, California (established in 1997).

The purpose of this letter is to present my comments and opinions regarding the adequacy to which the project proponents have addressed potential project-induced impacts to the surrounding environment. Materials I reviewed to complete this evaluation include:

- The Roessler THP/Timberland Conversion application and supporting maps and studies, THP No. 01-04-055 SON, prepared by North Coast Resource Management on behalf of Roger Roessler (president of Zapar, Inc.) and received by the CDF (Coast Area Office, Resource Management) on March 23, 2004;

- Timberland Conversion Plan application, prepared by Niel E. Fisher, North Coast Resource Management (RPF# not found) and supporting studies (including Cumulative Effects Analysis and Appendices A-P), document dates throughout 2003 and 2004;

- Erosion Control and Mitigation Plan, Roessler Vineyards, 36451 Annapolis Rosd, Annapolis, CA, prepared by ENTERRA Associates, Inc., March 28, 2003 (hereafter referred to as Erosion Control Plan);

- A letter from Wendy J. Wickizer, Division Chief Forest Practice, Department of Forestry and Fire Protection, Northern Region Headquarters, to Mr. Niel Fisher, dated April 22, 2004, outlining Review Team concerns and questions to be addressed during the upcoming preharvest inspection; and

- THPs, TCPs, and supporting technical studies associated with neighboring projects including THP 1-01-171 SON (Artesa Vineyards), THP 1-04-059 SON (Martin Property), and THP 1-04-030 (Hansen-Whistler).

Based on this review, it is my conclusion that the proposed Roessler-Zapar, Inc THP/TCP project poses a number of potential and likely significant impacts on the environment and surrounding property owners even if mitigations and best management practices (BMPs) are implemented as proposed. Many of the data, assumptions, site characteristics, and conclusions regarding potential impacts to local and watershed hydrologic conditions presented in the plans are incorrect and/or misleading. As a result, potential project impacts to surrounding resources and properties, whether adverse or beneficial, have not been addressed. Specific areas of concern and the rationale and facts on which I base my opinion are presented below. Because the THP and TCP do not accurately evaluate the potential impacts to hydrologic conditions, it is my opinion that further information and analyses, not mitigation, are necessary to ensure all impacts are discovered and addressed. The avenue for addressing these deficiencies is likely through the preparation of an Environmental Impact Report (EIR) for the project.

Potentially Inaccurate Watershed Runoff Estimates

The quantification of project-induced changes in storm water runoff is an important first-step in determining if a project will exacerbate erosion and sediment supply to downstream reaches, a leading cause of impaired water quality in the Gualala River watershed. No analyses or defensible data are presented to substantiate the claim that "runoff should not be appreciably changed as a result of project implementation" (Erosion Control Plan, page 5). This claim is based solely on the assumption that, "soil type and condition will remain the same after project implementation" and "a permanent grass cover crop will be substituted for second growth timber and brush, with similar infiltration rates" (Erosion Control Plan, pg. 5). The processes that control storm water runoff (rainfall interception by trees and brush, infiltration, vegetation density, evapotranspiration, soil properties, etc.) differ significantly between a vineyard with grass cover and forest[1].

Based on review of available watershed data, the 50-percent runoff factor presented in the Erosion Control Plan underestimates storm and annual runoff totals. Long-term annual runoff totals at a U.S. Geological Survey (USGS) stream gage on the South Fork Gualala River indicate

[1] If these comments appear familiar it is because they are very similar to those I submitted under the Martin THP No. 1-04-059. The reason for this is that the text in the Erosion Control Plan prepared by ENTERRA Associates Inc. for the Roessler THP (subject of this letter) is nearly identical, word-for-word, to the erosion control plan prepared by Erickson Engineering, Inc. for the Martin THP (1-04-059) and dated October 21, 2003. The date of the ENTERRA Erosion Control Plan for the Roessler project pre-dates the Erickson plan, but a cover letter accompanying the ENTERRA plan indicates it was, "patterned after the one prepared by Lee Erickson."

that 63-percent of annual rainfall leaves the watershed as runoff[2]. Thus, storm and annual runoff totals, and associated erosion potential, estimated for the THP project site may be 20-percent lower than those actually measured in the project watershed.

From a water supply perspective, the runoff discrepancy may translate into significantly reduced water availability for groundwater recharge (i.e. instead of 50-percent of annual rainfall being available for infiltration and "contributing to low-flow based flows in the lower reaches of Little Creek" (Erosion Control Plan, page 5), only 37-percent will be available for infiltration. Another problem is that these figures only reflect existing watershed conditions. In order to properly quantify the impacts of the project on hydrologic conditions, one needs to develop a detailed water budget comparing the perceived gains in available soil moisture as a result of logging against the retained vegetation water demands (evapotranspiration) and infiltration potential from the altered substrate. The relationships between groundcover type and infiltration potential are well understood in the scientific and water resources engineering communities as exemplified in the attached Figures. In general, these figures[3] demonstrate:

- Increased organic cover leads to increased infiltration rates;
- Areas covered in vegetation have higher infiltration rates than cultivated areas; and
- Forested areas commonly have higher infiltration rates than grasslands.

These bullets are in direct opposition to the claim in the Erosion Control Plan that states the proposed vineyard will have an infiltration rate similar to forested conditions.

Changes in runoff magnitude, both storm related and summer base flow were not presented in the Erosion Control Plan. It does not appear that any scientifically based analyses were completed to quantify changes in the magnitude and/or duration of runoff - the first step in evaluating potential erosion or water supply impacts. The Erosion Control Plan speculates that there will be little change in runoff conditions, but again, the basis for these statements are based on unsound data and questionable causal relationships. Scientific literature that I have reviewed regarding the affects of timber harvest on storm runoff indicate significant increases in peak flows (up to 50-percent in small, clear-cut basins)[4]

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[2] Rantz, S.E., 1974, Mean annual runoff in the San Francisco Bay Region, California, 1931-70. United States Geological Survey, Water Resources Division Miscellaneous Field Studies Map (MF-613).

[3] All figures from, ASCE, 1996, Hydrology Handbook. ASCE manuals and reports on engineering practice No. 28, 784p.

[4] Jones, J.A. and Grant, G.E., 1996, Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Orgon. Water Resources Research, v.32, no.4, pp. 959-974, April.

Marvin, S., 1996, Possible changes in water yield and peak flows in response to forest management. Volume III (Assessments, Commissioned Reports, and Background Information), Sierra Nevada Ecosystem Project, Final Report to Congress, Wildland Resources Center Report No. 37, University of California Davis.

Thomas, R.B. and Megahan, W.F., 1998, Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Orgon: A second opinion. Water Resources Research, v.34, no.12, pp. 3393-3403, December.

Ziemer, R.R., 1998, Flooding and stormflows. USDA Forest Service General Technical Report, PSW-GTR-168-Web.

Potentially Inaccurate Water Budget Parameters and Lack of Analysis
Review of available rainfall data for the project area suggests that the Erosion Control Plan is overestimating the average annual precipitation total for the site. In turn, overestimating the rainfall total overestimates the magnitude of both the runoff and infiltration variables (both expressed as percentage of total average annual rainfall), used to evaluate available project water supply. The Erosion Control Plan estimates potential runoff and infiltration based on 67-inches of annual precipitation. A 1971 USGS[5] isohyet (lines of equal average annual rainfall) map indicates a mean annual rainfall total of 44-inches for the project site. The 1974 USGS runoff report (see citation under footnote 2) reports a "mean annual basin wide" rainfall total of 51-inches for the South Fork Gualala River gage near Annapolis. The California Department of Water Resources Bulletin 118 reports an average annual rainfall total for the Annapolis area ranging from 36- to 49-inches[6]. The long-term (1976-2003) average annual rainfall total for Annapolis as determined from data obtained from the local news paper called the Independent Coast Observer is 58.2-inches. And finally, rainfall data (1959 - 2000) collected by Fred Radtkey at the Hedgepeth Ranch, located approximately 9 miles Southeast of Annapolis, yields an annual average rainfall total of 57.2-inches. Although some values are somewhat dated, the magnitude of discrepancy is not attributable solely to differing periods of record and a more in-depth analysis of a representative value is warranted.

The THP and Erosion Control Plan do not present vineyard water demands in an understandable fashion. Based on my review, I was not able to clearly determine the short-term and or long-term vineyard water needs, and whether these needs transition after "1-2-years" or "4 to 6-years" of initial vineyard planting. The THP does not present a comprehensive water budget that clearly compares project water demands to available water supply, an analysis that is required to evaluate impacts on existing resources.

Inaccurate Characterization of Groundwater Conditions and Potential Impacts
The Erosion Control Plan characterizes groundwater as coming from some deep, mysterious subterranean source. The Plan also describes site surface water-groundwater conditions as two independent and unrelated sources of water. It is my experience and professional understanding that surface water and groundwater resources are, in fact, closely interrelated in this area of the Gualala River watershed. The following narrative describes the geologic setting, history, and conditions within the project vicinity and the dominant processes controlling groundwater recharge and discharge to and from local aquifer system.

The project site is underlain by the Ohlson Ranch Formation, which, in turn, lies above Franciscan Complex bedrock. The main water bearing formation in the area is the Ohlson Ranch Formation (DWR, 2003; see footnote 6). This Formation consists of sandstone, siltstone, and conglomerate. The underlying Franciscan Complex consists of complexly folded and faulted metasedimentary (cemented), volcanic, and intrusive igneous rocks. The Franciscan Complex is considered non-water bearing relative to the Ohlson Ranch Formation, although it can yield enough water to wells for domestic uses (DWR, 2003). Evaluation of local geologic maps and reports along with regional geologic cross-sections indicate that the contact between the Ohlson Ranch and Franciscan Complex is essentially a horizontal to slightly eastward dipping plane, resulting in the thickest portions of the Ohlson Ranch Formation being located beneath the higher elevations of area ridges[7, 8, 9, 10]. The lateral extent and thickness of the Ohlson Ranch

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[5] Rantz, S.E., 1971, Mean annual precipitation depth-duration-frequency data for the San Francisco Bay Region, California. United States Geological Survey, Water Resources Division open-file report, prepared in cooperation with the U.S. Department of Housing and Urban Development, 23p.

[6] California Department of Water Resources, 2003, California's Groundwater. DWR Bulletin 118, updated 2003.

[7] Blake, M.C., Jr., Smith, J.T., Wentworth, C.M., and Wright, R.H., 1971, Preliminary Geologic Map of Western Sonoma County and Northernmost Marin County, California. U.S. Geological Survey and

Formation deposits are the primary control over groundwater storage capacity within these aquifers. Thus, in essence, the "Annapolis Ohlson Ranch Formation Highlands Groundwater Basin" described and named by DWR (2003), is actually an assemblage of independent and disconnected aquifers occupying the ridge tops, the extent to which can be determined from outcrop and geologic maps.

The sequence of geologic events that lead to this configuration is as follows. After emplacement, the Franciscan Complex, it was eroded to a relatively flat plain along the coast. About five million years ago, this surface was covered by silts, sands, and gravels of the Ohlson Ranch Formation in what was likely a broad shallow marine embayment covering most of Sonoma County (Blake et al., 1971; Rice and Strand, 1971[11]). Following deposition of approximately 500 feet of deposits, the combined effects of a net fall in sea level and uplift of the coastal mountains led to erosion and down cutting into the Ohlson Ranch Formation. Today, the Ohlson Ranch Formation ranges in thickness from about 20 to 160 feet and caps area ridge tops (DWR, 2003).

Reported yields from this formation range from 2 to 36 gallons per minute (gpm). It is reported that some wells in this formation go dry in the fall months (DWR, 2003). This phenomenon is due to dewatering of the aquifer by natural outflow at springs and seeps, and human-induced well pumping. Thus, the water table in the Ohlson Ranch Formation aquifers display a seasonal cycle of rise and fall in concert with infiltration and recharge during winter rains and declining levels during the summer dry season. The rate of summer decline in water levels and aquifer storage is controlled by the rate of natural and human-induced withdrawals. Similarly, the rate and total amount of wet-season recharge is dictated by available infiltration of rainfall.

It is important to note that the Brushy Ridge Ohlson Ranch aquifer has a finite size and supply of water and can only support a limited number of domestic and irrigation withdrawals without going into overdraft (aquifer overdraft occurs when annual withdrawals exceed the amount of natural rainfall recharge, resulting in long-term declines in groundwater levels and supply). Anecdotal accounts from long-term residents indicate that local well yields have declined at a faster seasonal rate over time, likely in response to the increased domestic and agricultural development and groundwater withdrawals on the Ridge.

Field observations and geologic mapping indicate that most area springs occur at the Ohlson Ranch-Franciscan Complex contact, where relatively coarser and higher permeability sands of the basal Ohlson Ranch Formation lie on top of relatively impervious Franciscan bedrock. In fact, once this association was understood, the location of seeps, springs, and wetlands become a useful aid in identifying and

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U.S. Department of Housing and Urban Development, San Francisco Bay Region Environment and Resources Planning Study Map (scale unknown; partial copy).

[8] California Department of Water Resources, 1975, Evaluation of groundwater resources: Sonoma County, Volume 1. Geologic and hydrologic data, Bulletin 118(4), prepared in cooperation with Sonoma County, 177p.

[9] Travis, R.B., 1952, Geology of the Sebastopol quadrangle, California. California Department of Natural Resources, Division of Mines Bulletin 162, 33p.

[10] Huffman, M.E., and Armstrong, C.F., 1980, Geology for planning in Sonoma County. California Division of Mines and Geology, Special Report 120, 31p.

[11] Rice, S.J., Smith, T.C., and Strand, R.G., 1976, Geology for Planning, Central and Southeastern Marin County, California. California Division of Mines and Geology Open File Report 76-2 (includes numerous plates).

mapping the location of the Ohlson Ranch-Franciscan Complex contact. Because there is a finite amount of storage associated with each Ohlson Ranch Formation aquifer, most spring/seep flow rates fall off throughout the dry season, similar to seasonal declines in well water levels.

Typically, in a water supply evaluation, it is assumed that there are no impact to groundwater resources if long-term natural groundwater recharge at a site is equal to or greater than the estimated consumptive use rate. Unfortunately, the THP/TCP analyses assume that project groundwater extraction for irrigation and domestic use are the only consumptive uses of groundwater beneath the site. Other potential consumptive uses at the site such as seasonal/perennial supplies to seeps, springs, and creeks that maintain aquatic and riparian habitats are not addressed. In addition, the cumulative or off-site effects from project groundwater pumping on existing consumptive uses are not addressed. Potential existing adjacent off-site consumptive uses include domestic, agricultural pumping as well as recharge to headwater wetlands, creeks and valley-bottom rivers that maintain water supply and beneficial water quality to aquatic organisms and riparian vegetation.

No Evaluation of Groundwater Safe Yield and Potential Pumping Impacts

The Erosion Control Plan states (pages 7-8), "no significant impacts to the local stream flows will be expected or could be measured by the presence of adjoining property wells or the existing well on the vineyard property." There is no data or scientifically-based rationale for this statement presented in the THP or TCP. Based on a sound understanding of hydrogeologic principles, aquifer descriptions from available reports and literature, and experience in conducting aquifer tests in similar lithologies along the Marin Coast, it is my opinion that the project could significantly and adversely impact groundwater levels in area wells as well as diminish spring/seep flows that serve as important summer supplies to area creeks.

Resource management regulations for Sonoma County contained in the Sonoma County General Plan provide a good example of the scientific consensus regarding the information and technical analyses needed to evaluate safe yields from groundwater sources, especially in water scarce regions like the project area. Policy RC-3h, adopted in 1989, requires proof of adequate groundwater supply for discretionary projects in Class III and IV areas. Pursuant to Figure RC-2a of the General Plan, entitled, "Schematic Map of Areas Subject to Resource Conservation Policy Requirements", the Roessler project site lies within a Class III area. More specifically, Policy RC-3h may deny discretionary applications and well permits in Class III areas without a geologic study and report that establishes that groundwater supplies are adequate and will not be adversely impacted by the cumulative amount of additional development.

Stipulations set forth in Section 916.10, 936.10, 956.10 (Domestic Water Supply Protection), Article 6 (Water Course and Lake Protection) of the California Forest Practice Rules may have particular bearing of the sufficiency of the THP in addressing hydrologic impacts. Part (a) of the Section indicates that if the proposed timber operations, "may threaten or degrade a domestic water supply the Director shall evaluate any mitigations recommended prior to the close of the public comment period (PRC 4582.7) and shall require the adoption of those practices which are feasible and necessary to protect the quality and beneficial use of the supply." Because there has been no analysis of potential impacts to groundwater resources, further data collection and analyses is the only way to identify and quantify groundwater impacts and develop a mitigation strategy, if necessary.

Information that is most commonly used to delineate and quantify aquifer size beneath a site includes driller boring-logs for wells. These logs provide descriptions of the characteristics of materials encountered during drilling including rock type and moisture content. Along with a knowledge of surface outcrop locations, descriptions from borings assist in extrapolating individual stratigraphic units between sites. Once an aquifer is identified in the Ohlson Ranch Formation, an aquifer (pump) test is necessary in order to evaluate its water bearing properties of an aquifer. If performed correctly, a well pump test can quantify the maximum pumping rate from the aquifer as well as a storage estimate for the aquifer. These parameters are needed to determine the safe yield from an aquifer.

The boring log and preliminary well yield test data presented in the THP/TCP do not provide the information necessary to evaluate and/or quantify available yields from the well and associated aquifer properties. These data also do not support the conclusion that this well can produce at a sustained rate of 10 gallons per minute (gpm) as repeatedly stated in the THP/TCP. My interpretation of the Well Completion Report No. 808747 and is as follows.

Site maps presented in the THP/TCP indicate two existing well locations on the site property: one near the northwest corner of the parcel and the other centrally located along the northern property boundary. Review of geology maps for the area indicate that the Ohlson Ranch Formation only underlies the northern boundary of the project property. I can not determine from the boring log if this 160-foot deep well is completed in Ohlson Ranch or Franciscan Complex. However, I suspect the well is screened in Franciscan Complex rocks as the Ohlson Ranch Formation would be relatively thin along the margins and would not likely be 160-feet thick at the edge of the ridge. The well is screened from 40- to 160-feet below ground surface (bgs) with filter pack extending from the bottom of the boring to 20-feet below ground surface. A 20-foot sanitary seal from 0- to 20-feet bgs (composed of bentonite clay) is likely a County requirement. The filter pack material is pea gravel which also leads me to think the well is screened within the Franciscan Complex. A finer grained sand would typically be required in the inter-annular space between well casing and rock if completed in the fine-grained, less competent Ohlson Ranch Formation – the filter pack is designed to prevent surrounding formation from entering the well screen while maximizing permeability to allow water to enter. High permeability material is preferred, but pea gravel is typically used in well-cemented bedrock wells. The well was drilled with and air rotary drill-rig and water table was encountered at 20-feet bgs.

The estimated yield reported on the log is not representative of the well's sustainable yield. What typically happens after drilling and well construction using an air-rotary drill rig is that a drill stem/pipe is lowered into the well and air is circulated through the stem to lift water out of the well. This process is called well development, and is done to flush dirty water out of the well and to flush the gravel pack. Typically, this development is done until the water coming out of the well runs clear. I assume that the drill stem was lowered to 5-feet off the bottom of the well and the yield from the well was estimated. Well development went on for 2-hours with all the water evacuated out of the well to a depth of 155-feet. Its important to note that this was likely not a pump-test to evaluate the optimum and sustainable yield from the well.

Typically, information that is collected and reported as part of standard aquifer (pump) test of an irrigation well includes:

- Continuous water levels in the pumping wells for a 24- to 72-hour pumping period;
- Water level recordings collected over an equal length of time after pumping has stopped to monitor the rate and extent of water level recovery;
- The pumping rate that produces an equilibrated (i.e. non-varying) water level condition after a reasonable duration of pumping (also at a conservative level above the pump to minimize exposure of the pump intake to air); and
- Impacts on surrounding wells, springs/seeps, and creeks.

Such an evaluation is necessary to make any defensible conclusion regarding sustainable yield of the pumped well, available water supply, and potential impacts to surrounding wells and other groundwater resources. The data presented in the THP/TCP is insufficient for estimating these parameters.

Lack of Cumulative Effects Impact Assessment

Much of the discussions pertaining to water supply and groundwater above attempt to rationalize why the surface water-groundwater interactions and the cumulative effects of project withdrawals need to be characterized for the Brushy Ridge-Ohlson Ranch aquifer system. The Roessler THP/TCP falls short in effectively evaluating the charactering potential impacts associated with the cumulative effect of local land-use changes and domestic/agricultural development.

In addition to the spatial and density distribution of sources of contributing impacts, the hydrology and water development reports submitted as part of the THP/Conversion solely describe the perceived changes associated with a discrete variable. This is a flawed approach, as it does not consider the cumulative/net effects of additive or competing processes and variables. A proper evaluation should also account for and integrate surface water (e.g., runoff, infiltration, etc.) and groundwater (e.g., withdrawals) conditions and processes. These hydrologic processes are intrinsically linked at the project site and conclusions suggesting there will be no change in runoff patterns or there is no link between surface water and groundwater resources are inaccurate without characterizing and simultaneously evaluating the other dominant processes at play (e.g., increased runoff, reduced infiltration, groundwater withdrawals, etc.).

If you have any questions or wish to discuss any opinions in this letter, please call me.

Sincerely,

Greg Kamman
Principal Hydrologist

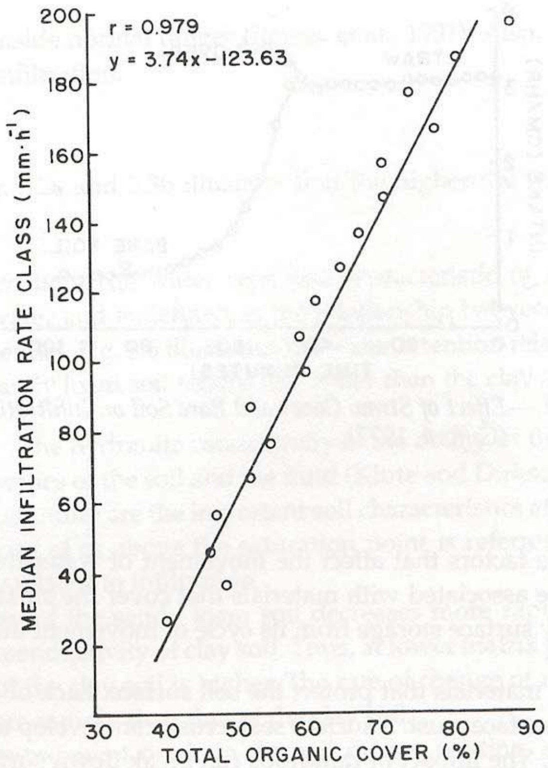

Figure 3.8.—Relationship of Median Infiltration Rate Classes with Total Organic Cover (%), Edwards Plateau, TX (Thurow, 1985).

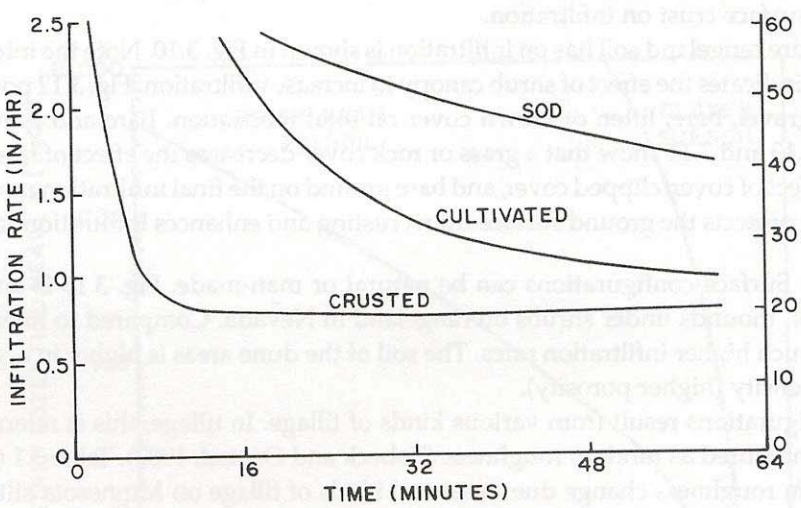

Figure 3.9.—Effect of Surface Sealing and Crusting on Infiltration Rate for a Zanesville Silt Loam (Skaggs and Khaleel, 1982).

Source: ASCE, 1996 (see Footnote 2)

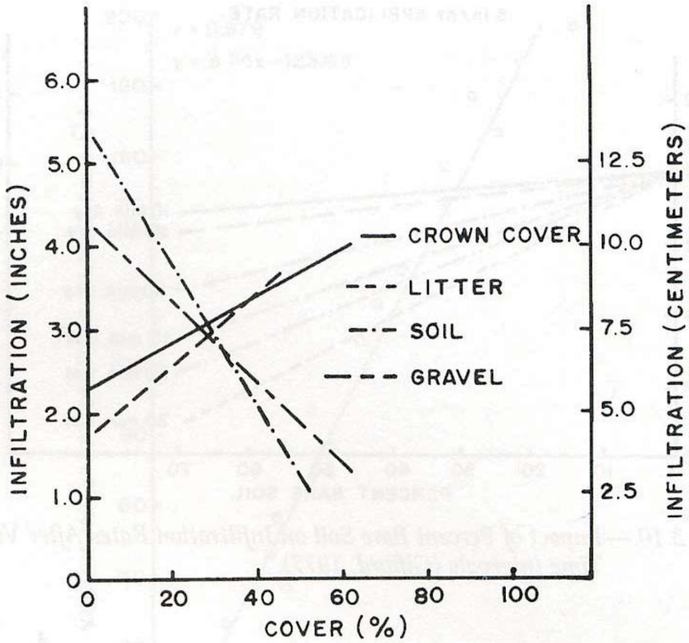

Figure 3.12.—Relationship of Various Covers to Infiltration Rates (Gifford, 1977).

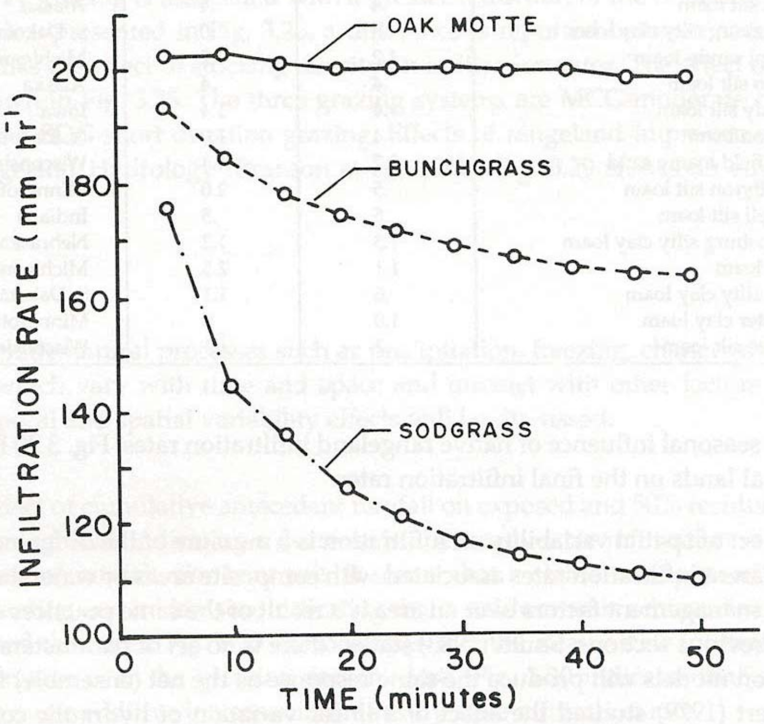

Figure 3.22.—Mean Infiltration Rates for Three Vegetation Types, Edwards Plateau, TX (Thurow et al., 1986).

Source: ASCE, 1996 (see Footnote 2)

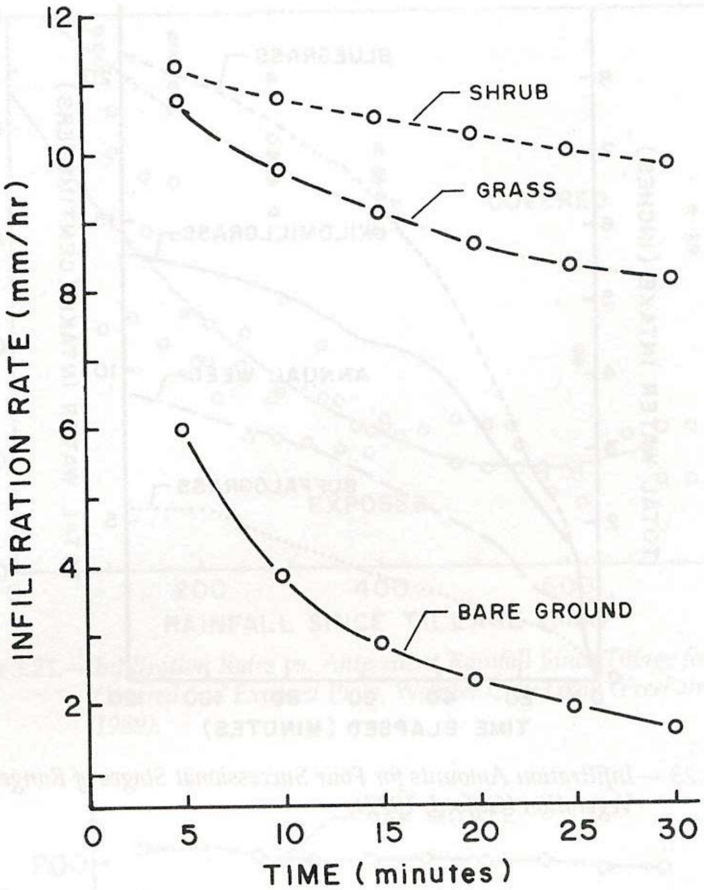

Figure 3.24.—Mean Infiltration Rates for Shrub (GRBI), Grass (CHRO), and Bare Ground (BAGR) (Mbakaya, 1985).

Source: ASCE, 1996 (see Footnote 2)