Appendix I

SID GEOTECHNICAL, INC.

Soil Engineering, Geology, Environmental Engineering

- potential settlement
- manure
- demo costs
- abandon water wells

June 30, 1998

Project No. 980040-02

TO: The Forecast Group, LP
10670 Civic Center Drive
Rancho Cucamonga, California 91730

ATTENTION: Mr. Dorian Johnson

SUBJECT: Preliminary Soil Investigation Report, Westra Dairy, A 110± Acres Site, Eucalyptus and Cleveland Avenue, Ontario Area, California

In accordance with your authorization, SID Geotechnical, Inc. has conducted a preliminary soils investigation for the subject site. The accompanying report presents a summary of our findings, with conclusions and recommendations for single family residential development. An environmental/hazard waste assessment of the site was provided under separate cover on June 22, 1998.

A rough grading plan was not available at the time of this investigation. The approximate locations of our exploratory trenches for this work are plotted on a reduced copy of the provided boundary map prepared by L.D. King Engineers of, Ontario, California.

If you should have any questions regarding this report, please do not hesitate to call our office. We appreciate this opportunity to be of service.

Very truly yours,

SID GEOTECHNICAL, INC.

Haytham Nabilsi, GE 2375
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
HAYTHAM NABILSI
No. 2375
Exp. 12/31/98
GEOTECHNICAL
STATE OF CALIFORNIA

Sm A. Siddiqui, GE 775
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
SID
SIDDIQUI
No. 775
Exp. 9/30/01
GEOTECHNICAL
STATE OF CALIFORNIA

Distribution: [3] Addressee

7265 Jurupa Avenue, Suite E • Riverside, CA 92504 • Tel: (909) 688-2300 • Fax: (909) 688-1060

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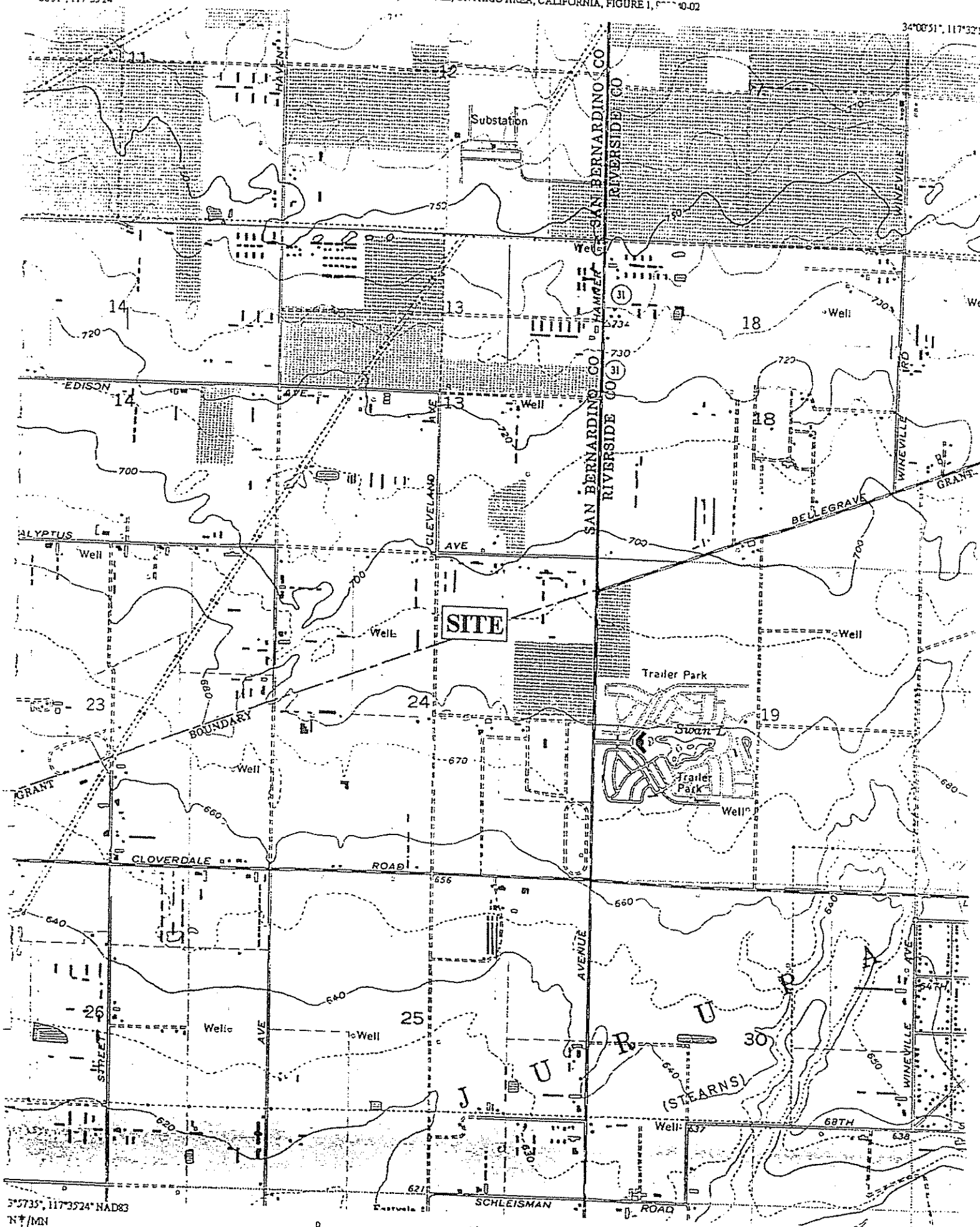

SITE
Substation
Well
Trailer Park
Swan L
SAN BERNARDINO CO
RIVERSIDE CO
HAVEN AVE
CLEVELAND AVE
HAMNER AVE
WINEVILLE AVE
EDISON AVE
BELLEGRAVE
GRANT
BOUNDARY
CLOVERDALE ROAD
SCHLEISMAN ROAD
68TH
(STEARNS)
JURUPA
AVENUE
STREET
11
12
13
14
18
19
23
24
25
26
30
31
720
730
700
680
670
660
640
620
750

INTRODUCTION AND SCOPE

The scope of our work included the following:

- Review soils data, maps, and reports pertinent to the site.
- Exploration of the site by means of 11 backhoe pits, upto to 11 feet deep, logging, sampling of select soils, observation for old fills, manure depth, caving condition, saturated soils, excavation characteristics, water seepage, etc.
- Laboratory testing of select soil samples to include moisture, density, maximum density, sieve analysis, and sand equivalent.
- Preparation of this report (3 bound copies) summarizing our findings, conclusions, and recommendations for site preparation, overexcavation/removal depth, allowable bearing, footings/slab-on-grade, depth/thickness, general grading specifications, and tentative pavement design. The report also includes seismicity of the site based on a computer search of known major faults within a 50 miles radius of the site.

SUMMARY OF SITE CONDITIONS AND PROPOSED DEVELOPMENT

Site Conditions

The subject property consists of a nearly rectangular shaped 110-acre parcel of land, which currently supports an active dairy farm. The property is located along Eucalyptus Avenue just west of Milliken/Hamner Avenue in the Ontario area of San Bernardino County, California. The southern most portion of the site is located within Riverside County, California. For site location refer to Figure 1, Site Location Map.

The subject property currently exists as a working dairy farm with appurtenant facilities such as fences, driveways, buildings, residences, and equipment. The majority of the southern site area is open land formerly used for agricultural crops in support of the dairy farm. Agricultural farming is no longer conducted at the property. The dairy processing and maintenance facilities, as well as residences, are located in the northern portion of the site, near Eucalyptus Avenue. Other related facilities include barns and covered storage areas.

Topographically, the site is generally flat with a gradient of less than two percent toward the south. Surface run-off is directed toward the south as sheet flow.

Three underground fuel storage tanks with associated pump dispensers were observed on-site. One tank and filling area is present in the northern part of the site near the entrance to the dairy along Eucalyptus Avenue. The other two tanks are located near the equipment maintenance/storage barn and are currently not used. Two above ground diesel storage tanks were also noted on the property. One is mounted on a concrete pad and is used in association with a diesel generator, the other is used to fill tractors and farm equipment.

Several water wells are present on-site and used for both domestic and irrigation supply.

Three separate residences were noted along the northern portion of the site. Two homes are present along the north side of Eucalyptus and one is located along the south side. These facilities include associated driveways and domestic storage.

The dairy processing facility is located in the north central portion of the site and includes equipment for the processing of cow milk.

Proposed Development

We understand that the site will be developed for single family residential development. It is expected that the residences will be of light wood frame/stucco construction supported on shallow footings with concrete slabs-on-grade.

No plans were available during this site investigation, however, based on the flat nature of the site, minor cut and fill grading is anticipated.

SUMMARY OF GEOTECHNICAL CONDITIONS

Subsurface Exploration

Eleven exploratory trenches were excavated on June 29, 1998 to a maximum depth of 11 feet below existing ground surface utilizing a Case 580 backhoe equipped with a 24-inch bucket. The trench locations were selected at random accessible locations (see Exploratory Trench Location Map, Plate 1).

The earth materials are non-homogeneous and variable in texture and plasticity. The materials essentially consist of a mantle of organics and manure from zero to 12± inches thick and alluvial deposits. Isolated scattered thicker manure piles on the order of 1½ feet and large piles were also observed.

The materials noted in our trenches varied in classifications from sandy silt, silty sand, clayey sand, to sand. The materials vary in density/consistency from medium dense to loose. The sandy silt encountered was very moist. In the northern part of the site, silty sand was the predominant material in the upper five feet which was underlain by indurated clayey sand. In the central portion of the site sandy silt was predominantly exposed in the trenches with sand/gravel exposed only in trench T5 at nine feet below ground surface. In the southern portion of the site, the exposed material was scattered silty sand and clayey sand.

A descriptions of the materials are presented in the form of Geotechnical Trench Logs in Appendix B. According to the Generalized Maps by County of San Bernardino Planning Department, the subject site is underlain by alluvium on the order of 400 feet thick.

Windblown Sand

The site is located within an area effected by blown sand during northerly windstorms. This should be considered during planning.

Laboratory Testing

In order to determine the engineering properties of the underlying soils, laboratory tests were performed on selected samples obtained from the trenches. The tests consisted primarily of natural moisture contents, densities, sieve analysis, and maximum dry density/optimum moisture content. The soil classifications are in conformance with the Unified Soil Classifications System (USCS), as outlined in the Classification and Symbols Chart (Appendix B). A summary of our laboratory testing is presented in Appendix C.

Groundwater

No groundwater was encountered within our exploratory trenches at the time this work was done. According to County of San Bernardino Generalized Maps, depth to groundwater may be on the order of 125 feet below ground surface. Perched zones may however exist above relatively impervious alluvial surfaces which may rise during winter rainfall season.

Water wells were noted on the property and are apparently used for irrigation and domestic purposes. Groundwater elevations could not be recorded from these wells during our site investigation. Groundwater data for site vicinity obtained from Western Municipal Water District regional well measuring program is as follows:

WELL NO	ELEVATION	DEPTH TO WATER	WATER ELEVATION	DATE
2S6W19E01S	685	104.5	580.5	12/28/97
2S6W19E02S	687.5	102	585.5	12/28/97
2S6W19E03S	--	102.9	584.6	12/2/97
2S7W24C	--	113.4	--	6/29/96
2S7W24D	--	139.1	--	10/28/94
2S7W24K	--	115.6	--	5/31/94

Flooding

Based on generalized maps, the site is not located in 100-year flood zone as designated by FEMA. The potential for flooding should however be evaluated by the design civil engineer and considered in planning and development.

Faulting/Seismicity

The latest assessments of seismogenic fault sources generally include estimating the maximum credible earthquake (MCE) and the maximum probable earthquake (MPE). The California Division of Mines and Geology (CDMG Note No. 43) defines the MCE as the maximum earthquake that appears capable of occurring under the presently-known tectonic framework. The MPE has been defined as being the largest or maximum earthquake that is likely to occur during a 100-year interval and shall not be less than the maximum historical event.

A computer search of all known Quaternary major faults within 50 miles of the site is presented in Appendix D. The computer search was performed by EQFAULT program.

In EQFAULT, the "mean" represents the best-fit curve for the range of acceleration levels (the median value or the 50th percentile of data scattered about a regression curve). The "mean+1 sigma" (one standard deviation) encompasses 84 percent of the data about a regression curve.

The tables in Appendix D summarize the shortest distance to the causative faults, magnitude of the maximum credible and maximum probable earthquakes, and horizontal peak ground accelerations at the site.

It is probable that not all active or potentially active faults in the region have been identified. Furthermore, seismic potential of the smaller and less notable faults is not sufficiently developed for assignment of maximum credible and maximum probable magnitudes and associated levels of ground shaking that might occur at the site due to these faults.

Seismically Induced Settlement

Seismically induced settlement generally occurs within areas of loose soils with relatively low density. The possibility of seismically induced settlement within surficial soils cannot be entirely precluded.

Secondary Seismic Hazards

Considering the location, topography, subsurface conditions and absence of near by large bodies of water, tsunamis, seiches, landslides rock falls, and liquefaction are not a potential hazard for this site. Flash flooding and general flooding potential at the site should be evaluated by the design engineer and considered during planning and development.

CONCLUSIONS

General

Based on the results of our field investigation, laboratory testing, and our analysis, it is our opinion that the proposed development is feasible from a geotechnical standpoint, provided the recommendations presented in this report are incorporated fully into the design and construction of the project.

- Undocumented fills, existing structures, reservoirs, windmills foundations, remnants/foundations of old demolished structures, old foundations, buried structures and buried utilities/irrigation lines, leach lines, septic tanks, etc. associated with current site use may be encountered throughout the project area. Therefore, extensive demolition, site clearance, and efforts to locate and remove all subsurface obstructions should be an important consideration.

- The earth materials at the site vary considerably in classification, and moisture content/consistency. Overexcavation, thorough mixing, moisture conditioning, drying back, and recompaction would therefore be a consideration.

- The onsite soils exclusive of oversize rock (larger than 6-inches in diameter, if any) and deleterious materials may be used as compacted fill materials.

- It is anticipated that all earth materials can be excavated by conventional earthmoving equipment in good working condition. Based on the types of earth materials, the use of heavy sheepsfoot rollers may provide the best compaction results. Caving of excavations in sandy materials should be anticipated

- Based on soil classifications and laboratory testing, the expansion potential of the near-surface soils at the site is expected to be very low to low. This would require evaluation of individual pads subsequent to completion of rough grading.

- Subsequent to site preparation, the use of shallow spread footings appears feasible for the proposed construction.

- The site is expected to be subject to strong to severe ground shaking from regional seismic events within the projected life of the proposed.

- The potential for liquefaction of the onsite soils is considered to be low.

- Blowing sand should be anticipated during northerly windstorms. Considerations may be required for mitigating blown sand during construction, and providing ground cover upon completion.

RECOMMENDATIONS

Site Preparation

All grading should be performed in accordance with our General Earthwork and Grading Specifications presented in Appendix E except as modified within the text of this report. The site should be cleared of all vegetation, roots system, manure, underground structures, foundations, metal/plastic irrigation pipes, abandoned utilities, leach lines, septic tanks, and all other deleterious materials which should be hauled offsite.

Serious effort should be made during removal of existing concrete walks and slabs to locate and remove any underground utilities, leach lines, seepage pits, septic tanks, buried trash, manure, etc. Abandonment of water wells should be performed in accordance with the general guidelines presented on Plate 2 and/or requirements of the Counties.

Depressions resulting from clearing operations, should be backfilled in a controlled manner. Any underground storage tanks, if encountered, should be removed in accordance with the Counties requirements. Concrete irrigation pipes may be crushed in-place and incorporated in the compacted fills. Unreinforced concrete may be broken into pieces (smaller than 6-inches) and dispersed into compacted fills, however nesting must not be permitted.

Overexcavation and Alluvium Removals

After site clearance as outlined above, areas extending at least five feet beyond building lines in plan should be overexcavated to a depth of at least four feet below existing ground or proposed grade, whichever is lower in elevation. Tree and vegetation roots should be traced and completely removed if encountered in bottom of the overexcavated areas. After overexcavation, the exposed surfaces should be further scarified to a depth of at least 12-inches, dried back or moisture conditioned and recompacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557-91 Test Method; prior to placement of fill. Deeper overexcavations specially to remove unsuitable saturated soils, remove existing deep structures or clean the bottom, may be required depending upon field observations of excavated bottoms by the soil engineer or his representative. The overexcavation criteria may be based on better than 85 percent relative compaction of the underlying natural soils evaluated by testing of excavated bottoms during grading. Street areas may be overexcavated and recompacted to a depth of 24 inches prior to placement of fills.

Compacted Fills/Imported Soils

Any soil to be placed as fill, whether presently onsite, from adjacent borrow areas or import, should be approved by the soil engineer or his representative prior to their placement. All onsite soils to be used as fill should be cleansed of any roots, oversize rock, or other deleterious materials. Cobbles and boulders, larger than 6-inches in diameter should not be placed in the vicinity of foundations and utility lines trenches. All fills should be placed in 6- to -8 inch loose lifts, thoroughly watered, or aerated to near optimum moisture content, mixed and compacted to at least 90 percent relative compaction. This is relative to the maximum dry density determined by ASTM D1557-91 Test Method. Heavy vibratory equipment and sheepsfoot rollers may provide the best compactive efforts.

Onsite soils with organic content may be diluted by mixing with underlying clean soils and may be utilized in fills provided the organic content is less than five percent. The mix should be continuously sampled and tested during grading. Any imported soils should be sandy (preferably USCS "SM" or "SW", and very low to low in expansion potential) and approved by the soil engineer. Imported fill from adjacent areas or offsite should be subject to appropriate tests prior to importing operation. The soil engineer or his representative should observe the placement of all fill and take sufficient tests to monitor the moisture content and the uniformity and degree of compaction obtained.

Cut/Fill Slopes

In general, cut slopes and fill slopes should be designed at inclination of 2:1 (horizontal to vertical) or flatter. Fill slopes should be compacted to at least 90 percent of the maximum dry density; to the outer slope face. We recommend overfilling, compacting and trimming to grade for fill slope construction. It is recommended that all slopes be planted as soon as possible subsequent to construction.

Building and Footing Setbacks

Buildings located adjacent to the top of slopes, and walls footings; should be setback one-half the height of the slope. The setback, however need not exceed 15 feet with a minimum setback of 5 feet per guidelines of the Uniform Building Code. This distance should be measured horizontally from the firm face of the slope to the closest element of the structure. The footings may be deepened to achieve the setback, as recommended.

Shrinkage and Subsidence

We estimate that shrinkage of alluvium soils upon removal and recompaction should be approximately 10 (±5) percent. Shrinkage is defined as the decrease in volume of soil upon removal and recompaction expressed as a percentage of the in-place volume. This shrinkage is exclusive of any losses due to removal of tree roots, debris, manure or removal of any underground structures and is based on 90 percent relative compaction. An increase in relative compaction obtained would increase the shrinkage factor. Furthermore, a subsidence of approximately 0.20 (±0.05) feet may also be considered during site preparation. The above shrinkage and subsidence estimates should be used with caution since they are not absolute values. We recommend that an earthwork balance area should be designated to allow for variations in the indicated shrinkage and subsidence estimates.

Tentative Foundation Design

Following site preparation and grading in accordance with the recommendations presented herein, the use of shallow spread footings is feasible. An allowable bearing value of 1500 psf is recommended. This bearing value may be increased by one third for temporary (wind or seismic) loads. Reinforcement and other requirements are presented on Plate 3 and may be tentatively designed for low expansion category. Expansion potential of foundation soils should be tested at the conclusion of rough grading.

Slabs-on-grade should be at least 4 inches thick (nominal) and should be reinforced with at least No 3 bars at 24-inches on-center both ways (or equivalent), properly centered in mid thickness of slabs. Slab reinforcement should be supported on concrete spacers for proper positioning at mid thickness. Slabs-on-grade should be provided with a 6-mil Visqueen moisture barrier properly protected with at least one inch of clean sand above the Visqueen and two inches of compacted clean sand below the Visqueen. Other recommendations are presented on Plate 3. Additional or heavier reinforcement than indicated above may be required by structural considerations and should be determined by the structural design engineer.

All concrete flat work including slabs subgrade should be compacted to at least 90 percent of the maximum dry density. Excess soils generated from foundation excavations should not be placed on building pads without proper moisture and compaction and should be verified to contain near optimum moisture content to a depth of 12 inches prior to placement of slab building materials. Moisture content should be tested in the field by the soil engineer.

The potential for slab cracking may be lessened by the addition of fiber mesh in the concrete, and careful control of water/cement ratios. In hot or windy weather, the contractor must take appropriate curing precautions after the placement of concrete.

The use of low slump mechanically compacted concrete (approximately 4 inches at the time of placement) is recommended.

Lateral Earth Pressures/Walls Below Grade

The following lateral earth pressures and soil parameters in conjunction with the above recommended bearing value (1500 psf), may be used for design of retaining walls with free draining level compacted backfills. If passive earth pressure and friction are combined to provide required resistance to lateral forces, the value of the passive pressure should be reduced to two-thirds of the following recommendations.

◦ Active Earth Pressure with level backfill (P_a)	30 psf (EFP), drained, yielding
◦ Active Earth Pressure, 2:1 ascending slope	45 psf (EFP), drained, yielding
◦ At Rest Pressure (P_o)	45 psf (EFP), drained, non-yielding (part of building wall)
◦ Passive Earth Pressure(P_p)	250 psf (EFP), drained,maximum of 2500 psf
◦ Horizontal Coefficient of Friction (μ)	0.35
◦ Unit Soil Weight (γ_t)	110 pcf

All retaining walls and block walls footings should be founded in compacted fill or firm native soils. We recommend drainage for retaining walls to be provided in accordance with Plate 4 of this report. Maximum precautions should be taken when placing drainage materials and during backfilling. All wall backfills should be properly compacted to at least 90 percent relative compaction.

Surface Drainage

The surface of all lots should be graded to provide positive drainage away from structures. Drainage should be directed to established swales and then to appropriate drainage structures to minimize the possibility of serious erosion. Surface drainage must be directed and maintained away from the foundations and slopes. Water, either natural or by irrigation, should not be permitted to run over slopes or to pond/saturate the surface soils.

Cement Type/Corrosion Potential

We recommend Type II cement for all concrete work in contact with soil. Ferrous metal pipes should be protected from potential corrosion by bituminous coating, etc.. We recommend that all utility pipes be nonmetallic and/or corrosion resistant. Considering the use of the site as a major dairy operation, the corrosion potential of the soils related to concrete and metal, should be evaluated by a qualified corrosion consultant.

Seismic Considerations

The site vicinity is located in Seismic Zone 4 (UBC 1997). Moderate to severe ground shaking can be expected at the site. The structural engineer should consider Counties codes, Uniform Building Code, seismic data presented in this report, the latest requirements of the Structural Engineers Association, and any other pertinent data in selecting design parameters.

Shoring/Trench Backfill

Trenches greater than four feet in depth should be shored or sloped at 1:1 (horizontal to vertical) or flatter in compliance with California OSHA requirements.

All utility trench and retaining wall backfills should be mechanically compacted to the minimum requirements of at least 90 percent relative compaction. Onsite soils derived from trench excavations can be used as trench backfill. Based on the sand equivalent test result of near surface soils backfills should be placed in thin lifts and compacted by mechanical means. No jetting, ponding, or flooding should be permitted within the building area or where trenches are in zone of influence of footing loads. Excavated material from footing trenches should not be placed in slab-on-grade areas unless properly compacted and tested.

Erosion Control

Once ground cover is removed, wind erosion can be expected to be a serious problem, in the event of strong north winds. We recommend that consideration be given to this aspect during all phases of development, with permanent solution, in the form of adequate ground cover and wind breaks, provided at the conclusion of construction.

Tentative Pavement Design

On the basis of classifications of onsite soils, the tentative pavement design may be based on an R-value of about 35 or better, corresponding to the near surface silty sands and sands. A Traffic Index of 5.5 is assumed for interior low volume streets. Based on our experience in this area, the corresponding structural sections should consist of at least 0.3 foot of asphalt concrete over 0.5 foot of Class 2 aggregate base over compacted native subgrade. Minimum pavement thickness by the Counties may apply.

The upper at least 12 inches of pavement subgrade should be scarified, watered as necessary and compacted to at least 90 percent relative compaction per maximum dry density determined by ASTM D1557-91. The base should be compacted to at least 95 percent relative compaction. All subgrade and base must be firm and unyielding prior to placement of asphalt concrete.

Final pavement design recommendations should be based on R-value tests of representative pavement subgrade soils upon the completion of rough grading and Traffic Indices provided by the Counties (pavement thickness will increase if the R-value of subgrade soils drops below 35).

Rough Grading Plan Review

The recommendations provided in this report are based on preliminary design information and subsurface conditions as interpreted from limited exploratory trenches at the site. SID Geotechnical, Inc. should review the rough grading plans prior to start of earthwork and construction. Drilling of a few deep borings and consolidation tests to further evaluate the depth of alluvium removals should also be considered. Our preliminary conclusions and recommendations therefore will be reviewed and monitored during site grading, and revised accordingly if exposed geotechnical conditions vary from our preliminary findings and interpretations.

Additional Observation and/or Testing

SID Geotechnical, Inc. should observe and/or test at the following stages of construction.

- During site clearance and removal of any underground obstructions.
- During all overexcavations, fill placement, and compaction.
- Following footing excavations and prior to placement of footing materials.
- During all utility trench backfills, subgrade of streets, sidewalks, curb/gutter, and streets base compaction prior to paving.
- When any unusual conditions are encountered.

Report of Field Density Testing During Grading

A report of field density tests should be prepared subsequent to the completion of grading. The report should include a summary of work performed, laboratory test results, and the results and locations of field density tests performed during grading.

LIMITATION OF INVESTIGATION

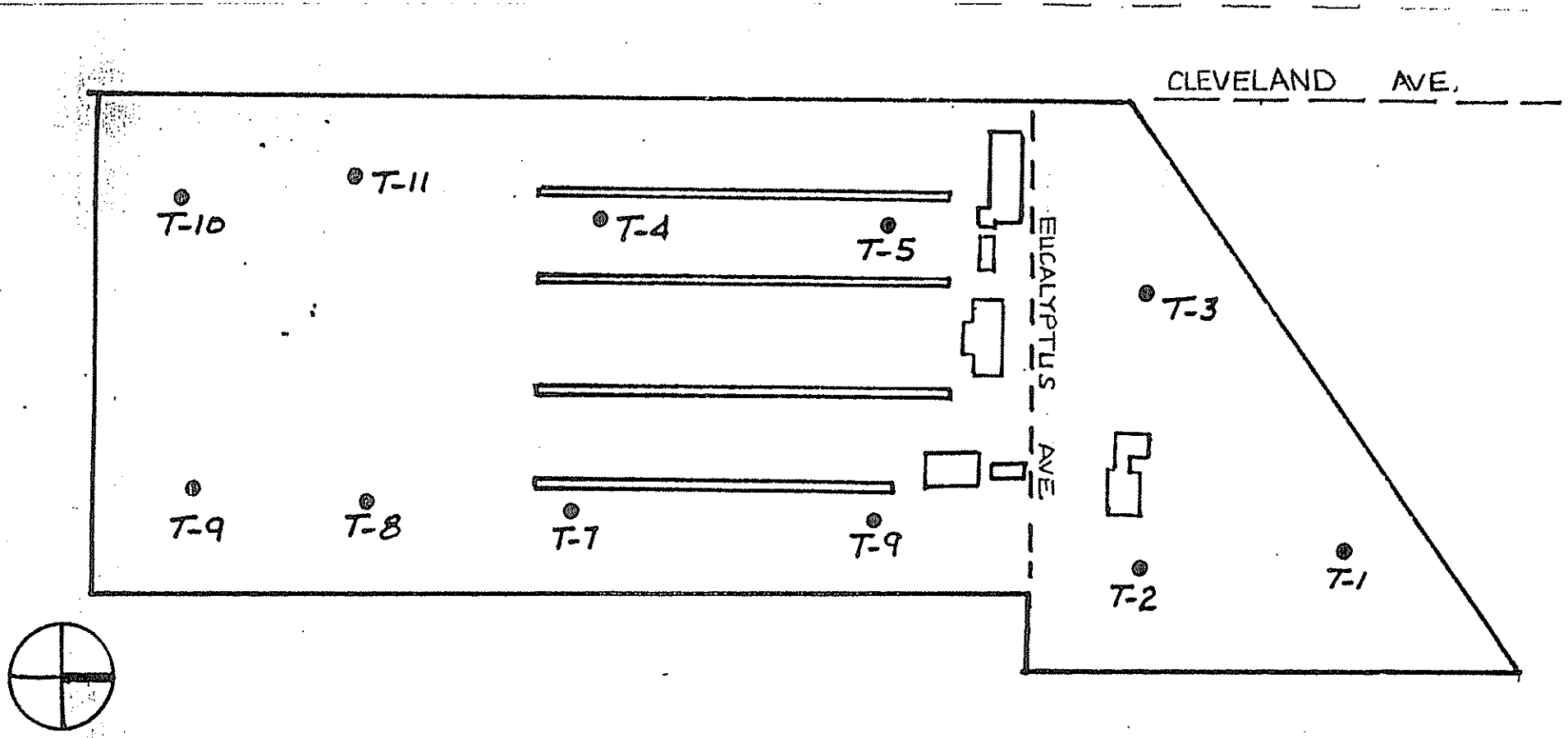
Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers practicing in this or similar locations. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

The test pits, field and laboratory test data are believed representative of the project site; however, soil conditions can vary significantly between test pits. As in most major projects, conditions revealed by excavation may be at variance with preliminary findings. If this condition occurs, the possible variations must be evaluated by the Project Geotechnical Engineer and designs adjusted as required or alternate design recommended.

This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractor carry out such recommendations in the field.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for other than our own personnel on the site; therefore, the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein to be unsafe.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In additions, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge.



T-11 Approximate Location of Exploratory Trench

WESTRA DAIRY, 110± ACRES
ONTARIO AREA, CALIFORNIA

Project No 980040-02
Date 6/30/98
Plate No 1

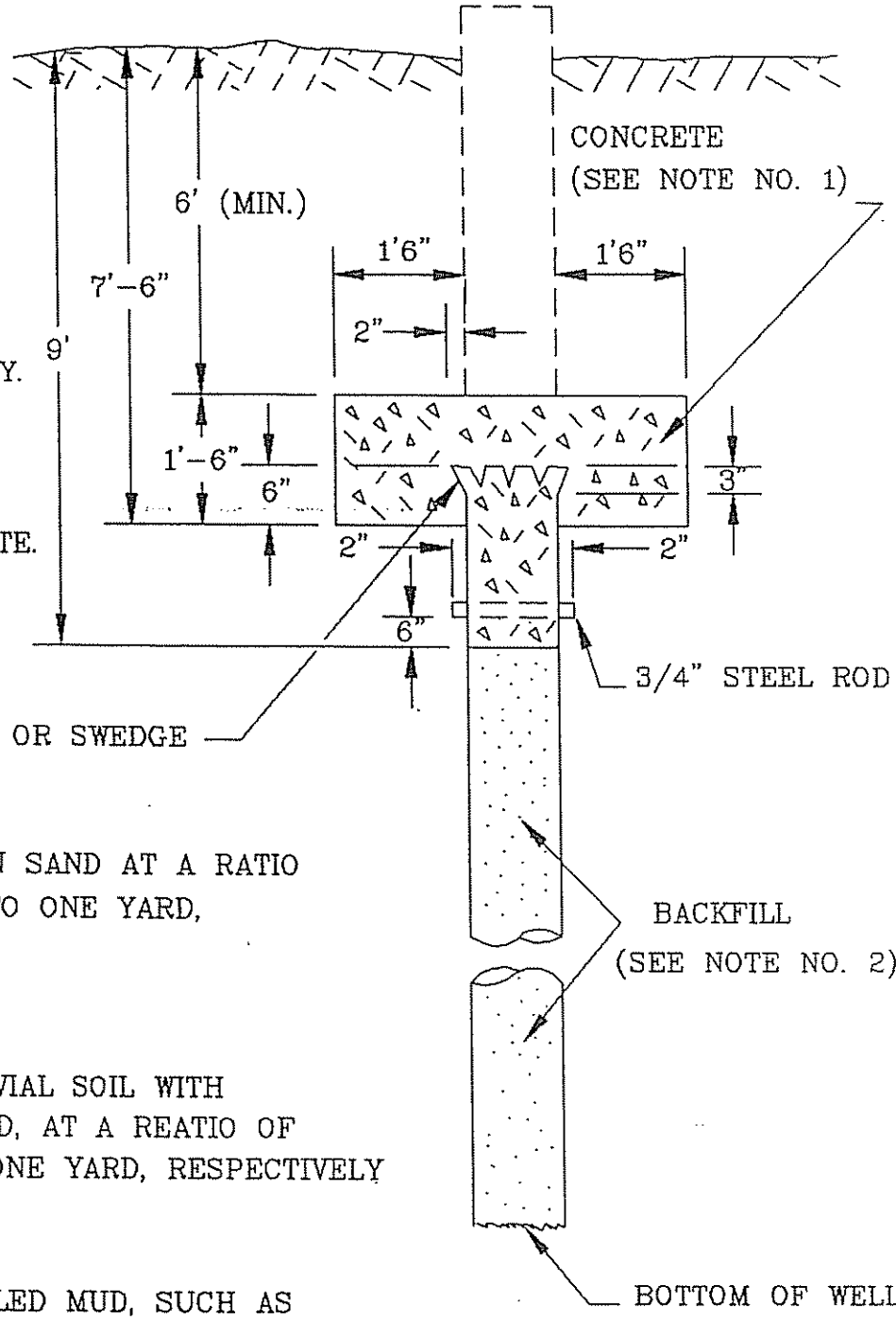
SID GEOTECHNICAL, INC.

NOTE NO. 1: USE:

CEMENT, SAND, AND ROCK IN A 1:3:4 RATIO, RESPECTIVELY.

OR

2000 PSI/28-DAY READY-MIX CONCRETE.



NOTE NO. 2: USE:

CEMENT AND CLEAN SAND AT A RATIO OF THREE SACKS TO ONE YARD, RESPECTIVELY

OR

CEMENT AND ALLUVIAL SOIL WITH LITTLE OR NO SAND, AT A REATIO OF THREE SACKS TO ONE YARD, RESPECTIVELY

OR

CLEAN, WELL PUDDLED MUD, SUCH AS ROTARY OR BENTONITE.

SPECIFICATIONS FOR THE BACKFILLING OF ABANDONED WATER WELLS	PROJECT NO. 980040-02 PLATE NO. 2

MINIMUM FOUNDATION AND SLAB RECOMMENDATIONS FOR EXPANSIVE SOILS

(ONE- AND TWO- STORY RESIDENTIAL BUILDINGS)

	U.B.C. EXPANSION INDEX 0-20 VERY LOW EXPANSION	U.B.C. EXPANSION INDEX 21-50 LOW EXPANSION	U.B.C. EXPANSION INDEX 51-90 MEDIUM EXPANSION	U.B.C EXPANSION INDEX 91-130 HIGH EXPANSION
1-Story Footings (See Note 1)	All footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom.	All footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom.	Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom.	Exterior footings 24" deep. Int footings 18" deep. Reinforcemen continuous footings: one No. 5 ba and bottom; alternately, two No. 4 top, two No. 4 bars bottom.
2-Story Footings (See Note 1)	Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom	Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom.	Exterior footings 18" deep. Interior footings 12" deep. Reinforcement for continuous footings: one No. 4 bar top and bottom.	Exterior footings 24" deep. Int footings 18" deep. Reinforcemen continuous footings: one No. 5 ba and bottom; alternately, two No. 4 top, two No. 4 bars bottom.
Minimum Footing Width	Continuous: 12" for 1-story. Continuous: 15" for 2-story. Isolated column: 24"	Continuous: 12" for 1-story. Continuous: 15" for 2-story. Isolated column: 24".	Continuous: 12" for 1-story. Continuous: 15" for 2-story. Isolated column: 24"	Continuous: 12" for 1-story. Contin 15" for 2-story. Isolated column: 2
Garage Door Grade Beam (See Note 2	A grade beam 12" wide x 12" deep (18" deep for 2-story) should be provided across the garage entrance.	A grade beam 12" wide by 12" deep (18" deep for 2-story) should be provided across the garage entrance.	A grade beam 12" wide x 18" deep should be provided across the garage entrance.	A grade beam 12" wide x 24" should be provided across the ga entrance.
Living Area Floor Slabs (See Notes 3, 4 and 5)	Nominal 4" thick slab. 6x6 - 10/10 WWF reinforcement at mid-height. 6-mil Visqueen moisture barrier on pad grade with 1" sand above Visqueen.	Nominal 4" thick slab. 6x6 - 10/10 WWF reinforcement at mid-height. 6-mil Visqueen moisture barrier above 2" sand base with 1" sand above Visqueen.	Nominal 4" thick slab. 6x6 - 6/6 WWF reinforcement at mid-height. 6-mil Visqueen moisture barrier above 3" sand base with 1" sand above Visqueen.	Full 4" thick slab. 6x6 - 6/6 reinforcement at mid-height Visqueen moisture barrier above 4" base with 1" sand above Visqueen.
Garage Floor Slabs (See Notes 4 and 6	Nominal 4" thick slab on pad grade. Garage slabs should be quarter-sawn.	Nominal 4" thick slab on 2" sand base. Garage slabs should be quarter-sawn.	Nominal 4" thick slab on 3" sand base. Garage should be quarter-sawn or reinforced with 6x6 -10/10 WWF at mid-height.	Nominal 4" thick slab on 4" sand Garage slabs should be quarter- and reinforced with 6x6 - 6/6 WW mid-height.
Presoaking of Living Area and Garage Slabs	Near-optimum to a depth of 6".	(1.2) x optimum to a depth of 12".	(1.3) x optimum to a depth of 18".*	(1.4) x optimum to a depth of 24".*

*Presoaking of living areas and garage slabs in lots with medium expansion and high expansion potential should be observed and tested

NOTES:

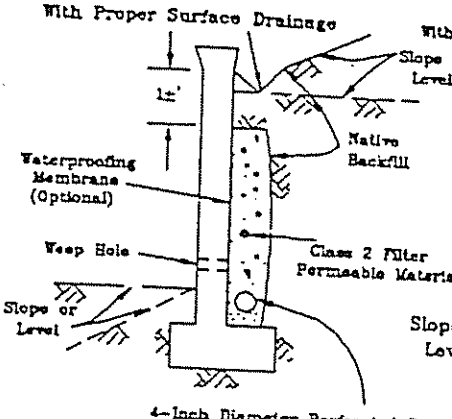
1. Depth of interior or exterior footings to be measured from lowest adjacent finish grade.
2. The base of the grade beam should be at the same elevation as that of the adjoining footings.
3. Living areas slabs may be tied to the footings as directed by the structural engineer. For HIGH EXPANSION: Dowels consi of No. 3 bars should be placed at 36 inches on centers in the footings and bent 3 feet into the slab.
4. It has been observed that welded wire fabric reinforcement seldom stays at the design height within concrete slabs. We recom the use of No. 3 bars at 24 inches O.C. instead of 6x6 - 10/10 WWF and No. 3 bars at 18 inches O.C. instead of 6x6 - 6/6 W
5. 6-mil Visqueen sheeting has proved successful. Equivalents are acceptable.
6. Garage slabs should be isolated from stem wall footings with a minimum 3/8" felt expansion joint.
7. Sand base should have a Sand Equivalent (SE) of 30 or greater (e.g., washed concrete sand).

Post-Tensioned Slabs

As an alternative to conventional foundations, building may be supported on post-tensioned slabs, to be designed by a struc engineer in consultation with the geotechnical consultant. In addition, a post-tensioned slab is also recommended for VERY expansion potential (Expansion Index greater than 130), if encountered. Post-tensioned slabs should have perimeter footings emb a minimum of 12 inches below the adjacent grade. The slabs should be designed such that they can be deformed approximately 1 vertically over a width of 30 feet without distress in the event of shrinkage or swelling of the supporting soils. Living area should be underlain by a 6-mil Visqueen moisture barrier covered by a 1-inch layer of sand. Presoaking is recommended for tensioned slabs: (1.2) x optimum to a depth of 12 inches, (1.3) x optimum to a depth of 18 inches, and (1.4) x optimum to a of 24 inches for MEDIUM, HIGH and VERY HIGH expansion potential soils, respectively. Placement of 4 inches of sand base is suggested for post-tensioned slab systems.

SUBDRAIN OPTIONS FOR NATIVE MATERIAL BACKFILL

OPTION N2: Pipe Surrounded with Class 2 Material

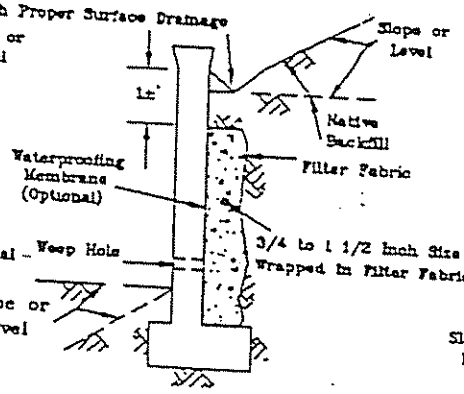


4-Inch Diameter Perforated Pipe

Class 2 Filter Permeable Material Grading Per Caltran Specifications

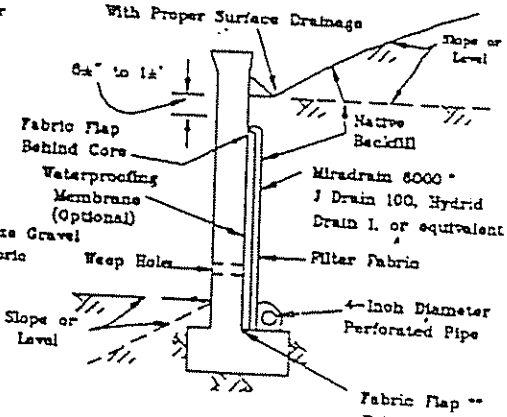
Sieve Size	Percent Passing
1"	100
3/4"	90–100
3/8"	40–100
No. 4	25–40
No. 8	18–33
No. 30	5–15
No. 50	0–7
No. 200	0–3

OPTION N1: Gravel Wrapped in Filter Fabric



Proper Outlet Should be Provided for Gravel Subdrain (See Notes)

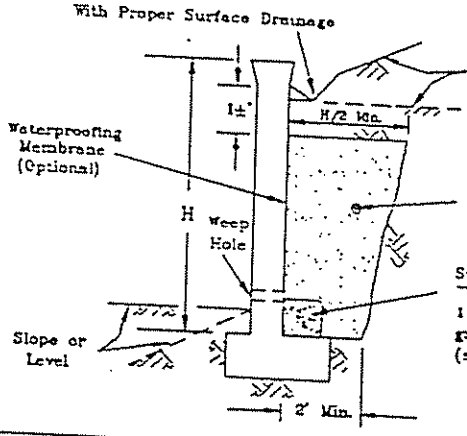
OPTION N3: Geotextile Drain



* Miradrain 6000 or J Drain 100 for non-waterproofed walls; Miradrain 6200 or J 200 for completed waterproofed walls

Peel back the bottom fabric flap, place pipe next to core, wrap fabric around pipe and tuck behind core.

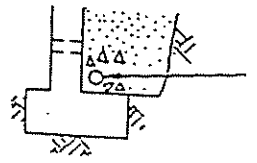
SUBDRAIN OPTIONS FOR CLEAN SAND BACKFILL



Clean sand backfill having sand equivalent of 30 or greater (can be densified by water jetting)

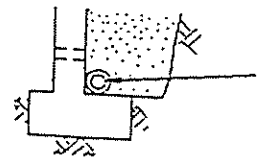
Subdrain Option S1:

1 ft.³/ft. of 3/4 to 1 1/2" size gravel wrapped in filter fabric (see notes for outlet)



Subdrain Option S2:

4" diameter perforated pipe surrounded with 1 ft.³/ft. of Class 2 filter material per Caltrans specifications as above



Subdrain Option S3:

4" diameter perforated pipe wrapped in filter fabric

Notes:

- Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down.
- Filter fabric should be Mirafi 140N, 140NS, Supac 4NP, Amoco 45-45, Trevira 1114, or approved equivalent.
- All drains should have a gradient of 1 percent minimum.
- Outlet portion for gravel subdrain should have a 4"-diameter pipe with the perforated portion inserted into the gravel approximately 2' minimum and the nonperforated portion extending approximately 1' outside the gravel. Proper sealing should be provided at the pipe insertion enabling water to run from the gravel portion into rather than outside the pipe.
- Waterproofing membrane may be required for a specific retaining wall such as a stucco or basement wall.
- Weephole should be 2"minimum diameter and provided at 25' minimum in length of wall. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to discharge through the curb face or equivalent should be provided, or for a basement-type wall, a proper subdrain outlet system should be provided. Open vertical masonry joints(i.e., omit mortar from joints of first course above finished grade)at 32' maximum intervals may be substituted for weepholes. Screening such as with a filter fabric should be provided for weepholes/open joints to prevent earth materials from entering the holes/joints.

RETAINING WALL BACKFILL AND SUBDRAIN DETAIL

PROJECT NO. 980040-02

PLATE NO. 4

APPENDIX E

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1.0 GENERAL INTENT

These specifications present general procedures and requirements for grading and earthwork as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installations of subdrains, and excavations. The recommendations contained in the geotechnical report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict. Evaluations performed bythe consultant during the course of grading may result in new recommendations which could supersede these specifications or the recommendations of the geotechnical report.

2.0 EARTHWORK OBSERVATIONS AND TESTING

Prior to the commencement of grading, a qualified geotechnical consultant (soils engineer and engineering geologist, and their representatives) shall be employed for the purpose of observing earthwork procedures and testing the fills for conformance with the recommendations of the geotechnical report and these specifications. It will be necessary that the consultant provide adequate testing and observations so that he may determine that the work was accomplished as specified. It shall be the responsibility of the contractor to assist the consultant and keep him apprised of work schedules and changes so that he may schedule his personnel accordingly.

It shall be the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and approved grading plans. If, in the opinion of the consultant, unsatisfactory conditions, such as questionable soil, poor moisture conditions, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the consultant will be empowered to reject the work and recommend that construction be stopped until the unsatisfactory conditions are rectified.

Maximum dry density tests used to determine the degree of compaction will be performed in accordance with the American Society of Testing and Materials, test method ASTM D1557-78.

3.0 PREPARATION OF AREAS TO BE FILLED

3.1 Clearing and Grubbing

All brush, vegetation, and debris shall be removed or piled and otherwise disposed of.

3.2 Processing

The existing ground which is determined to be satisfactory for support of fill shall be scarified to a minimum depth of 6 inches. Existing ground which is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until the soils are broken down and free of large clay lumps or clods and until the working surface is reasonably uniform and free of uneven features which would inhibit uniform compaction.

3.3 Overexcavation

Soft, dry, spongy, highly fractured or otherwise unsuitable ground, extending to such depth that surface processing cannot adequately improve the condition, shall be overexcavated down to firm ground, approved by the consultant.

3.4 Moisture Conditioning

Overexcavated and processed soils shall be watered, dried-back, blended, and/or mixed, as required to attain a uniform moisture content near optimum.

3.5 Recompaction

Overexcavation and processed soils which have been properly mixed and moisture-conditioned shall be recompacted to a minimum relative compaction of 90 percent.

3.6 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal : vertical), the ground shall be stepped or benched. The lowest bench shall be a minimum of 15 feet wide, shall be at least 2 feet deep, shall expose firm materials, and shall be approved by the consultant. Other benches shall be excavated in firm materials for a minimum width of 4 feet. Ground sloping flatter than 5:1 (horizontal : vertical) shall be benched or otherwise overexcavated when considered necessary by the consultant.

3.7 Approval

All areas to receive fill, including processed areas, removal areas and toe-of-fill benches shall be approved by the consultant prior to fill placement.

4.0 FILL MATERIAL

4.1 General

Material to be placed as fill shall be free of organic matter and other deleterious substances, and shall be approved by the consultant. Soils of poor gradation, expansion, or strength characteristics shall be placed in areas designated by consultant or shall be mixed with other soils to serve as satisfactory fill material.