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**STATE OF CALIFORNIA**
**STATE WATER RESOURCES CONTROL BOARD**

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| In the Matter of the Petitions of<br><br>ELFIN FOREST COALITION,<br>QUESTHAVEN MUNICIPAL WATER DISTRICT<br>and CHRISTWARD MINISTRY<br><br>For Review of Waste Discharge Requirements Order No. 92-02 of the California Regional Water Quality Control Board, San Diego Region, for Vertical Expansion of the San Marcos Landfill in San Diego County. Our File Nos. A-782 and A-782(a). | **ORDER NO. WQ 93-8** |

BY THE BOARD:

## I. INTRODUCTION

On January 22, 1992, the California Regional Water Quality Control Board, San Diego Region (Regional Water Board), adopted Order No. 92-02 prescribing waste discharge requirements for the discharge of nonhazardous solid wastes to a vertical expansion of the San Marcos Sanitary Landfill, an existing unlined Class III waste management unit in San Diego County. The expansion project is being proposed by the County of San Diego (County). Elfin Forest Coalition, Questhaven Municipal Water District and Christward Ministry (petitioners), residents or property owners of the surrounding area, oppose expansion of the landfill, and have raised technical objections to the waste discharge requirements adopted by the Regional Water Board.

## II. BACKGROUND

The existing landfill operates under requirements contained in Order No. 78-78 of the Regional Water Board. The

requirements authorized the discharge of approximately 11.3 million cubic yards of nonhazardous solid waste at a 103-acre waste management unit located on a 205-acre site in a tributary canyon of Copper Creek. Copper Creek flows intermittently into Escondido Creek (a perennial stream approximately two miles south of the landfill). The existing landfill is in the San Elijo hydrologic subarea approximately one mile south of San Marcos Lake and six miles east of the Pacific Ocean.

The Regional Water Quality Control Plan for the San Diego Region (Basin Plan) identifies municipal and domestic supply as beneficial uses of the surface and ground water in the San Elijo hydrologic subarea; the surface waters are also used for water contact recreation, warm and cold fresh water habitat, and the preservation of rare and endangered species. Water quality objectives for the entire San Elijo hydrologic subarea have been relaxed above drinking water standards for chloride, sulfate, and total dissolved solids due to the Regional Water Board's assessment of background water quality in this hydrologic subarea (Regional Water Board Staff Response to Petitions for Review of Regional Water Board Order No. 92-02, Waste Discharge Requirements for the County of San Diego, San Marcos Sanitary Landfill, dated September 14, 1992, page 8).

The landfill site and surrounding area is underlain by a highly fractured bedrock formation known as the Santiago Peak Volcanics. The Santiago Peak formation exhibits widespread variability not only in degree of fracturing and weathering, but also in geochemistry. For example, local mineralized areas south

and west of the present landfill along Copper Creek were the subject of limited historical prospecting and mining for copper. Natural heterogeneity in fracturing, weathering, and geochemistry contributes to the variability in ground water occurrence and chemistry observed at and around the site. Local sources of recharge (e.g., rainfall, intermittent stream flow, irrigation return water, landfill leachate) also affect local ground water occurrence and chemistry.

Ground water underlying the area is limited in quantity and variable in quality. There are only minor alluvial deposits in the vicinity of the landfill. These deposits may be saturated during intermittent rainstorms, but do not provide reliable or persistent ground water storage. Existing monitoring wells completed in the limited alluvium west of the landfill in the Copper Creek area have contained ground water in the past, but were dry as of August 1991. The U.S. Geological Survey (USGS) reported in a 1983 study of the San Elijo hydrologic subarea that ground water in the alluvium was "of limited value" because of water quality problems with respect to chloride, sulfate, and total dissolved solids.

Ground water occurs primarily in fractures and in weathered zones within the Santiago Peak Volcanics. According to the USGS survey, ground water production from these fracture zones ranges from less than 2 gallons per minute to 125 gallons per minute. Seasonal springs and seeps have been observed in the vicinity of the landfill where intermittent water-bearing fractures intersect the ground surface. The most complete

historical data from monitoring well SMGW-16 indicate that ground water levels in the fractured bedrock were at least 35 feet lower in the summer of 1991 (after years of extended drought) than in the spring of 1984.

The 1983 USGS report did not comment on water quality with respect to fractured bedrock. Rather, it acknowledged the fact that "little information is available on ground water in the San Elijo hydrologic subarea". However, water samples taken from several monitoring wells completed in fractured bedrock in the immediate vicinity of the landfill meet recommended secondary drinking water standards for these constituents. Therefore, ground water in the vicinity of the landfill is currently suitable for use as drinking water, at least locally. Conversely, samples from other monitoring wells in the immediate vicinity of the landfill contain concentrations of chloride, sulfate, and total dissolved solids that are substantially higher than these good quality waters. There is no consistent pattern to the distribution of wells that yield good quality waters and those that yield water with higher concentrations of pollutants.

The Regional Water Board noted the potential for water from seeps in the canyon to infiltrate the landfill wastes and Order No. 78-78 included requirements for the County to intercept leachate flowing through the fractured bedrock. The County installed extraction wells along the toe of the landfill and, in 1979, began installing a drainage network in the floor of the canyon to collect leachate and convey it to a lined retention pond. The unlined "underdrain" was excavated about 7-18 feet deep

by 10 feet wide into highly-fractured bedrock in the preexisting canyon for a cumulative length of about 2,500+ feet. The volume of flow from the underdrain varies from a routine flow of 3-5 gallons per minute (gpm) to wet weather flows in excess of 10 gpm. Samples from the retention pond, including the recent submittals from the County, contain dissolved concentrations of several volatile organic compounds characteristic of leachate from solid waste.

In 1980 the Regional Water Board directed the County to investigate possible violations of Order No. 78-78 associated with leachate seepage. The County subsequently relocated its ground water monitoring and leachate extraction wells to address this issue and to bring its monitoring system into compliance with our revised regulations governing monitoring for discharges of waste to land which were adopted in 1984. In 1987, pursuant to Water Code Section 13273, the County submitted to the Regional Water Board a Solid Waste Assessment Test (SWAT) report indicating that volatile organic constituents were detected in several monitoring wells. More recent monitoring also discloses the presence of such constituents.

The San Marcos Sanitary Landfill is approaching the maximum capacity contemplated by Order No. 78-78. The maximum anticipated elevation of the discharge subject to Order No. 78-78 was 750 feet above sea level. The County proposes discharging an additional 8.75 million cubic yards of waste to a "new" waste management unit located on top of the waste in the existing unlined landfill. The highest elevation of the expanded landfill

would be about 200 feet higher than the existing landfill, at an elevation of 950 feet above sea level.

In 1990 the County submitted a Report of Waste Discharge (ROWD) to the Regional Water Board for the proposed vertical expansion. The County proposes to install a clay liner and leachate collection and removal system (LCRS) between the existing unlined unit and the new vertical expansion as an "engineered alternative" to site characteristics capable of preventing the impairment of beneficial uses of waters of the State.

By Order No. 91-25 (March 11, 1991) the Regional Water Board prohibited vertical expansion of the landfill based on its finding that the information submitted in the County's ROWD failed to demonstrate that the existing site of the San Marcos Sanitary Landfill would satisfy the siting criteria for a Class III waste management unit.

The County undertook an extensive site investigation to remedy the deficiencies in its initial ROWD. Due to the Regional Water Board's budgetary constraints, the County provided funding for the Regional Water Board to hire a technical consultant to review the supplementary technical reports submitted by the County. The Regional Water Board's consultant was directed to assess the potential impact of the proposed expansion on beneficial uses of ground and surface waters and to assess whether or not the mitigation measures proposed by the County would conform to the provisions of our regulations governing discharges of waste to land (codified as Chapter 15 of Division 3 of Title 23

of the California Code of Regulations (23 C.C.R. §§ 2510-2601, Chapter 15)).

The Regional Water Board relied on the consultant's assessment of the technical documentation in its deliberations regarding the County's renewed application for waste discharge requirements for the vertical expansion of the San Marcos Sanitary Landfill and concluded that the vertical expansion could be undertaken in a manner that would "result in the reasonable protection of the beneficial uses of ground and surface waters" (Regional Water Board Staff Response, page 6). The Regional Water Board found that, while the site itself was not suitable for a Class III waste management unit, the County's proposal to install a liner beneath the vertical expansion, together with the existing system of underdrains and leachate interception wells, would satisfy our criteria for an engineered alternative to the requirements prescribed in Chapter 15. The County proposed and the Regional Board Order No. 92-02 incorporated the following measures:

a. A minimum 2-foot thick clay liner with permeability of $10^{-6}$ cm/sec to cover the entire existing landfill;

b. Immediately above the clay layer a 12- to 18-inch thick permeable "sand" layer will be placed to serve as a leachate subdrain layer;

c. Multiple 12-inch clay intermediate cover layers at 20-foot intervals within the 200-foot thick lift, each layer having a permeability of $10^{-6}$ cm/sec;

d. Daily cover having a permeability of approximately $3 \times 10^{-5}$ cm/sec will be used on the active portion of the landfill to further reduce infiltration;

e. Final cover consisting of a 24-inch compacted foundation of approved soil, a 24-inch clay cap of $10^{-6}$ cm/sec permeability over the foundation layer, a 12-inch vegetative soil cover above the clay layer, and grading of the final surface to facilitate drainage;

f. 3:1 final slopes, clay-capped as described above;

g. Collection and retention onsite of all surface runoff from the landfill resulting from a 24-hour 100-year frequency storm event. The retention basins would be lined to prevent percolation of contents in the event that waste materials were present in runoff from the landfill.

h. Provision of a 1-acre-foot lined basin to retain all discharges from the underdrain system.

i. A landfill gas collection system; and

j. Use of SMGW-30 as a planned hydraulic barrier to prevent downstream migration of leachate in the event that leachate production occurs.

The petitioners contend generally that the requirements contained in Order No. 92-02 are inappropriate because they do not implement our Chapter 15 regulations properly. The petitioners have raised several technical issues in support of this contention.

1. The "engineered alternative" to prescriptive geologic siting requirements does not ensure "equivalent" water quality protection.

2. There is insufficient evidence to conclude that beneficial uses of ground water will not be impaired.

3. The proposed clay liner and leachate collection and removal system to be constructed on top of an

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existing, unlined landfill will not provide reliable containment.*

## III. CONTENTIONS AND FINDINGS

### A. Regulation of Discharges at Municipal Landfills

Review of the contentions raised in the petition involves interpretation of our Chapter 15 regulations governing discharges of waste to land.

In Chapter 15 we established four categories of waste "based on an assessment of the potential risk of water quality degradation associated with each category of waste" (23 C.C.R. § 2520(a)). Each category of waste (with the exception of inert waste) must be discharged only to a suitably classified waste management unit. Waste management unit classifications were crafted to require increasing levels of separation or isolation between wastes and waters of the State for categories of waste that present a greater threat of pollution. Class I waste management units provide the greatest level of containment and isolation and Class III landfills provide the least.

We have classified municipal solid waste as "nonhazardous solid waste" using a definition that echoes the statutory definition of "solid waste" in Division 30 ("Waste Management", commencing with § 40000) of the Public Resources Code (23 C.C.R. § 2523). Nonhazardous solid waste may be discharged at a Class III waste management unit "where site characteristic

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* *All other contentions raised in the petition which are not discussed in this order are dismissed. (Title 23, California Code of Regulations, Section 2052; People v. Barry, 1987, 194 Cal.App.3d 158.) On April 9, 1993, the County requested that the record be augmented to include several documents. By letter dated April 23, 1993, this request was granted in part.*

provide adequate separation between nonhazardous solid waste and waters of the state" and "where soil characteristics, distance from waste to ground water, and other factors will ensure no impairment of beneficial uses of surface water or of ground water beneath or adjacent to the landfill" (23 C.C.R. § 2533). Class III landfills that cannot satisfy these siting criteria must have "containment structures which are capable of preventing degradation of waters of the state as a result of waste discharges to the landfill if site characteristics are inadequate" (23 C.C.R. § 2540(c)).

Within this framework of performance standards, we established statewide minimum standards for the construction of classified waste management units. For example, a Class III unit must have a single clay liner at least 1 foot thick with a permeability of not more than $1 \times 10^{-6}$ cm/sec (23 C.C.R. §§ 2533, 2542) where site characteristics alone do not ensure water quality protection.

Chapter 15 also contains requirements for the technical documentation that must be submitted to the Regional Water Quality Control Board in a ROWD for discharge of waste to land (23 C.C.R. § 2595). The person proposing a discharge must provide all the technical information needed to support any findings required by the regulations and must demonstrate that the proposed discharge will be in compliance with the applicable provisions of Chapter 15. It explicitly requires that all hydrologic, geologic, and engineering information necessary to design, evaluate, and

monitor a project involving discharges of waste to land be submitted to the Regional Water Quality Control Board.

Chapter 15 specifically authorizes the Regional Water Quality Control Boards to prescribe more stringent requirements as needed at each site to protect water quality in accordance with the performance standards applicable to each category of waste management unit (23 C.C.R. § 2510(a)). The regulations also provide that where the discharger can demonstrate that it is not feasible to comply with the prescriptive standards, a Regional Water Board can consider an "engineered alternative" to the prescribed standard, provided that the engineered alternative conforms to any applicable performance standard and provides a level of protection for water quality that is equivalent to the prescribed standard (23 C.C.R. § 2510(b)).

In addition, it should be noted that the United States Environmental Protection Agency has promulgated nationwide standards for discharges of solid waste at "municipal solid waste (MSW) landfills" under Subtitle D of the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. § 6940, et seq.). These standards, contained in Part 258 of the federal environmental regulations (Title 40 of the Code of Federal Regulations (C.F.R.)), are directly applicable to owners and operators of MSW landfills (regardless of the issuance of any permit or requirements) and will take effect in October of 1993. The federal MSW landfill standards prescribe a level of containment for MSW that is substantially more stringent than that currently prescribed for nonhazardous solid waste by Chapter 15. New MSW landfills must be

provided with a liner system that is more stringent than the minimum liner system prescribed for a Class II waste management unit under Chapter 15; the federal regulations call for a composite liner system consisting of 2 feet of clay with a permeability of 1 x $10^{-7}$ cm/sec together with a synthetic liner (40 C.F.R. § 258.40). These new federal standards do not apply to vertical expansions. However, based on our authority to prescribe requirements that are more stringent than our minimum Chapter 15 standards, it is appropriate to consider these new federal standards.

B. San Marcos Sanitary Landfill

Having discussed the general requirements governing discharges of waste to land, we will now focus on the San Marcos Sanitary Landfill.

1. Contention: The petitioners contend that the existing site of the San Marcos Sanitary Landfill is unsuitable for use as a Class III waste management unit. They assert that the County's proposal to install a liner system between the existing unit and the vertical expansion as an "engineered alternative" to the prescribed siting criteria does not satisfy the requirement that engineered alternatives provide a level of protection for water quality that is consistent with the applicable performance standard and equivalent to that provided by the standards prescribed in Chapter 15. Petitioners also contend that hydrogeologic assumptions and conclusions regarding the ground water system are not accurate and are not supported by evidence in the record.

Findings: We find that the County's "engineered alternative" to the suitable site characteristics prescribed in our regulations for discharges of nonhazardous solid waste, while far exceeding the construction standards of Chapter 15, may not be capable of preventing degradation of waters of the State.

We provided dischargers with the opportunity to employ innovative technologies as alternatives to the prescriptive standards in Chapter 15 provided that any "engineered alternatives" ensure compliance with applicable performance standards (23 C.C.R. § 2510(b)). In this case, our regulations provide explicitly that if site characteristics cannot prevent the impairment of beneficial uses of waters of the State, the discharger must install a liner capable of preventing degradation of surface or ground water (23 C.C.R. §§ 2533(b)(2), 2540(c)). Our regulations also establish minimum engineering characteristics for the liner (23 C.C.R. § 2533(b)(2)). The system proposed by the County in this case far exceeds the minimum prescriptive standard in 23 C.C.R. § 2533(b)(2). However, it may not satisfy the performance standard contained in 23 C.C.R. § 2540(c). Our major concern is whether the system is adequate to address and overcome major deficiencies at the site, including the fact that the site overlies fractured bedrock and that the expansion will occur on an unstable base.

The Regional Water Board concluded that natural site conditions do not provide adequate separation of existing wastes from ground water. The record indicates that it based its conclusion of equivalent protection on a number of measures.

These included the proposed clay liner system and the existing network of underdrain trenches and the system of leachate interception wells that were installed as a "hydrologic barrier" to leachate migration through the fractured bedrock, and other technical assumptions and conclusions to compensate for the inadequate natural site conditions.

For the reasons discussed below, we are concerned whether these features are adequate to overcome the deficiencies at the site.

First, the Regional Water Board relied on the reported conclusion that ground water flow is primarily toward the west and that "virtually all underflow from the site" flows exclusively through a single fractured zone. (Regional Water Board Staff Response, page 10.) Thus, the Regional Water Board concluded that any potential leakage from the site would be detected and could be extracted effectively by one existing well (SMGW-30) which would act as a hydraulic barrier.

This conclusion, however, is not supported by the data in the record. Rather, it is based on a comparison of water level measurements in a number of wells which are perforated at significantly different depth intervals in an aquifer with a vertical flow component. Such a comparison would produce erroneous results and cannot be relied upon to project a reliable picture of ground water movement through fractured bedrock.

Under three-dimensional, hydrodynamic flow conditions, the measured water levels in monitoring wells depend on the length and depth of the perforated intervals. Thus, in order to

determine the horizontal flow components, one must compare only those wells which are perforated at the same elevations.

Furthermore, a pumping test of monitoring well SMGW-30 indicated hydraulic connection with SMGW-31 (about 400 feet northeast) but no connection with SMGW-16 (only 250 feet southeast). These results indicate the inability of SMGW-30 to provide a reliable barrier to "virtually all underflow from the site". Therefore, the postulated westward ground water flow direction, relied upon by the Regional Water Board, was based upon an inaccurate assumption and is not supported by substantial evidence in the record.

Second, the Regional Water Board relied upon the results of a mathematical ground water model as additional support for its reliance on SMGW-30 as a "hydraulic barrier" in the event of leakage. However, this model was never calibrated to site conditions or verified by on-site observations to demonstrate its predictive reliability.

The County's consultant described this particular application of this ground water model as a "simplistic conceptual model". He further cautioned that "there is insufficient control on the ground water flow system to construct a calibrated numerical model that purports to simulate either water level changes or solute transport within the landfill". (County of San Diego, Department of Public Works, Response to Order No. 91-25, Appendix B, Hydrologic Program, November 22, 1991, prepared by David Huntley, Ph.D., page 6-1.) Thus, the model should not be used to support the Regional Water Board's

finding that SMGW-30 will provide an effective or reliable hydraulic barrier to offsite migration.

Third, the existence of downward vertical flow further complicates monitoring system design. Existing or potential leakage from the landfill could follow numerous, inadequately defined pathways which may bypass the northwest trend of the water-bearing fracture zone. The geophysical testing attempted at the site was not sufficiently comprehensive to identify locally important water-bearing fractures or contaminant pathways. Even if a very large-scale geophysical survey of the site could be undertaken, it is not likely that the results could be relied upon to identify possible pathways for leachate migration through the fractured bedrock.

Given the fact that three-dimensional ground water flow conditions have not been defined adequately, potential flowpaths for leachate cannot be accurately predicted from existing data. The evidence in the record, therefore, does not demonstrate that existing monitoring wells provide reliable detection of likely, alternative flowpaths.

Fourth, the Regional Water Board relied on existing monitoring wells to provide water quality results. However, these wells are not capable of providing accurate and representative results because they are perforated over very long intervals (100-200 feet). Such long perforated intervals both diminish the accuracy of water level measurements and limit the accuracy and utility of water quality samples drawn from monitoring wells.

Well screens which are open to 100-200 feet or more of fractured bedrock may create artificial interconnection between water-bearing fractures which would not otherwise be connected. On the one hand, they create a potential for cross-contamination between leachate-bearing fractures and deeper, unaffected ground water. On the other, they increase the likelihood that concentrations of dissolved leachate constituents will be diluted to nondetectable levels by the artificial introduction of unaffected ground water. In addition, long well screens may contribute to degassing of volatile constituents, which further decreases the accuracy and usefulness of water quality analyses. Very long perforated intervals may also introduce vapor phase constituents which migrate from the existing, unlined landfill through nonwater-bearing fractures which are intersected by the well.

Accurate water quality measurements where there are strong vertical flow components (hydrodynamic conditions), like accurate water level measurements, require short perforated intervals, generally 5-10 feet. Where there are a number of water-bearing fractures at depth, additional, separate, short-screened wells should be constructed to provide representative samples from each water-bearing zone.

The County's existing monitoring wells do not conform to these special construction requirements for monitoring water quality under vertical flow conditions in fractured bedrock. Thus, actual, in-place concentrations of leachate constituents

which might reflect a more serious impact on ground water may be barely detectable or obscured by dilution and volatilization.

Fifth, the Regional Water Board relied on an existing "underdrain" to prevent contact between existing wastes and ground water. However, the available evidence indicates that this "underdrain" is limited in its areal extent and in its ability to capture and remove ground water seeping out of more than 100 acres of highly fractured bedrock exposed beneath existing unlined landfill or rainfall and liquid waste components which percolate through the existing wastes.

The primary means of local ground water recharge is rainfall percolating through fractures. Just as rainfall percolates through fractures, so too will a portion of effluent flows in the "underdrain" percolate into underlying fractures. The record does not indicate what proportion of total flow in the unlined "underdrain" is eventually collected and transported to the lined retention pond and how much is lost to underlying, water-bearing, highly-fractured bedrock enroute. Therefore, the record does not support the conclusion that the "underdrain" is effective in collecting, retaining, and transporting liquids (whether ground water seepage or leachate).

Sixth, the Regional Water Board also concluded that vertical flow components would somehow prevent contact between ground water and existing trash. However, rather than preventing contact between waste constituents and ground water, vertical flowpaths provide additional uncontrolled, and as yet undefined, conduits to ground water.

Intermittent ground water seeps have been observed historically in or near the existing, unlined landfill. Such seeps depend primarily on local fractured and weathered zones and on local recharge conditions. They should be expected in such variably fractured and weathered bedrock formations typical of the Santiago Peak formation.

Local, shallow fracture systems, which may not be connected to deeper, water-bearing zones, may also transport percolating rainfall into the wastes via ephemeral seeps and springs even without a uniform rise in the regional ground water table. Thus, the Regional Water Board's reliance on vertical ground water flow to prevent contact with landfill trash is not supported by the data.

In summary, the highly-fractured, water-bearing bedrock underlying and surrounding the existing, unlined landfill, provides innumerable, unimpeded conduits to ground water to seep into buried wastes, and for landfill leachate and vapor phase constituents to migrate from wastes to ground water. The proposed "hydraulic barrier" west of the landfill (monitoring well SMGW-30) cannot be relied upon to prevent all potential offsite migration of contaminated ground water because of deficiencies in its design and because of the practical impossibility of intercepting ground water flows through fractured bedrock. Nor does the existing "underdrain" provide a reliable alternative barrier to ground water seeping into existing wastes or leachate percolating from the wastes to ground water because of its limited scope and because any leachate that might enter the unlined underdrain would

be as likely to migrate into the underlying bedrock fractures as to be conveyed to the retention pond.

Because of the issues outlined above, we are concerned as to whether the County's proposed contained structures, while far in excess of the construction standards contained in our regulations, are adequate. We will address this concern later in the Order.

2. Contention: There is insufficient evidence to conclude that beneficial uses of ground water will not be impaired because the technical information submitted in support of the report of waste discharge is insufficient or inaccurate, and because the present ground water monitoring system is inadequate. The petitioners contend that the Regional Water Board failed to consider likely alternative ground water flow directions. The petitioners also contend that existing water quality problems caused by the unlined landfill have not been adequately considered.

Finding: The record contains information that the ground water in the area is limited in quantity, that limited use is being made of it, that the quality of the water resource has been impacted by natural factors and that the quality is variable. On the other hand, the record does not contain sufficient information upon which to conclude, should leakage from the landfill occur, that it can be intercepted and prevented from impacting ground water quality.

First, as discussed above, the record does not contain a reliable depiction of three-dimensional ground water flow properties or representative ground water quality.

The Regional Water Board's conclusion that all potential underflow from the landfill would follow a single fracture zone in the event of a release, as discussed above, is not supported by the record. On the contrary, evidence in the record indicates that existing releases from the landfill are not confined to any single assumed or identified pathway. Thus, reliance by the Regional Water Board on the so-called "hydraulic barrier" provided by SMGW-30 to prevent any impairment of beneficial uses is not supported by substantial evidence in the Regional Water Board's record.

Second, the Regional Water Board concluded that leachate from the existing unlined landfill has had adverse effects on ground water but that there is no impairment of beneficial uses because the San Elijo hydrologic subarea is already marginal or poor for drinking water due to high concentrations of chloride, sulfate, and total dissolved solids. Thus, the Regional Water Board implied that any degradation of water quality caused by the landfill has not impaired and does not threaten to impair an already degraded condition.

However, this implication is not supported by the record. At least locally, there are zones of good quality ground water in fractured bedrock which could be degraded by releases of leachate containing high concentrations of chloride, total

dissolved solids, or volatile organic compounds from the existing unlined landfill, or the proposed vertical expansion.

Third, the Regional Water Board relied on moisture analyses of several samples from landfill borings taken during the summer of 1991 to support its conclusion that there is little chance for leachate to be developed within the existing landfill or proposed vertical expansion. The conclusion that unsaturated conditions in refuse will prevent leachate formation or migration through wastes is based on an erroneous assumption that fluids migrate via a uniform wetting front. On the contrary, moisture (e.g., rainfall or liquid waste components) does not percolate through extremely heterogeneous deposits such as municipal wastes via a uniform wetting front. Rather, liquid migration can proceed rapidly along discrete preferential pathways, bypassing much of the solid mass.

It is likely that substantial rainfall percolates through existing wastes and contributes to flow in the "underdrain". Reported discharges from the "underdrain" of up to 13 gpm during heavy 1983 rainstorms (and 1-5 gpm during other times) suggest that rainfall percolates readily through the landfill wastes. Thus, the facts do not support reliance on ambient unsaturated conditions in selected waste samples to prevent future leachate generation in the existing unlined landfill or in its vertical expansion.

Fourth, there are other sources of potential leachate. The waste discharge requirements for the vertical expansion would permit the discharge of semisolid wastes with up to 50 percent

liquid content. In addition, dewatered sewage sludge and water treatment residues containing liquids could be discharged at the vertical expansion as long as they are not "hazardous" and have a liquid content of 80 percent or less (as authorized by 23 C.C.R. § 2520(d)).

Fifth, a variety of nonnaturally occurring, volatile organic compounds have already been detected repeatedly in several monitoring wells and in the "underdrain" effluent. For example, chloroform, trichlorethene, 1,1 dichloroethane, and methylene chloride were first detected in 1986 and were detected again as recently as 1991. There are other volatile constituents which have been detected one or more times. These include the following: 1,1,1 trichloroethane, toluene, benzene, acetone, carbon disulfide, and 1,2 cis- and trans-dichloroethane. This evidence indicates that waste constituents (either in the liquid or vapor phase) have migrated from the unlined landfill to ground water at depth in fractured bedrock.

There is some discussion in the record that because the same constituent is not necessarily present in subsequent resampling (months or even years later) of the same well that original detection must be due to laboratory error. However, it would be erroneous to assume that landfill leachate is constant in chemical characteristics, in concentration, in geographical source location within the landfill, or in rate of generation and migration. These properties are never constant.

Landfill leachate is derived from extremely heterogeneous solid and liquid wastes. The source, chemistry,

concentration, and volume of leachate generated varies over time and space within existing waste deposits. The effects of leachate during any one sampling event on dissolved constituent concentrations in ground water are variable. One should not necessarily expect repeatable results between samples, especially when those samples are separated by months or years.

Additionally, the deficiencies of the monitoring system at the San Marcos landfill, as discussed above, prevent representative sampling of true ground water conditions and limit the accuracy and reliability of analytical results. There is, furthermore, no demonstration that these wells are capable of intercepting the maximum concentration of constituents in a potential plume from the existing unlined landfill. The fact that these inadequately constructed wells have detected potential contaminants at all, suggests that conditions may be worse than indicated by any particular concentration reported by the laboratory.

We therefore conclude that the record fails to demonstrate that ground water degradation would not occur if the containment system doesn't work.

3. Contention: The proposed liner beneath the vertical expansion will not provide reliable containment of new wastes because a clay liner built on an unstable foundation of existing waste cannot be relied upon to maintain its structural integrity or effectiveness as a barrier to leachate movement for the long term. Petitioners contend that the County has not demonstrated that the proposed liner system can be relied upon to retain its

integrity in the face of differential settlement that is estimated to produce discontinuities of 10-20 feet or more over the life of the landfill.

Findings: We are concerned with the settlement potential since settlement at the landfill could jeopardize the integrity of the containment system.

First, the short- and long-term reliability of an engineered structure depends on the stability of its foundation. In an area such as the San Marcos landfill where natural conditions facilitate rather than obstruct the migration of leachate to ground water, only a reliable liner can assure water quality protection. Reliable, engineered containment systems require a structurally stable foundation which will resist consolidation and differential settlement over time.

The proposed containment system would be constructed on an unstable "foundation" of up to 200 feet of pre-existing, partly consolidated, heterogeneous wastes. This waste will be subject to significant consolidation, compaction, and differential settlement over the next 30 years. A computer simulation indicates that differences in settlement could be in the range of 10-30 feet. Measurements of surface monuments at a canyon landfill site in Los Angeles County between 1964 and 1981 indicated variable settlement rates ranging from 3-31 feet (Raymond Huitric, P.E., Los Angeles County Sanitation Districts, "Sanitary Landfill Settlement Rates", Presented June 1, 1981 at Technische Universitat, Berlin). The rate and amount of settlement observed at the surface varied

across the landfill. (This reported settlement occurred without the additional loading which would occur beneath the proposed vertical expansion at the San Marcos landfill.)

The evidence in the Regional Water Board's record is in dispute as to whether the liner and leachate collection system proposed by the County can withstand the vertical displacements associated with the anticipated levels of differential settlement without disruption or failure.

Second, the driving force for leakage through a compacted clay liner is hydraulic head. Therefore, the key to minimizing leakage is to minimize leachate head acting on a liner. The reliability of an intact containment system, then, depends on how efficiently it can remove leachate before it migrates through the underlying liner.

At low rates of leachate generation (i.e., rates that do not exceed the rate at which the clay liner material can absorb moisture), large quantities of leachate will percolate through a saturated clay liner which meets current minimum Chapter 15 permeability and construction standards. Without a synthetic "flexible membrane" liner or other measures to restrict infiltration of fluid into the clay liner, a leachate collection and removal system will not be very efficient because only a portion of liquids that reach the Leachate Collection and Removal System will ultimately be removed.

A single clay liner with permeability of $1 \times 10^{-6}$ cm/sec (1.03 ft/yr) could transmit more than 30 million gallons of leachate per year across its 103-acre surface area even if the

liner and LCRS were not subject to rupture or other disruptions because of differential settlement. (This estimate of the amount of leakage that could be transmitted is based upon a conservative assumption that hydraulic head is equivalent only to that necessary to maintain saturated conditions in the liner.)

Differential settlement across 103 acres could also promote ponding of leachate in unanticipated low spots and localized depressions. These conditions could further disrupt the efficiency of the leachate collection and removal system in removing leachate. With ponding of leachate, the hydraulic head acting on the liner will increase locally and result in even higher leakage rates.

The County contends that its containment system is adequate to withstand any settlement problems at the site and that any leachate generated will not escape the multiple liner system. It has submitted several studies in support of its conclusions. While these studies are not without persuasive merit, they do not eliminate our concerns as to whether the containment system is adequate.

## IV. ADDITIONAL ISSUE

We will now proceed to review, on our own motion, the issue of whether additional engineered features could remedy the site's deficiencies and address the water quality concerns outlined above. In evaluating the adequacy of containment features at the landfill, we are guided by certain principles. The Legislature has given us a charge that "activities and factors which may alter the quality of the waters of the State shall be

regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible." (Water Code § 13000.) The Legislature has also determined that "conservation in the direction of high quality should guide the establishment of objectives both in water quality control plans and in waste discharge requirements." (Final Report of the Study Panel to the California State Water Resources Control Board, March 1969.) In following these principles in this case, we must balance several factors. First, the site is not a very good site from a water quality standpoint. Its major deficiencies are the fractured bedrock and unstable base. Second, the amount of ground water underlying the site is limited in quantity and variable in quality. Order No. 92-02 contains a guarantee of alternative water supply should the ground water be degraded as a result of landfill operations. The deficiencies at the site would ordinarily call for extraordinary containment features. However, the extent of these features must be tempered by consideration of the limited resources to be protected.

Given the deficiencies at the site, a number of additional protective measures seem both reassurable and prudent and should be added to Order No. 92-02. Many of the features have already been planned by the County but are not required by Order No. 92-02. First, containment features required by Order No. 92-02 should be strengthened. Second, long-term structural

integrity of these features must be ensured despite significant, anticipated differential settlement and landfill gas generation in existing underlying wastes. Third, the existing provision for an alternative water supply should be retained to guarantee water supply service to any user of water that may have their supply affected by the existing or expanded landfill.

Therefore, vertical expansion at the San Marcos landfill should not proceed without amendments to the Order which provide for substantial design and other improvements.

These additional features are:

a. Leachate collection systems should be installed with each of the intermediate clay covers. These "mini-sumps" will assist in keeping leachate from coming into contact with the liner system.

b. Vapor barriers should be installed with each of the clay covers. These barriers will assist in keeping the liners elastic and thereby better able to withstand the stresses and strains of settlement.

c. A proposed waste size reduction system, to be installed as part of the recycling center at the landfill should be fully developed. This system, by increasing the moisture holding capacity of the waste, will assist in minimizing the creation of leachate. It will also address the concern about differential settlement by assuring a uniform type of waste product.

d. Compaction of waste at the site should be required. Physical compaction of the waste will further address differential settlement concerns.

e. An enhanced gas collection and venting system should be fully developed. The system should be capable of removing volatile organic constituents (VOCs) from the landfill.

f. Settlement plates or other settlement measuring devices should be installed to measure actual settlements.

g. Moisture sensors should be installed to monitor the moisture content of the landfill. These sensors should be placed beneath the primary clay liner to detect any moisture migrating out of the vertical expansion.

h. A geomembrane liner should be installed above the final clay cover. Such a requirement will provide significant additional long-term protection to the site.

We find that such features, together with provisions already provided by the Regional Water Board, will result in an adequate containment system. Accordingly, we will approve the waste discharge requirements with the addition of the specified features. If future monitoring or measurement indicates that the integrity of the containment system is in jeopardy, the Regional Water Board is directed to immediately address the matter, including the issue of stopping waste disposal at the site.

## V. CONCLUSIONS

Based on the foregoing discussion we conclude as follows:

1. The originally proposed "engineered alternative" to the prescriptive geologic siting requirements may not ensure "equivalent" water quality protection.

2. There is insufficient evidence to conclude that beneficial uses of ground water will not be impaired.

3. The proposed clay liner beneath the vertical expansion may not provide reliable containment of new wastes.

4. Vertical expansion of the San Marcos Sanitary Landfill should not proceed unless substantial design and other improvements are incorporated.

5. The waste discharge requirements should be revised to ensure adequate water quality protection and thereafter remanded to the Regional Water Board for implementation.

## VI. ORDER

IT IS HEREBY ORDERED that Order No. 92-02 of the California Regional Water Quality Control Board, San Diego Region, containing waste discharge requirements for the vertical expansion of the San Marcos Sanitary Landfill, is amended as follows:

1. The caption of the waste discharge requirements is amended to read in relevant part:

> Order No. 92-02 as amended by State Water Board Order No. WQ 93-8.

2. Finding No. 54 is added to read:

> After adoption of Order No. 92-02, petitions for review were filed with the State Water Resources Control Board (State Water Board). On June 17, 1993, the State Water Board adopted Order No. WQ 93-8. All findings and conclusions of Order No. WQ 93-8 are added to this Order by reference as are the substantive recommendations contained therein.

3. Provision B.16 is added to read:

> Upon commencement of operation of the landfill's recycling center, at least 75 percent of all waste disposed at the site shall be no greater than 4 inches in size.

4. Provision B.17 is added to read:

> Physical compaction of all wastes disposed at the site shall take place on a routine basis.

5. Provision B.8 is revised to read:

> At closure, the San Marcos Landfill shall receive a final cover which is designed and constructed to function with minimum maintenance and consists of, at a minimum, 2-foot thick foundation layer which may contain waste materials, overlain by a 2-foot thick clay liner having a permeability of $1 \times 10^{-6}$ cm/sec or less, by a geomembrane liner consisting of 60 mil

high-density polyethylene (HDPE) material or equivalent, and finally by a 1-foot thick vegetation soil layer, or an engineered equivalent final cover approved by the Regional Board pursuant to 23 CCR Subsections 2510(b) and (c).

6. Provision D.3 is revised to read:

Intermediate and daily cover over wastes discharged to the landfill shall be designed and constructed to minimize percolation of precipitation through wastes. As proposed by the discharger and noted in the Findings of this Order, intermediate cover shall consist of or be equivalent to multiple 12-inch clay intermediate cover layers at 20-foot intervals within the 200-foot lift, each layer having a permeability of $10^{-6}$ cm/sec, and daily cover during the rainy season, October through March, shall have a permeability of $3 \times 10^{-5}$ cm/sec. All clay covers shall be overlain by vapor barriers. Additionally leachate collection systems shall be installed with each of the intermediate clay covers.

7. Provision D.16 is added to read:

The following additional containment and water quality protection features shall be installed or incorporated:

a. An enhanced gas collection and venting system;

b. Settlement plates or other suitable settlement measuring devices; and

c. Moisture sensors.

8. Provision E.1.c. is added to read:

SUPPLEMENTAL REPORT--The discharger shall submit a detailed report for the development of new components required by State Water Board Order No. WQ 93-8. These components included: leachate collection systems for the intermediate clay covers, vapor barriers for the clay covers, the enhanced gas collection and venting system, settlement plates, moisture sensors and the geomembrane liner within the final cover. The report shall also outline the use of compactors and the waste size reduction system at the landfill.

DUE DATE: Prior to discharge of waste to the expansion area or an alternative date established by the Executive Officer.

IT IS FURTHER ORDERED that the matter is remanded to the Regional Water Board for implementation and action consistent with this Order.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on June 17, 1993.

AYE: John Caffrey
James M. Stubchaer

NO: Marc Del Piero

ABSENT: None

ABSTAIN: None

Maureen Marché
Administrative Assistant
to the Board