County of Santa Cruz

DEPARTMENT OF PUBLIC WORKS

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JOHN A. FANTHAM
DIRECTOR OF PUBLIC WORKS

AGENDA: DECEMBER 14, 1999

December 8, 1999

SANTA CRUZ COUNTY BOARD OF SUPERVISORS
701 Ocean Street
Santa Cruz, California 95060

SUBJECT: AMESTI ROAD DEWATERING PROJECT PHASE I REPORT AND PHASE II DESIGN ENGINEERING AGREEMENT

Members of the Board:

In September 1998, your Board approved a contract with EMCON Associates of Sacramento to investigate and attempt to stabilize the large landslide that severed Amesti Road in 1995 just west of Crow Avenue. Using funding authorized by the State Office of Emergency Services (OES) for protective emergency measures along with our 25 percent local match Road funds, EMCON initiated an engineering investigation of the storm-related slide damage. Under that contract, they were first to provide a report on the specific reasons for this landslide and how to arrest further slide movement in order to stabilize this section of Amesti Road, and then proceed to install the necessary dewatering system. Once this was accomplished and the results verified through a monitoring program, Public Works could then activate the Federal Emergency Management Agency (FEMA) DSR No. 1203-27263 to obtain funding to assist with the actual repair of the failed sections of the county road.

The engineering work by EMCON was to be provided in three individual phases. This initial phase, which began in the fall of 1998, provides for the investigative study and recommended solution as to how to halt the landslide by dewatering the area below Amesti Road. The second upcoming phase of work originally called for EMCON to design *and install* groundwater extraction wells. Phase III was then to cover the monitoring of the dewatering process to determine if the slide had been stabilized.

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Attached for your Board's review is the Phase I Report by EMCON and their subconsultant, Cotton, Shires and Associates (CSA) of Los Gatos. This report describes the controlling factors behind this very significant landslide. Included in their report is a proposed method of stabilization employing groundwater interception wells which EMCON feels may allow for the eventual repair of Amesti Road. Below is a summary of their report.

FINDINGS

The team of engineers (EMCON and CSA) determined that the slide is much larger than anticipated, is still very active, and is part of a large, ancient slide. They warn that future movement or advancement of the top of the slide (the head scarp) could eventually result in damage to the surrounding residential areas (see Exhibit A). The 1,500 foot by 500 foot slide is approximately 68 feet deep at the head scarp near Amesti Road, and 15 feet deep near the slide toe (see Exhibit B). They have confirmed that the slide continues to move during high groundwater events, which they believe is attributed to the following conditions: the presence of non-porous clay deep within the slide that tends to trap water and cause sliding; the seepage of rain water and surface runoff into slide fissures throughout the entire slide mass, a significant portion of which is on private property; and the injection of septic effluent into the water table from the residential community east of the slide (the Crow Avenue area).

Their report goes on to suggest that unless both the general surface water (runoff) and septic effluent injection (Crow Avenue leach pits) are not controlled, it is highly likely that further sliding will continue uphill toward the Crow Avenue area. They also note that the presence of leachate in the slide could complicate the County's being able to obtain a discharge permit for the dewatering process from the Regional Water Quality Control Board.

RECOMMENDATIONS

EMCON is recommending the installation of sixty groundwater extraction wells spaced approximately 100 feet apart, along with four horizontal weeps at the toe of the slide at an estimated cost of approximately $560,000 (see conceptual layout, Exhibit C). Their report also suggests that additional wells may yet be necessary but cannot be estimated at this time. They recommend that some other type of septic effluent discharge may be necessary for the homes in the Crow Avenue area to minimize their burden on the proposed dewatering system. They also recommend that well installation take place during the driest part of the year to prevent further landslide movement (due to high groundwater) from shearing the wells, and that the existing surface fissures in the area of the slide be graded so that runoff is redirected out of the slide mass. Both the upgradient and downgradient property owners along with the County (Public Works) would seem to be likely participants in financing for the actual operation and maintenance of the dewatering system and the required grading since most of these proposed wells and existing fissures are located on private property and therefore outside the public domain and the control of the Department of Public Works.

In conclusion, if long range stabilization of the Amesti Road study area is to be achieved, the funding budgeted for this project in the fiscal year 1999/2000 Road Budget will *not* be sufficient for *all* the work at hand, although it is sufficient to fund the design. Moreover, it may not be appropriate to fund all of the construction costs from the Road Budget, as most of the dewatering system and the benefits to be derived therefrom lie outside of the County's road right-of-way. To fully stabilize this landslide with some factor of safety, after EMCON develops more accurate cost estimates, could end up costing upwards of $1,000,000. It would therefore seem that in order to determine what these actual costs will be, the County should have EMCON proceed with the design phase using the funds now available for this project, and use that information to consider where we go from here.

Toward that end, since the final solution now appears to reach far beyond the limits of the County's right-of-way or its Road Budget, it would appear that any solution will most likely involve the participation of the Planning Department and Environmental Health, so as to identify appropriate funding sources for the construction and operation of the dewatering system, and a long term solution to the area's landslide stability problems and its septic effluent disposal concerns,

Attached is EMCON's Phase II design contract proposal for a not-to-exceed amount of $92,400.00, along with an amendment to their existing independent contractor agreement authorized in September 1998. The revised proposal (which now separates out the actual well *construction work* from the design phase) calls for EMCON to continue ongoing monitoring of the existing ground movement system, design the expanded dewatering well system, provide for future landslide monitoring, reconnaissance and replacement of inclinometers, and prepare the plans and specifications so that, once the required funding sources have been identified and the necessary permits obtained, Public Works could then bid and construct the necessary dewatering facility installations. Sufficient funding for this second phase of the project remains available in the approved 1999/2000 Road Budget, which includes a one-time 75 percent contribution from OES with the balance coming from the Road fund.

It is therefore recommended that the Board of Supervisors take the following action:

1. Accept and file the attached Amesti Road Dewatering Project Phase I Report from EMCON.

2. Direct Public Works, Planning, and Environmental Health to meet and develop alternative funding options and program responsibilities.

3. Approve the attached amendment to agreement with EMCON for Phase II engineering design services for the Amesti Road Landslide Stabilization Project for a not-to-exceed amount of $92,400.00.

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4. Authorize the Director of Public Works to sign the agreement on behalf of the County.

5. Direct Public Works, Planning and Environmental Health to return to the Board on or before March 7, 2000, with a report on the outcome of Phase II design of the stabilization of the Amesti Road landslide, alternative funding options, and program responsibilities.

Yours truly,

JOHN A. FANTHAM
Director of Public Works

TLB:bbs

Attachments

RECOMMENDED FOR APPROVAL:

County Administrative Officer

copy to: D. A. Christian, Office of Emergency Services
Harry Sherwood, Federal Emergency Management Agency
City of Watsonville Water Department
EMCON Associates
Environmental Health
Planning Department
Public Works Department

ARDBB

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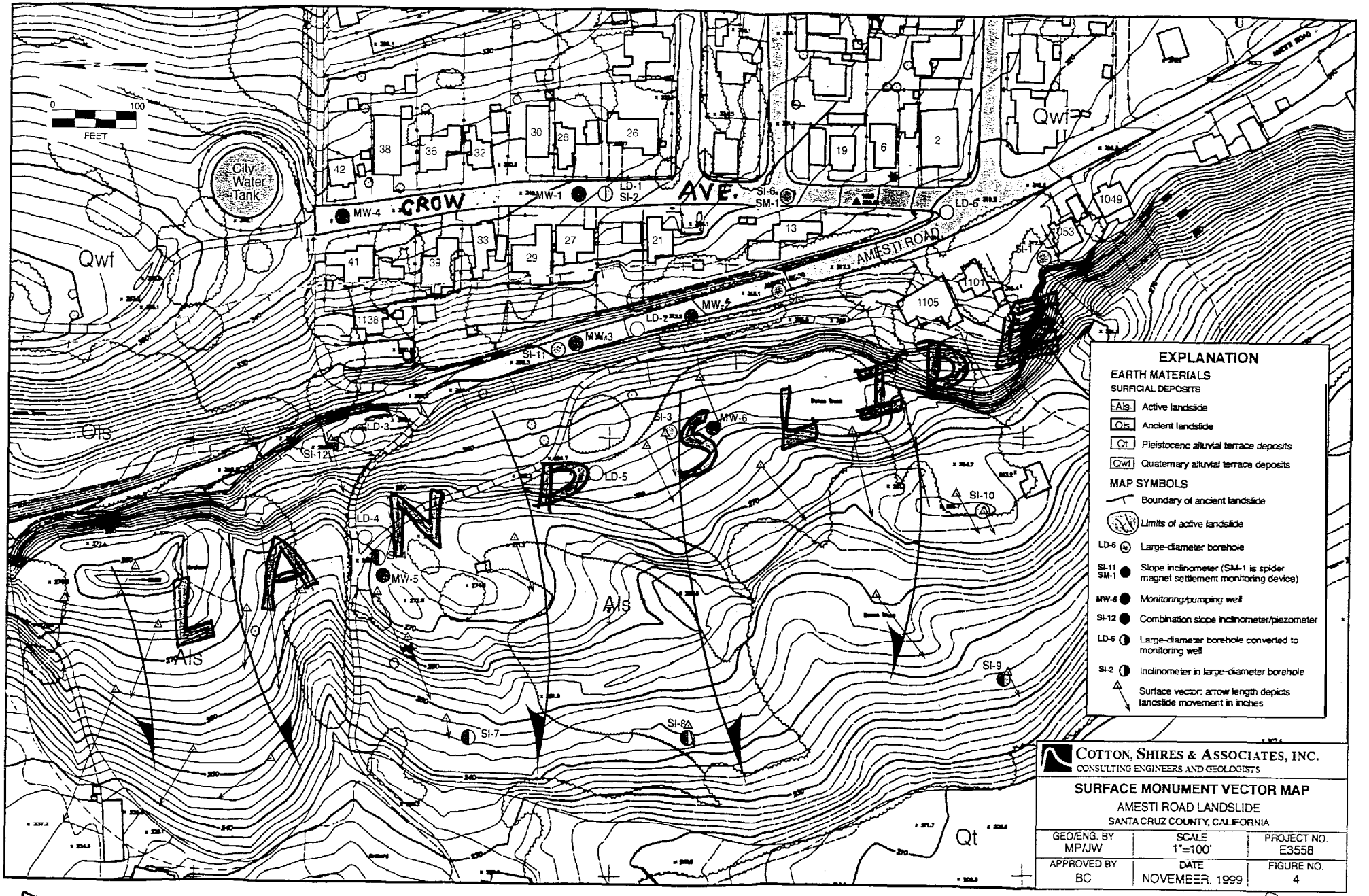

EXHIBIT A

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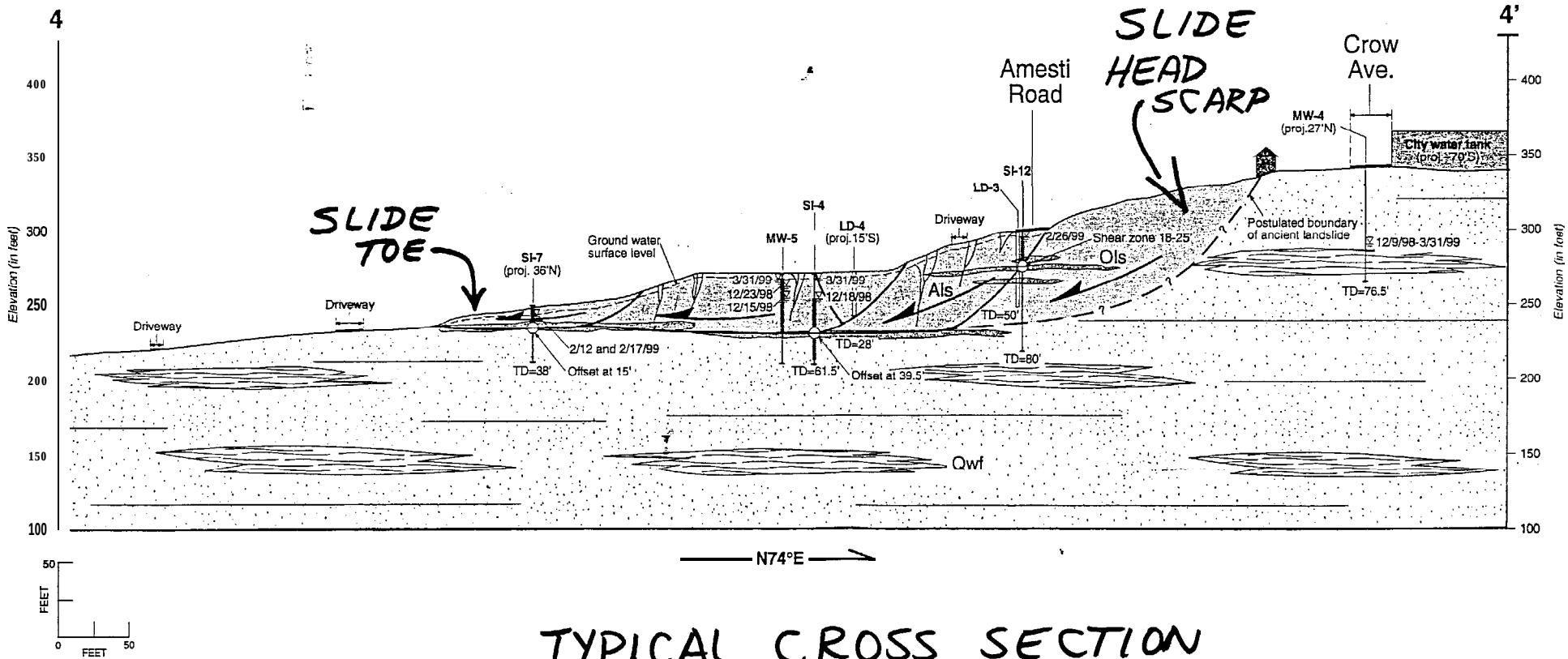
DRAFT



TYPICAL CROSS SECTION THROUGH LANDSLIDE

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EXHIBIT B

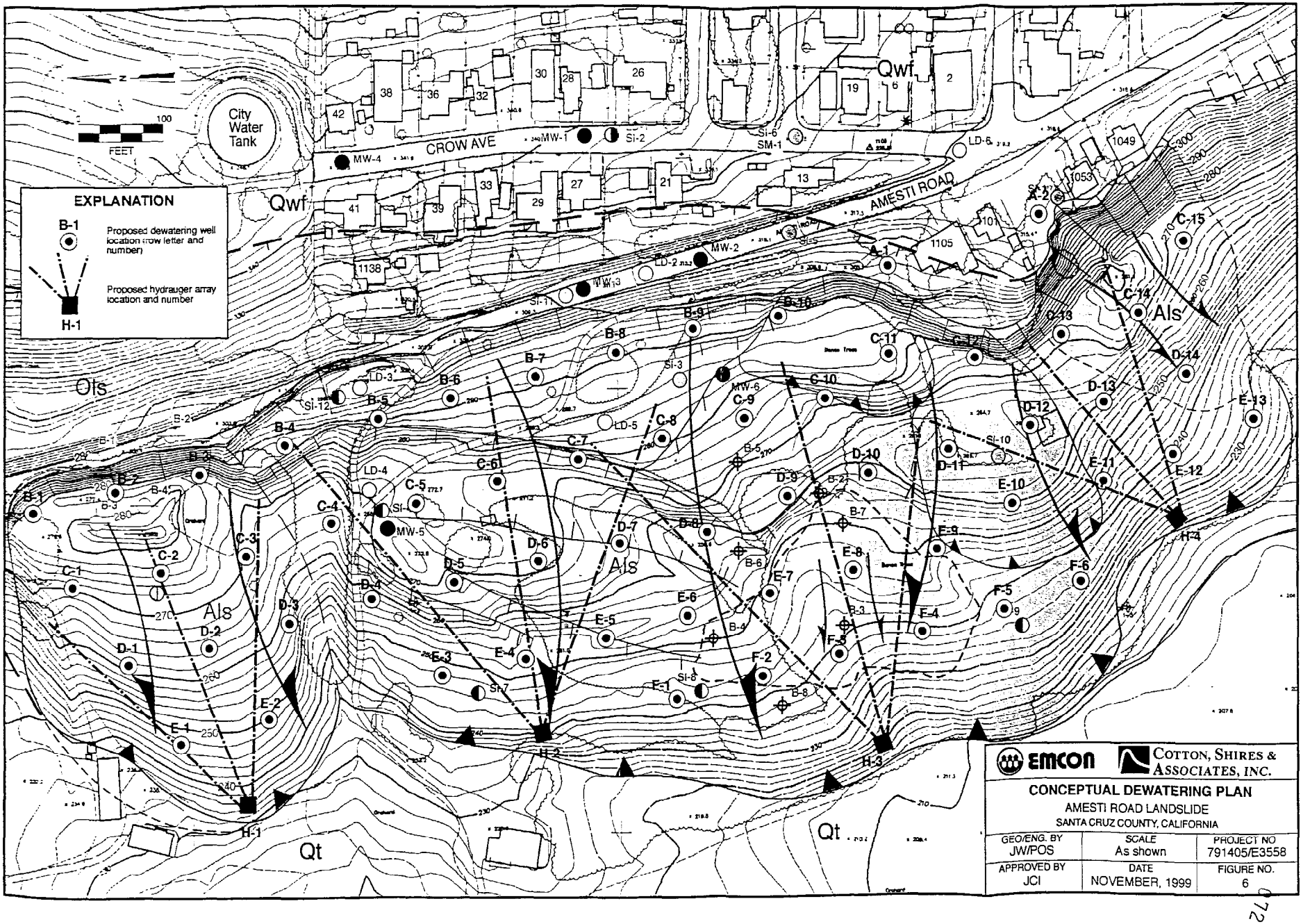

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EXHIBIT C

0129

AMENDMENT TO AGREEMENT 0730

The parties hereto agree to amend Contract Number 81688 dated September 3, 1998, by and between the COUNTY OF SANTA CRUZ and IT/EMCON, for engineering design and investigation services for the dewatering stabilization of the Amesti Road Landslide Stabilization Project by amending the terms of the contract to allow for a revision to the Phase II amount and scope of work as described in the attached proposal. This amendment will reduce the Phase II amount from $230,536 to $92,400 by eliminating the well construction portion of the work from EMCON's contract.

All other provisions of said contract shall remain the same.

DATED: _____

COUNTY OF SANTA CRUZ
DEPARTMENT OF PUBLIC WORKS

_____
DIRECTOR OF PUBLIC WORKS

CONTRACTOR:
IT/EMCON

BY: _____

ADDRESS: 1433 N. Market Blvd.
Sacramento. CA 95834-1943

TELEPHONE: (916) 928-3300

Approved as to form:

_____
Chief Assistant County Counsel

DISTRIBUTION: Auditor-Controller
Public Works
Contractor

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ARB

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REV.7199

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December 8, 1999
Proposal 778383

Sill Williamson, P.E.
Senior Civil Engineer
County of Santa Cruz
Department of Public Works
701 Ocean Street, Room 410
Santa Cruz, California 95060

Re: Proposal for the Revised Phase II Portion of the Amesti Road Landslide Stabilization Project

Dear Mr. Williamson:

The purpose of this letter is to transmit a proposal for the revised Phase II portion of the Amesti Road Landslide Stabilization Project (ARLSP). The ARLSP is subdivided into several phases. Phase I of **the** project, a groundwater and landslide investigation, was completed in November 1999 (Phase I Amesti Road Storm Damage Assessment Report, IT/EMCON, November 19, 1999).

BACKGROUND

The Amesti Road storm damaged site is located near the intersection of Amesti Road and Crow Avenue in Santa Cruz County, California (Figure 1). The damage to the site consists of an embankment failure (landslide) of approximately 1,500 feet length and 500 feet in width that has destroyed two homes and sections of Amesti Road. The first occurrence of movement of the Amesti Road landslide occurred during the winter of 1981-82 (a year with record precipitation). Since this time, major movements of the landslide have occurred during the wet winters of 1992-1993, 1994-1995, 19951996, and 1997-1998.

EMCON along with our subcontractor Cotton, Shires and Associates (CSA) was retained by Santa Cruz County in 1998 to provide engineering and construction services for investigative engineering and dewatering of the subject storm damages Ko Amesti Road. The contract was 'For the following three phases of work:

- Phase I - Groundwater and Landslide Investigation ($280,947)

- Phase II - Design/Build Groundwater Extraction System ($230,536)
- Phase II - Groundwater Monitoring Program ($38,903)

The original schedule for the Phase I portion of the work showed a March 1999 completion dare. However, as the investigation proceeded it was discovered that the landslide had not stopped moving following the winter 1997/1998-damage event. This ongoing movement required CSA to monitor the movement of the landslide longer than what was originally allocated in the Phase I budget. The monitoring of the landslide continued through September 1999 requiring six additional monitoring events. Because of the continued movement of the landslide and the valuable slope stability information gathered during the ongoing movement, the final slope stability analysis was delayed until October 1999.

The findings and recommendations of the Phase I investigation are as follows:

FINDINGS

Based on our combined investigations, we are presenting the following findings:

- The landslide was initially recognized in 1981 as a smaller feature lower on the slope that has since grown episodically, both laterally and upslope, to its present size. Amesti Road was impacted by the landslide in 1995. The continued upslope progression of the landslide appears to be a result of incremental removal of downslope and lateral support. The total volume of earth materials within the active landslide appears to be approximately one million cubic yards.

- The landslide is characterized as a "landslide complex" consisting of discrete lobes that have coalesced into an approximately 1,500-foot long, by 500-foot wide active landslide (see Figure 4). The long dimension of the landslide is roughly parallel to Amesti Road, which is perpendicular to the direction of landslide movement.

- The entire Amesti Road active landslide appears to be part of a larger ancient landslide. The steep embankment areas to the south of the active landslide are also highly susceptible to landslide movement in the future. Such future expansion of landslide could cause damage to Amesti Road and residential structures in the area beyond that which has already occurred.

- We have identified a potentially unstable, incipient landslide lobe referred to as the Southern Promontory that appears to be an area likely to experience landslide movement in the future. We have installed an inclinometer in this area to monitor ground movements at depth.

- The majority of the site is underlain by horizontally bedded, unconsolidated gravel, sand, silt and clay associated with stream terrace deposits of the Quaternary Watsonville Tcrracc. Organic clay and peat deposits are interbedded within the stream deposits and appear to be associated with lagoon or back bay environments of deposition.

- The basal rupture surface of the landslide appears to be founded primarily within a near-horizontal, organic-rich clay deposit. The basal rupture surface attains a maximum depth of nearly 68 feet below the ground surface in the upslope portion of the landslide and is as shallow as 15 feet below ground surface near the toe of the landslide

- Since the active Amesti Road landslide occurred within a preexisting older landslide, and since the initial landslide occurred approximately 200 to 250 feet below the roadway, it appears that the construction of Amesti Road, which we understand was performed in the early 1900's, has had little to no influence on the stability of the nearby slopes.

- Rainfall and the resultant rise in groundwater levels apparently most recently triggered landslide movements in the winter of 1998/99. This movement, which totaled approximately 2 to 3 inches, was characterized by consistent, relatively slow creep movements along areas of preexisting landslide movement. Pronounced ground cracks arc visible at the headscarp of the landslide due to the 1998/99 movements.

- The instability of the landslide mass is primarily associated with high groundwater conditions within unconsolidated, weak, stream ten-ace deposits. Headward migration of the landslide appears to have progressed upslope during years of high rainfall and elevated groundwater levels.

- Groundwater levels within the Amesti Road landslide were closely monitored throughout the winter, spring and summer of 1999, and were found to be elevated to within 1 to S feet of the ground surface during the rainy season, while the landslide was moving. The groundwater levels ranged from 4 to 6 feet below the ground surface in the late spring when the landslide movement

- slowed considerably. We back-calculated a representative cross section through the Amesti Road landslide using a groundwater level of 4 feet below ground surface at the time when landslide movement ceased.

High groundwater conditions are likely associated with:

1. A high percentage of clay and silt sediments at the basal rupture surface that prevent vertical infiltration through the landslide and **allow** for the build-up of excessive pore pressures;

2. Injection of septic effluent into the residual water table from the community to the east of Amesti Road;

3. Surface water runoff that is directed onto the active landslide area; and

4. Open fissures within the landslide mass that allow for direct recharge of the landslide by rainfall and surface water runoff.

- Unless groundwater, surface water, and septic effluent discharge controls are initiated, it is highly likely **that** the Amesti Road landslide will continue to reactivate and migrate laterally and upslope, eventually impacting the community to the east. The injection of septic effluent into deep leach pits may be providing a continuous, high baseline water level within the active landslide and upslope areas.

- Based on slope stability analyses, it appears that if the Amesti Road landslide continues to fail to the point where it no longer provides lateral support for upslope properties, the landslide could retrogress upslope to the second row (eastern side of the road) of houses along Crow Avenue before reaching stability.

- Slope Stability Calculations indicate that the static stability of the landslide mass can be increased to a factor of safety of FS-1.5 if groundwater levels can be maintained at a depth of approximately 28 feet below the ground surface within the landslide area.

- The Amesti Road site is anticipated to be subjected to moderate to strong seismic ground shaking in the future. **A** maximum ground acceleration of 0.64g, and a shaking duration lasting several tens of seconds should be

anticipated. The 1989 Loma Prieta earthquake reportedly was responsible for re-activation of the landslide, at a time of relatively low groundwater and dry antecedent moisture conditions.

- Based on slope stability analyses, it appears that the landslide will **move** from approximately 12 to 20 inches during design earthquakes of magnitudes 6.5 to 7.5, respectively, even with the dewatering system in place and operational.

- Slope stability analyses were performed on the in-situ conditions and have not been performed to include the possible reconstruction alternatives for Amesti Road. It should be understood that, depending upon the repair option employed for reconstructing Amesti Road (i.e., engineered fill, retaining walls, tie back walls, etc.), the slope stability results may be altered such that the groundwater level necessary to maintain a suitable factor of safety may have to be modified.

- A survey monitoring array was established along the surface of the landslide to enable surface monitoring once the inclinometers become unreadable due to excessive landslide movements. To date, all of the inclinometers remain functional; however, most of the inclinometers within the landslide are near their functional limits (2 to 3 inches of differential displacement), and are anticipated to be sheared off soon after the landslide initiates movements in response to the upcoming 1999/2000 winter rains.

- Based on hydraulic testing of representative samples of the landslide **mass, it** appears that the subsurface conditions cannot easily be dewatered. Because of the clayey, silty soil conditions, extraction wells are only expected to yield 0.5 to 0.8 gpm. The multi-lobe nature of the landslide will likely inhibit drainage and groundwater flow within the landslide mass. Movement of the landslide **mass has** internally sheared and offset the more permeable substrates that might readily transmit and drain groundwater (i.e., the more the landslide moves, the more difficult it becomes to dewater and stabilize).

- The amount of County and OES funding available **in** Phase II appears to be insufficient to stabilize the landslide mass to a level necessary for maintenance of Amesti Road on a long term basis. Alternative funding sources will be needed to fund both construction and long-rem operation of the dewatering system.

RECOMMENDATIONS

The recommendations of the study are as follows:

- Install approximately 60 extraction wells and 4 hydrauger arrays in the landslide mass. The wells should be installed at about 100-foot centers within the active landslide area (see Figure 4). Our preliminary engineers construction cost estimate to install this extraction system is approximately $560,000; however this cost estimate is very preliminary and a more definitive estimate will be prepared after the design of the system is completed in Phase II of the project. It should be noted that too date, none of the original Phase II funding ($230,536) has been committed and should be available to partially fund this estimate.

- The installation of hydraugers should be considered as a pilot program because of the benefit afforded by gravity drainage and the relatively low cost of installation. The success of hydraugers in fluvial deposits will need to be judged as part of the pilot program and monitoring and maintenance issues will need to be addressed. Hydraugers would also provide continual landslide drainage if a pump system failure were to occur. Hydraugers alone, would most likely be unable to draw down the groundwater to acceptable levels; consequently, vertical dewatering wells will likely need to supplement hydraugers or to act alone if hydraugers are unsuccessful.

- If a dewarering program is to be successful, measures must be taken to maintain the dewatering system during large storm events when the power supply is likely to be interrupted. This coincides with a time when groundwater levels could be expected to be at their highest levels. Estimated annual operations and maintenance costs, including standby generators (rented or from County equipment), are $13 1,600.

a We recommend that the dewatering system incorporate flexible pipe connections to account for possible landslide movement, and to compensate for potential settlement due to dewatering.

- The timing for installation of a dewatering system will be critical to the successful performance of the system. Specifically, the dewatering system, as a whole, should be able to be installed within the period of 2 to 3 months, corresponding to the time when the landslide has ceased movement for the summer dry months. We recommend that the landslide be 'essentially stopped' prior to installation of the first of the wells in the dewatering system.

'Essentially stopped' means that the landslide has slowed to the rate of approximately 0.1 inch per month. In the summer of 1999, the landslide slowed to achieve this movement rate by June. It should be understood that heavy winter rains in 199912000 could push this timing back well into July or even August of 2000.

- **As** part of a future project phase, additional wells may be necessary to control movement of the entire landslide mass. These additional wells may be necessary to reduce the 100-foot spacing in the initial pattern of wells. These additional wells could be installed if high groundwnter levels were noted in the monitoring wells and/or if significant movement continues to be detected **in** the inclinometers within rhe landslide mass. At this time, it is not possible to determine whether or where the well spacing should be closer than 100 feet; however, it is prudent to consider that additional extraction wells may be required and to consider how they would be funded.

- Surface water must be **strictly** controlled within **the** landslide area. All surface water above the active landslide area should be re-directed around the landslide. The landslide area should be regraded to fill in open fissures and large depressions to promote surface drainage off of the landslide. Previous experience with **this** site dictates that this task be performed prior to the onset of winter rains. Our preliminary engineers' estimate of the construction cost estimate to regrade the landslide area is approximately $20,000; however since most of the fissures are within private property, the individual property owners may be responsible for completing this task.

- Right-of-way and/or easement agreements with the existing owners of the properties encompassed by the landslide would have to be acquired for mstallation of the proposed groundwater extraction system and/or regrading of the landslide area. The County should consider obtaining access rights to the area south of the active Amesti Road landslide for the purpose of investigating the stability of the slopes in this area.

- To monitor the effects of the groundwater extraction system and movement of the landslide mass, six to eight additional monitoring well/inclinometers should be installed to adequately monitor the landslide and determine acceptable movement rates whereby the dewatering well installation can begin. The estimated cost to install the additional monitoring well/inclinometers is approximately $20,000; however this cost estimate is preliminary; and a more definitive estimate will be prepared after the design of the monitoring system is completed in Phase II of the project.

- Continued surface and subsurface monitoring of the landslide and upslope areas will be necessary to assess the performance of the dewatering system. **We** recommend that an additional 1 year period of monitoring be funded at an approximate cost of up to 29,000 (depending if monitoring is continued monthly or bi-monthly). This includes monthly readings of all inclinometers, piezometers, and extensometers. In addition, we would continue to survey the surface monuments as a backup system should all of the inclinometers be sheared off completely due to rapid landslide movements. We would provide Santa Cruz County with a summary of the monthly readings. If the existing inclinometers become unreadable due to excessive shearing, then we recommend additional inclinometers be installed.

- Limits should be placed on the amount of septic disposal upslope of the landslide mass. The present septic effluent disposal methods, including injection through the use of deep pits in the community to the east of Amesti Road, are not advantageous to the control of groundwater in the landslide mass. The injection and infiltration of effluent to the water table upgradient of the extraction system places an additional dewatering burden on the extraction system.

- Based on chemical data, and pending approval by the Regional. Water Quality Control Board, discharge of extracted groundwater to Corralitos Creek appears to be a feasible option for stabilizing the landslide. An NPDES permit should be obtained from the RWQCB for the discharge of the extracted groundwater into Corralitos Creek.

- The septic effluent disposal methods used in the community to the east of Amesti Road could influence the RWQCB to require the pre-treatment of the extracted groundwater. Pre-treatment design may have to mitigate Fecal-Coliform bacteria (including E-coli) and nitrates. The septic effluent constituent loading to the groundwater is not advantageous for obtaining an NPDES permit from the RWQCB.

- Our preliminary engineers' construction cost estimate to install a pre-treatment system, if one is required, is approximately $350,000; however this cost estimate is very preliminary and a more definitive **estimate** can be prepared after the NPDES permit is issued by the RWQCB and the design of **the system** (it warranted) is completed in Phase II of the project.

- The landslide has grown to such a size and contains a complexity of sub-slides that makes it very difficult to predict where extensive dewatering may be required. We do not believe that it is technically feasible to opine **that any** dewatering system, no matter how extensive it is, will prevent **all** future movement within the Amesti Road landslide mass. However, we believe that if some form of groundwater, **surface** water, and septic effluent discharge control is not initiated, **the** landslide will continue to move and enlarge upslope toward the community to **the** east of Amesti Road.

SIGNIFICANT COST IMPLICATIONS OF THE PHASE I INVESTIGATIONS

The significant cost implications of the Phase I investigations are as follows:

- Estimated cost for the Design/Build Groundwater Extraction System increased from $280,947 to approximately $560,000. The original Phase XI budget was predicated on the assumption that 20 extraction wells would be necessary to stabilize the landslide. However, the Phase I investigation discovered geotechnical and hydrogeologic conditions that would require a more extensive dewatering system. The proposed revised dewatering system may contain 60 extraction wells and four hydrauger arrays. This is essentially a three-fold increase in the number of extraction points (wells and hydraugers). The original Phase II Design/Build estimate had an average cost of approximately $14,000 per extraction point. The proposed revised Phase II Design/Build preliminary estimate has an average cost of approximately $8,800 per extraction point.

- The Phase I investigation discovered a number of large depressions and open fissures in the landslide area. These topographic features allow surface water to enter the landslide mass and add to its instability. Therefore, it is recommended that the landslide surface be regraded to promote drainage off of the landslide area. Our preliminary estimate of this additional Phase II task is $20,000, although this cost does not address access/easement costs or impacts on the surrounding orchard. The original Phase II estimate did not assume that

the landslide area would require regrading to remove large depressions and open fissures.

- The Phase I investigation discovered that the landslide mass is very mobile, with significant movement following the winter rains continuing into the mid-summer months. As a result of this significant ongoing movement six to eight of the existing 12 inclinometers could likely to be destroyed by the landslide during the 1999/2000 rainy season. These inclinometers are necessary to monitor the ongoing movement in the landslide mass, and to act as a gauge or an early warning system as to when another failure muy □□□◆□ in the Amesti Road area. Our preliminary estimate to replace destroyed inclinometers is approximately $20,000. The original Phase II estimate did not assume a replace cost for destroyed inclinometers.

- Because of the significant ongoing movement of the landslide mass one of the recommendations of the Phase I investigation was that the construction of the dewatering system be delayed until the landslide is essentially stopped (0.1 inches per month). Therefore, continued monitoring of the landslide mass is critical to the successful performance of the system. In the summer of 1999, the landslide slowed to this rate in June. The 1999/2000 rainy season could reactivate movement in the landslide that could continue on into July or August of 2000. At the present time CSA, our geotechnical subcontractor, is not monitoring the movement in the landslide mass. Because of the potential danger that continued movement of the landslide could trigger a new catastrophic failure, which could destroy or produce significant damage to homes in the subdivision to the east of Amesti Rand, it is recommended that monitoring of the landslide be restarted. Our estimate For continued monitoring of the landslide is approximately $29,000 per year. The original Phase II estimate did not account for any ongoing landslide monitoring prior to the construction of the dewatering system. This cost could be reduced if monitoring frequency was reduced to bimonthly.

- One of the findings of the Phase I investigation was that the injection of septic effluent from the homes in the subdivision to the east of Amesti Road appears to be contributing to the high water level conditions in the landslide mass. The chemical analysis of the groundwater in the landslide mass indicates that the groundwater could be discharged to Corralitos Creek. However, we are aware that the Regional Water Quality Control Board (RWQCB) could require pretreatment of the groundwater prior to discharge into the creek. Because of the septic waste discharges to the groundwater, a pretreatment system could entail the treatment of Fecal-Coliform bacteria

(including E-coli and nitrate). Our preliminary estimate to install a pretreatment system, if one is required, is approximately $350,000. At this point in the project it is not possible to determine if the RWQCB, which must issue an NPDES permit to discharge the groundwater to the creek, will require a pretreatment system. The original Phase II estimate did not assume a pretreatment system for the extracted groundwater.

- It should be noted that the various repair options for reconstructing Amesti Road following dewatering will affect the stability of the landslide, and thus, the dewatering program should be modified to account for the road repairs. Supplemental slope stability **analyses** should be incorporated into the investigation and design of the roadway repairs, and the potential impact that these repairs will have on the stability of the landslide should be addressed.

REVISED PHASE II SCOPE OF WORK

This revised Phase II cost estimate is for the following tasks:

- Fund additional and current landslide monitoring events by CSA in preparation of the Phase II engineering
- Engineering design of the proposed dewatering system and landslide grading Plan
- Ongoing landslide monitoring
- Replace all destroyed inclinometers identified during monitor reading visits, as necessary

Following the completion of the engineering design a more definitive construction cost estimate for the dewatering system and the landslide grading, and for a potential pretreatment system will be provided to the County for funding purposes. A detailed estimate of the revised Phase II casks are contained below.

Additional Landslide Monitoring During **Phase I**

The original contract estimate for monitoring of landslide movement anticipated that significant movement **for the** year would end after the winter season (e.g. March). Field measurements taken during the Phase I investigation indicated that significant earth movement was continuing beyond this date. Monthly monitoring was consequently

continued until September to continue data collection for use in the engineering slope analysis. These additional monitoring events were required to determine the magnitude of the total annual movement as well as to determine when movement stopped. This led to six additional monthly monitoring events than originally estimated at a per event cost of $2,400 for a total cost increase of $14,400.

Additional Engineering Design Services for Expanded bewatering System

Based on rhe results of the Phase I investigation it appears certain that rhe originally proposed dewatering system comprising 20 extraction wells will not be adequate to sufficiently dewater the landslide to reduce movement. Preliminary analysis indicates that a combination of 60 wells, four (4) hydrauger arrays, a grading and surface water diversion plan, and potentially a water treatment system for the extracted ground water will be needed to attain the intended results. The expanded well field design and additional work elements has led to an increase in the level of effort needed to complete the design than originally estimated.

The design will include ground water modeling using the data collected during the Phase I ground water investigation to establish an initial distribution of well points, anticipated pumping rates, and well depths. The model will use Modflow ™ software. In addition, slope stability modeling (using the PC Stable ™ program) will be performed to verify the concept of increasing the landslide's factor of safety to FS-1.5 by dewatering. All well collection pipe lines, header systems, and the potential treatment plant design will be sized for flow rates determined by these calculations.

A complete equipment and materials list will be prepared for both estimating and contracting purposes. The treatment system will only be identified to a conceptual design stage until the need of such a unit is fully established, EMCON will assist the County in acquiring all necessary permits for the construction phase of the project.

Total costs associated with the increased scope of engineering services are estimated be $24,000.

Additional work elements and associated design costs are described below:

Ongoing Landslide Monitoring $29,000
(approx. $2,400 per month)

We will continue to monitor the inclinometers and piezometers during the time interval between the end of Phase I and the initiation of the groundwater pumping program. It is our opinion that this data will be critical to the understanding of the subsurface characteristics leading to landsliding, will provide early warning of incipient landslide movement above the active landslide, and will help to determine the critical time when landslide movement stops so that the dewatering system can be installed. As a cost savings monitoring could be performed bi-monthly rather than monthly.

We will prepare a brief technical summary report and appropriate illustrations to summarize the findings of our monitoring program and provide these to the County on a monthly basis.

Funding to Replace Destroyed Inclinometers $20,000

Approximately 6 small-diameter boreholes will be excavated for the exclusive purpose of re-establishing slope monitoring stations (inclinometers) within the landslide that were lost (or will. be lost shortly) due to landslide movements. The purpose of these monitoring stations is to determine the depth of landslide movement, the movement direction, the rate of movement, and the relative rates of movement between different portions of the landslide and the subdivision. With the existing useable inclinometers and our surface monitoring array, we can continue monitoring the landslide movements if several of the seven landslide inclinometers are lost. Consequently, this task can be performed on an as needed basis depending upon the amount of landslide movement during the upcoming winter.

Southern Embankment Reconnaissance Investigation — $5,000

Based upon the results of the Phase I landslide investigation, we have identified the area south of the active Amesti Road landslide (i.e., Southern Embankment) as being susceptible to future landslide movement capable of adversely impacting Amesti Road (as well as private residential-structures).

Consequently, it is our opinion that it wold be prudent to investigate these areas at this time from a reconnaissance-level standpoint to provide the County with information rhac could characterize levels of risk to Amesti Road and identify possible future courses of action needed in this area.

Historical and recent aerial photographs will be obtained and analyzed with a stereoscope to evaluate the site conditions along the Southern Embankment and document changes over time.

Reconnaissance-level geologic mapping will be performed on the existing topographic base map generated during Phase I. Several representative engineering geologic cross-sections will. be developed at the sites where the Southern Embankment poses the greatest potential risk to Amesti Road.

A brief letter-report will be provided that summarizes the results of the reconnaissance mapping. The engineering geologic map and engineering geologic cross-sections will be included in the summary report. An evaluation of the site conditions will be performed and recommendations will be provided.

If you have any questions, please call either of the undersigned.

Sincerely,

EMCON

J. C. Isham
Project Manager

Steve Hickey
Project Engineer

AMESTI ROAD LANDSLIDE STABILIZATION PROJECT

REVISED SCOPE OF SERVICES FOR PHASE II ENGINEERING DESIGN AND ADDITIONAL FIELD MONITORING

Additional Landslide Monitoring	$14,400
Engineering Design of Expanded Dewatering system	$24,000
Ongoing Landslide Monitoring	$29,000
Funding to Replace Destroyed Inclinometers	$20,000
Southern Embankment Reconnnisance	$ 5,000
Total Estimate	$92.400

COUNTY OF SANTA CRUZ

REQUEST FOR APPROVAL OF AGREEMENT

0746

TO: Board of Supervisors
County Administrative Officer
County Counsel
Auditor-Controller

FROM: PUBLIC WORKS (Dept.)

(Signature) (Date)

The Board of Supervisors is hereby requested to approve the attached agreement and authorize the execution of the same.

1. Said agreement is between the COUNTY OF SANTA CRUZ (Agency)
and IT/EMCON
1433 N. MARKET BOULEVARD, SACRAMENTO, CA 95834-1943 (Name & Address)

2. The agreement will provide for engineering design and investigation services for the dewatering stabilization of the Amesti Road Landslide Stabilization Project

3. Theagreementisneeded because the work can be performed most expeditiously by contract.

4. Period of the agreement is from Board Approval to June 30, 2000

5. Anticipated cost is $ Reduce 138,136.00 (Phase II) 12-14-99 Board (Fixed amount; Monthly rate; Not to exceed)

6. Remarks: Contract $412,250.00; 6% Overhead $24,735.00; Total $436, 985.00

7. Appropriations are budgeted in 621198 ! 70761 ! 3665 ! (Index#) 3590 (Subobject)

NOTE: IF APPROPRIATIONS ARE INSUFFICIENT, ATTACH COMPLETED FORM AUD-74

Appropriations ~~are~~ are not available and ~~have been~~ will be encumbered. Contract No. 81688 Date 12/8/99

GARY A. KNUTSON, Auditor - Controller
BY Ronald J. Silva Deputy.

Proposal reviewed and approved. It is recommended that the Board of Supervisors approve the agreement and authorize the Director of Public Works to execute the same on behalf of the Department of Public Works (Agency).

County Administrative Officer

Remarks:

(Analyst)

BY Date

Agreement approved as to form. Date

WBW:bbs

Distribution:
Bd. of Supv. - White
Auditor-Controller - Blue
County Counsel - Green
Co. Admin. Officer - Canary
Auditor-Controller - Pink
Originating Dept. - Goldenrod
*To Orig. Dept. if rejected.

ADM - 29 (6/95)

State of California)
County of Santa Cruz) ss

I ex-officio Clerk of the Board of Supervisors of the County of Santa Cruz, State of California, do hereby certify that the foregoing request for approval of agreement was approved by said Board of Supervisors as recommended by the County Administrative Officer by an order duly entered in the minutes of said Board on

County Administrative Officer

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BY Deputy Clerk