THE CAMPO EIS

The government agencies, nonprofit organizations, and private citizens who commented on the Campo EIS raised a wide variety of concerns: the alleged lack of demand for additional landfill capacity in San Diego County; the effect of the project on the value of surrounding properties; the possibility that earthquakes might lead to a catastrophic failure of the containment systems; and the litter, noise, traffic congestion, and air pollution that the project might generate.

The comments ranged from the ethereal to the earthy. The San Diego Astronomy Association, a nonprofit educational organization whose observatory is within two miles of the project site, expressed concern that landfill operations would raise dust, which would scatter light, degrading viewing conditions at "one of the finest locations for observational astronomy on the North American continent."[11] One BAD supporter eschewed technical comments, simply characterizing the two-volume draft EIS as an "abhorrent waste of taxpayer monies by the leeches of society representing a bloated bureaucracy."[12]

The unifying themes of the critical comments were an overriding concern with the possibility of groundwater contamination, a distrust of government, and a defiant resolve to

stop the project. A Boulevard resident addressed an open letter to "all the 'BIG WHEELERS' and 'DEALERS' who have been lying to us" concerning the project. "This is the only water and air we've had, have, or ever will have out here," he wrote. "*We've worked* all our lives for what we have, and we are not going to 'roll over' at the 'whim' of some 'self-important, arrogant' people or companies with a great deal of *money* to *buy 'boot-lickers.'*"[13]

Donna Tisdale's mastery of the EIS process would be the envy of any environmental lawyer. BAD submitted lengthy comments on every aspect of the EIS and coordinated with other organizations submitting comments. Donna testified at all three of the public hearings held on the EIS by the Bureau of Indian Affairs, and at times almost seemed to function as the hearing officer as she orchestrated the order of witnesses and asked the forbearance of the more unruly of her supporters. Nevertheless, Donna seemed no more inclined than other BAD members to trust the system she had mastered or to accept its outcome if it were adverse to her cause. "I have also heard that Ron Jaeger, the California Director of B.I.A., has called me a troublemaker," she testified at one of the hearings. "And in defense, well, I could be. Just don't cross me. All we're trying to do is cooperate with the system. And if the system doesn't work, then we will be troublemakers."[14]

By far the most serious concern raised by BAD is the possibility of groundwater contamination. Just how high the stakes are for Donna and her neighbors was established in a separate administrative proceeding. Under a provision of the federal Safe Drinking Water Act, BAD submitted a petition asking EPA's Region 9 to determine that the proposed landfill would be located above an aquifer that is the "sole source" of drinking water in the vicinity.

At the public hearing conducted by EPA, the supporters of BAD again expressed a sense of alienation from government, with one witness declaiming: "This is the age of Ross

Perot. This is the grass roots people that are fed up with you politicians telling us how it's going to be. We're tired of you stickin' shit down our throat. We ain't havin' it anymore. You know, people are rising up and we're throwing you out of office. If you don't start wisin' up and doin' what the people want, you're history."[15]

After reviewing hydrogeological studies of the area, Region 9 determined that the Campo/Cottonwood Creek aquifer does meet the statutory criteria for designation as a sole source aquifer: the people in a four-hundred-square-mile area draw almost all of their drinking water from domestic wells tapping into the aquifer. Economically feasible alternative sources of drinking water are not available. Building a pipeline to the isolated, sparsely populated area would be prohibitively expensive; a comparable project in San Diego County a decade earlier had cost approximately $170 million. Moreover, the exploding population of southern California has long since outstripped the water supply; the water supply agencies serving San Diego County would not be willing to annex the area. In the absence of practicable alternative sources of drinking water, contamination of the aquifer would create a significant hazard to public health.[16]

As Donna had understood it would be, the sole source aquifer designation was largely a symbolic victory for BAD. Under the federal Safe Drinking Water Act, the practical effect of a designation is that federal financial assistance is not available to a project that the EPA administrator determines may contaminate a sole source aquifer. However, the Campo landfill project is not federally financed. Therefore, the designation gave EPA no additional leverage.

OF OPEN DUMPS, DRIP COFFEE MAKERS, AND WITCHES' BREW

A facility of the sort proposed by the Campos is known as a *municipal solid waste landfill.* The change in terminology re-

flects more than an exercise in euphemism. The open dumps in which most United States waste was deposited until recently lacked important pollution controls that are incorporated into many modern landfills.

One of the most common pollution problems associated with an open dump is that rainwater seeping through the garbage may contaminate the groundwater underneath the dump, with a poisonous plume of contaminated leachate possibly spreading well beyond the boundaries of the facility. The formation of leachate can be illustrated by comparing an open dump with a drip coffee maker. The dry coffee is the garbage, the water poured into the top is rainwater, and the dark, brewed coffee dripping out of the bottom is leachate.[17] Leachate is a witch's brew because the waste through which it percolates is laced with toxic substances.

Unlike dumps, which accepted industrial waste as well as municipal garbage, modern municipal landfills do not accept hazardous waste, as such. The major source of potential contamination in the waste that would be accepted by the Campo landfill is household hazardous waste. There is no standard definition of this term. However, *household hazardous waste* is generally understood to include such common items as home maintenance products (e.g., paint, paint thinner, stain, varnish, and glue) and yard maintenance products (e.g., pesticides, insecticides, and herbicides). In most cases these products are not hazardous while in storage, or during use if properly handled, but they release potentially toxic substances after they have been discarded. More than one hundred substances listed as hazardous under the federal Resource Conservation and Recovery Act are present in household products, including metals (e.g., mercury, lead, and silver) and organic chemicals (e.g., trichlorethylene, benzene, tuolene, and parathion).

The United States Congress' Office of Technology Assessment summarized a number of studies of the household hazardous waste component of municipal solid waste. In two

communities—New Orleans and California's Marin County—the household hazardous waste was sorted out of the trash from single-family dwellings and weighed. Between 0.35 and 0.40 percent of the total municipal solid waste was considered hazardous, and each household threw away an average of fifty to sixty grams (approximately two ounces) of household hazardous waste each week. Other studies in Albuquerque and the Puget Sound area in Washington reached similar conclusions: In general, household hazardous waste comprises less than one percent of municipal solid waste.

Data from other communities indicated that the hazardous constituents themselves were present in even lower quantities—less than 0.2 percent.[18] Assume for the sake of argument that 0.2 percent is the correct figure. There would still be ample cause for concern, for if the Campo landfill were to accept waste at the projected rate of 3,000 tons per day, it would receive 12,000 pounds of household hazardous waste each day.

THE CAMPO DESIGN EXCEEDS STATE AND FEDERAL REQUIREMENTS

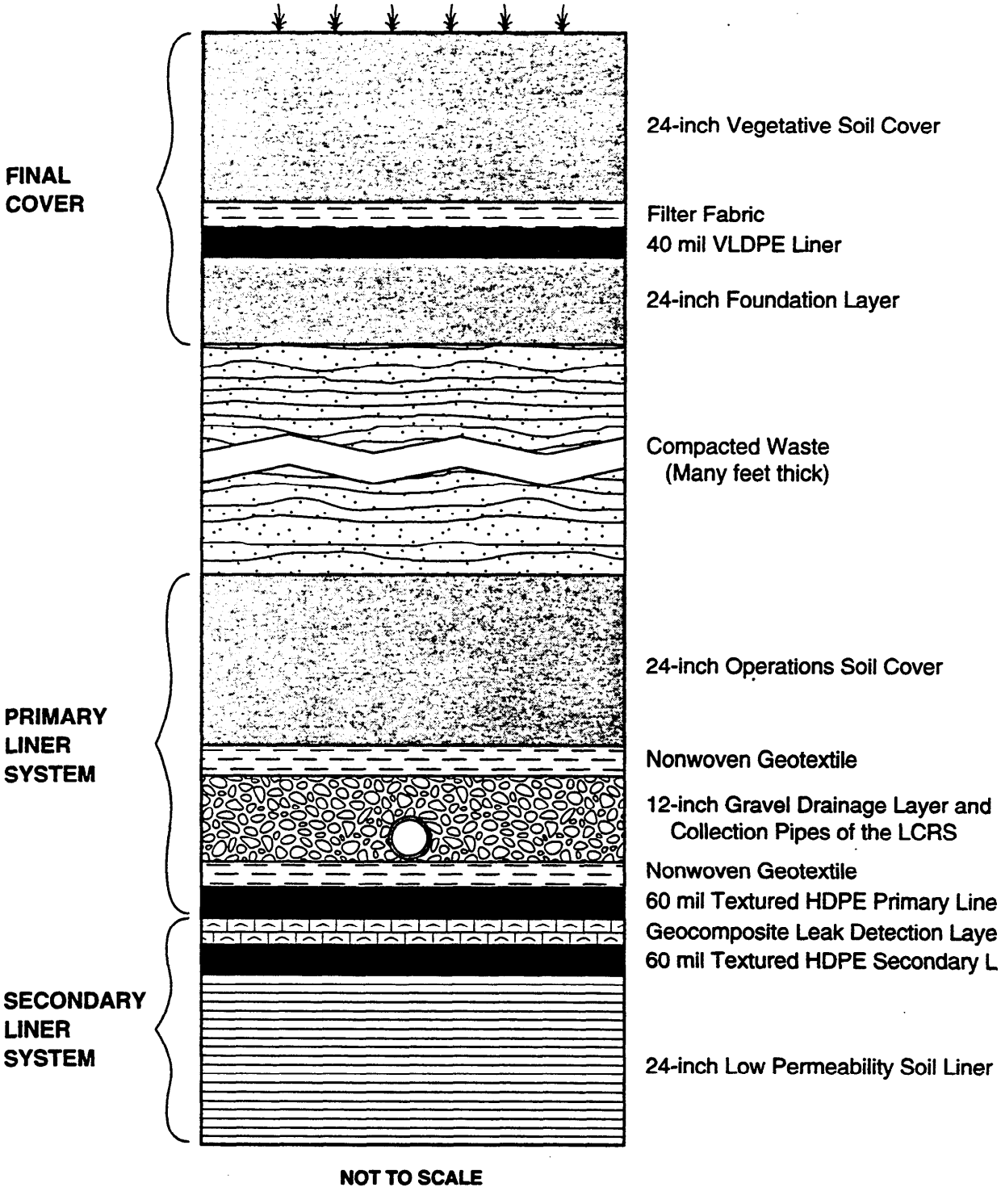
The Campos do not deny that household hazardous waste leaching from a landfill can pose a serious threat of groundwater contamination. The Campos contend, however, that their facility would not pose such a threat because the design specifications of the landfill regulations the tribe has adopted are more protective than the standards required by either the federal government or the state of California. To explain the design features of the proposed Campo facility, we shall return to the comparison of an open landfill with a drip coffee maker. Again, the dry coffee is garbage, the water poured into the top of the coffee maker is rainwater, and the brewed coffee dripping out the bottom is leachate. A modern landfill might be described as a kind of anti–coffee maker. That is, there is a "lid" on the top of a modern landfill to prevent the

infiltration of moisture into the garbage, and one or more liners on the bottom to prevent the escape of any leachate that does form. The design of the Campo landfill incorporates both of these features. It would have a cover to prevent rainwater from entering the landfill and forming leachate, and it would have a *double* liner and leachate collection system.

The final cover over the landfill would be eight feet thick. There would be three feet of soil over the waste, including twelve inches of low-permeability soil. That layer of soil would be covered by a 40-mil synthetic liner. (By comparison, the "commercial strength" lawn bags one buys at the grocery store are 1.4 mil thick.) The liner, in turn, would be covered by another five feet of soil.

There would be two *liner systems* underneath the waste. The primary liner system is intended to collect any leachate that forms in the landfill. The primary liner would be a 60-mil high-density polyethylene. The leachate collection system above the primary liner would consist of twelve inches of gravel containing six-inch perforated collection pipes. A two-foot layer of soil would be placed above the gravel to protect the collection system and primary liner from the overlying waste. The secondary liner system is intended to detect and remove any leachate that migrates through the primary liner system. Leachate from both collection systems would drain to sumps; when the sumps were full, the leachate would be tested to determine whether it was hazardous and it would then be disposed of appropriately.[19]

The importance of these design features should not be underestimated. When the Campo project was announced, only one percent of existing landfills had synthetic liners to prevent the escape of leachate, and only eleven percent had systems to collect and remove leachate. In the absence of such safeguards, it is not surprising that 184 municipal landfills had by 1986 made the United States Environmental Protection



Typical profile of landfill containment system

Agency's Superfund list of the most contaminated sites in the nation.[20] Nor is it surprising, though it is tragically ironic, that the legacy of contamination at older landfills has made it next to impossible to gain community acceptance for proposals to open new, safer facilities.

Some critics believe that modern landfills that comply with the latest federal requirements still pose an unacceptable risk of groundwater pollution. They point out that landfill covers may deteriorate; that synthetic liners are not perfectly impermeable and may be defectively manufactured or improperly glued at the seams; and that leachate collection systems may become clogged with silt or microorganisms, corroded by chemicals in the leachate, or simply smashed by the tons of overlying waste.[21]

For those of us who are not scientists or engineers, the difficulty of maintaining landfill covers may be more easily understood than the problems associated with landfill liners or leachate collection systems. Because a landfill cap is designed to be relatively impermeable, rain will run off it at a velocity determined by the quantity of the rain and the slope of the cap. Unfortunately, some of the cap soil may be carried away with the runoff, contributing to sheet and rill erosion, and, ultimately, gullying of the cap. Moreover, as the soil dries, cracks will form. Subsequent rains will penetrate the cracks. In winter, moisture in the cracks may freeze and expand, widening the cracks. To minimize rain and wind erosion, vegetation may be planted. However, as the roots of the plants penetrate the cap, they may compromise its physical integrity. Moreover, plants provide cover and food for burrowing animals. One study revealed that mice, shrews, and pocket gophers can move 10,688 pounds of soil to the surface per acre per year. Earthworms alone can have a substantial impact, passing from two to fifteen tons of soil through their digestive tracts per acre per year. The holes left as earthworms move through the soil increase water infiltration.

Writing in the industry publication *Waste Age*, David I. Johnson of Michigan State University observes: "At this point, you may well say, 'If we plant, we're encouraging plant and animal penetration of the clay cap. If we don't plant, we get erosion or freeze-thaw destruction of the cap.'" "Unfortunately," Johnson points out, "that is one of the fundamental dilemmas left us by the normal processes of change in the natural world, be they the progressive conversion of a grassy field to a forest or the utilization of cracks in concrete sidewalks by ants and dandelions. This same successional development process," Johnson concludes, "will detrimentally affect long-term landfill cap integrity."[22]

Potential problems with the landfill cover, liners, and leachate collection systems were raised by some of the organizations and individuals who commented upon the draft environmental impact statement. The final environmental impact statement included responses to comments raising such concerns. For example, penetration of the landfill cap by roots or burrowing animals was acknowledged to be a "serious concern." To address the concern, Campo EPA regulations require that the vegetation growing on the landfill be of a type having roots "no deeper than the top layer of cover soil, and that the soil be deep enough to prevent penetration of the cap by burrowing animals." For this reason, the response explained, Campo EPA had decided to require that the top layer of soil be five feet deep, rather than the two-foot depth originally proposed.[23] As for the liners, the response to comments stated that appropriate quality control/quality assurance measures would be taken during the manufacture and installation of the liners to ensure their integrity. For instance, all the seams in a liner would be field tested and a certain number of the seams would be laboratory tested.[24] Turning to the leachate collection systems, the response to comments indicated that, for example, clogging would be prevented by flushing the systems periodically.[25]

The Campo landfill would be significantly safer, the final environmental impact statement concluded, than a landfill satisfying minimum federal design criteria, which require less durable covers and specify single-liner rather than double-liner containment systems. The probability of a *failure* in one or more cells of the Campo landfill was analyzed. A failure was defined as a breach of all lines of defense. In the case of the Campo landfill, this would mean, simultaneously, failure of the final cover, which would permit rainwater to enter the landfill and migrate through the waste; failure of the leachate collection and removal system; failure of the primary liner; failure of the leak detection system; failure of the secondary liner; and failure of the low-permeability soil underlying the secondary liner. Failure of less than all of these components within a single phase of the landfill was not considered likely to result in release of leachate from the landfill.

The cumulative probability of a failure of a landfill meeting the minimum federal design criteria is about 70 percent over a period of 150 years, according to the final environmental impact statement, whereas the cumulative probability of a failure of a landfill of the Campo design is only 3 percent over the same time period. "In terms of reliability, this means that the proposed Campo design is 97 percent reliable when considered over the time period that includes 30 years of operation, 30 years of post-closure maintenance, and 90 years of no activity. . . . At 100 years after startup, the proposed Campo design is expected to be 99.8 percent reliable, compared to a reliability of 78 percent for a federally compliant design."[26]

BUT IS THE SITE FATALLY FLAWED?

Though a landfill of the Campo design may be significantly less likely to experience a failure than a landfill merely meeting minimum federal design criteria, the Campo landfill would still be required by EPA's municipal solid waste landfill regula-

tions to have a system of wells to monitor whether contaminated leachate is escaping into the groundwater.

If there is a fatal flaw in the proposed Campo landfill, it inheres in the nature of the rock underlying the project site. There are two types of rock, differentiated by their degree of weathering and decomposition. Weathered and highly decomposed bedrock extends to a maximum depth of 110 feet beneath the surface of the proposed facility. The weathered bedrock is soft and crumbles easily. Unweathered bedrock, which is resistant to the blows of a hammer, lies beneath the weathered bedrock.

It is the unweathered bedrock that is the cause of concern. It is igneous rock—that is, it was formed by the cooling and consolidation of magma. Igneous rocks tend to form *fracture systems* as they cool or react to other geologic forces. These fracture systems serve as conduits for groundwater while making it difficult, perhaps impracticable, to monitor its movement and quality.

Under EPA's regulations, the system of monitoring wells surrounding a landfill must be adequate to detect whether the groundwater passing underneath the landfill is becoming contaminated. When the regulations were proposed in 1988, EPA sought comment on the question of whether landfills should simply be prohibited in certain sorts of hydrogeologic formations because of the inherent difficulty of monitoring groundwater in such formations. The preamble to the proposed rule stated: "Some geologic settings that could preclude effective groundwater monitoring are fractured bedrock where complex fractures and joint systems impeded flow direction prediction."[27]

In response to comments that landfills should be foreclosed from locating in unmonitorable areas, EPA said that it agreed. However, rather than adopting a rule that would have precluded siting a landfill above fractured bedrock, EPA sought to deal with the matter on a case-by-case basis through its

groundwater monitoring requirements. Under the regulations, a landfill cannot be sited above fractured bedrock, unless the developer can demonstrate the feasibility of adequate groundwater monitoring. In other words, the burden of proving that the groundwater monitoring requirements can be satisfied at the proposed site is on the project proponent.[28] In its comments on the final environmental impact statement prepared on this project, EPA Region 9 concluded that MidAmerican had not carried that burden of proof.

WHAT ARE DNAPLS, AND WHY SHOULD WE CARE?

To illustrate its concerns about the feasibility of monitoring groundwater in fractured bedrock for possible contamination, EPA hypothesized that leachate containing a *dense nonaqueous phase liquid* or *DNAPL*, like the tetrachloroethylene found in cleaning solvents, made its way through the landfill's two liner and leachate collection systems.

Nonaqueous phase liquids are organic compounds that tend not to mix with water, dissolving very slowly. A dense nonaqueous phase liquid—that is, one having a density greater than does water—tends to sink through groundwater. Common dense nonaqueous phase liquids include chlorinated solvents like tetrachloroethylene—a man-made substance widely used for dry cleaning fabrics and textiles and for metal-degreasing operations.

Spot remover containing tetrachloroethylene is likely to be included in the household waste reaching the proposed Campo landfill. Tetrachloroethylene is thought to be capable of causing cancer in humans.[29] Accordingly, health-based standards for maximum concentrations of DNAPLs in groundwater have been established at five parts per billion. The release of just sixteen ounces of spot remover containing tetrachloroethylene could contaminate twenty-five million gallons of water to levels unsafe for human consumption.

If a failure of the Campo landfill containment systems re-

sulted in a release of a DNAPL like tetrachloroethylene, a slug of the material would migrate downward through the unsaturated zone above the groundwater table and then through the pore spaces of the weathered bedrock within the saturated zone. The slug of DNAPL would dissolve slowly into the groundwater as it penetrated the saturated zone of the weathered bedrock. The groundwater contaminated by the dissolving DNAPL is known as the *dissolved phase.* The dissolved phase of the contaminant would be carried along with the groundwater as it flowed through the weathered bedrock toward the boundary of the landfill.

Where groundwater flows through relatively homogenous, porous rock, such as the weathered bedrock at the Campo site, a plume of a dissolved-phase contaminant disperses across a wide volume of an aquifer. Therefore, the system of wells Mid-American has designed to monitor the groundwater flowing through the weathered bedrock should detect the release of a contaminant that dissolved sufficiently. However, because DNAPLs dissolve very slowly, a concentrated slug of tetrachloroethylene might migrate through the unweathered bedrock undetected.

Upon reaching the base of the weathered zone, the slug could drain into any one of the numerous fractures in the unweathered bedrock, further dissolving into the groundwater contained within the fracture as it continued to migrate downward. In its comments on the final environmental impact statement, EPA Region 9 expressed serious misgivings as to whether a slug of DNAPL migrating down such a fracture would be detected by the system of monitoring wells Mid-American planned to drill into the unweathered bedrock.

A monitoring well along the landfill boundary would have to be drilled to a depth of over four thousand feet, EPA pointed out, to intercept a slug of DNAPL seeping down a continuous fracture that dipped at an angle of sixty degrees. "The footprint of the facility overlies the traces of approx-

imately 50 such fractures, some greater than 0.5 mile in length. Because fractures are intercepted by other fractures at depth, groundwater contaminants would likely follow an unpredictable path from fracture to fracture beneath the site," EPA noted.[30]

In explaining his concerns to me, an EPA staff hydrogeologist used the following illustration: Detecting the release of a DNAPL in the fractured bedrock underlying the Campo landfill site "would require interception of a moving line (the slug) along a plane (the fracture) by a point (the well). If one of the numerous fractures were likened [to a] football field inclined below the surface, the chance of finding the contaminants from the facility boundary with a [monitoring well drilled into the unweathered bedrock] would be similar to successfully spearing a worm crawling along the fifty-yard line with a needle from over a distance of four thousand feet above while wearing a blindfold."

The comments filed by the staff of the California Integrated Waste Management Board regarding the final EIS echoed EPA's concerns regarding the monitorability of groundwater in fractured bedrock. "The proposed composite liner will eventually leak due to construction flaws, seismic events, and operator error. This is a reality and an unavoidable event," the waste board emphasized. The landfill's groundwater monitoring system, therefore, must be capable of "detect[ing] the escape of pollution quickly and prevent[ing] its entering the complex fracture aquifer. [However, w]ithout an exact knowledge of the location and nature of the fracture zones beneath and adjacent to the proposed landfill, such a ground-water monitoring system cannot be properly designed," the waste board continued. Important tests performed by Mid-American concerning the fracture zone were "inconclusive," the waste board found. "Until the location and nature of the fractured bedrock system can be accurately described it is not possible to propose measures that will assure mitigation of potential

groundwater contamination. Additional hydrogeologic studies need to be conducted to provide that kind of information," the waste board concluded.[31]

Mike Connolly believes that the waste board staff spoke out of turn in making these comments. He notes that AB 240 gives the State Water Resources Control Board, not the state waste board, responsibility for water quality issues arising under a cooperative agreement between the state and a tribe concerning a reservation landfill project. The waste board itself, as distinguished from its staff, has not addressed the question whether the site is monitorable, and because of the division of duties under AB 240, is not expected to. Nor has the state water board addressed the monitorability issue, although it may do so when it reviews the license to operate the Campo landfill, assuming that the Campo EPA in fact grants such a license to Mid-American.