LOR GEOTECHNICAL GROUP, INC.
Soil Engineering ▲ Geology ▲ Environmental

April 15, 2013

Engineering Resources, Inc.
1820 Commercenter Circle
San Bernardino, CA 92408

Project No. 40155BB.1

Attention: Mr. John Egan, P.E.

Subject: Geotechnical Evaluation of Damaged Storm Drain System, Western Side of East Highlands Ranch Community Center, Highland, California.

Mr. Egan,

As requested by you, we have completed our evaluation of the subject site area and have prepared geotechnical recommendations for repairing the damaged storm drain.

BACKGROUND

At the time of our site visit with you in March of this year, and at the time of preparation of this letter, the subject damaged 48-inch diameter storm drain consisted of the outlet pipe and rip-rap energy dissipater within the upper portion of a slope located about 250 feet south of Highland Avenue and 180 feet east of Rockspring Lane, within the western portion of the East Highlands Ranch Community Center property. The area is thought to mostly have been damaged by erosion from past rain events, however, a broken water line across the area appears to have also contributed to the erosion which ultimately caused the last two storm drain segments to collapse due to lack of support. It is our understanding that initial damage to this storm drain system was first noticed after the major storm event of December 2010.

As noted during our review of historic aerial photographs of the site and vicinity, the site area initially was utilized as part of a citrus grove. Although apparently never covered by citrus trees, dirt access roads for the groves previously existed nearby. The site, at this time, generally consisted of the northwest corner of a drainage course, Bledsoe Gulch, which had been offset by the San Andreas fault (which is located within approximately 50 feet and to the north of the site). Within many local areas, hydraulic mining of the local hillsides, using water cannons to generate soil materials, was a common practice used by farmers in order to fill in low areas prior to the planting of trees. It is not clearly evident in the early aerial photographs, but it may be the case that the site area was partially included within an area that was filled in order to create the topographic conditions needed to establish the local citrus grove development.

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Based upon our review of historic aerial photographs, the site area remained relatively unchanged from the late 1930's through the late 1980's. In the mid to late 1980's, grading for development of the East Highlands Ranch started and, during this time, the groves around the site were removed and a dirt road was graded in just west of the site. Soil piles were stockpiled in areas adjacent to this dirt road and some fill soils were placed just to the northeast of the site. Between 1986 and 1991, significant quantities of fill soils were placed in areas including the site and areas to the west and north. These fills were apparently placed in connection with grading for the adjacent residential housing tract located to the southwest.

Relatively minor amounts of fill materials appear to have been placed within the site area but mainly to the west and northwest of the site in the early 1990's. This grading created a flat area (temporary parking?) on the east side of Rockspring Lane which is located to the west of the site. The 2001 aerial photographs which we reviewed show that areas to the west, north and northeast were partially graded , mostly to create dirt haul roads. This dirt roads were very close to the site, however, it does not appear that fill was placed within the site area.

By 2005, the Community Center and related improvements had been constructed. The ribbon gutter that currently extends to the site over the approximate storm drain location, as well as the storm drain outlet structure, had been built. During grading and construction for this project, fill was placed just northeast of the site, but only a minor amount of fill appears to have been placed within the immediate site area.

This firm conducted soils investigations of the Community Center site prior to site development (LOR, 2002 and 2003). During our investigations, we documented that fills in excess of 30 feet were present onsite. Our client at the time opted to not remove all of the fill materials for economical and practical considerations and, as reported within our referenced compaction reports (LOR, 2004), only minimal removals were conducted within areas of deep fill within the parking lot areas. In addition, our records indicate that we did not provide observation and/or compaction testing service during construction of the subject storm drain.

OBSERVATION OF CURRENT CONDITIONS

The site area consists of the eroded upper portion of an existing slope, west of the East Highlands Ranch Community Center, where the subject 48-inch diameter storm drain empties into adjacent Bledsoe Gulch. At the time of our site visit, erosion had created a void, into which the last two storm drain segments fell, that measured approximately 30 feet wide, 40 feet long and up to about 15 feet in depth. Along with the pipe segments, loose soils and concrete panels from formerly existing

flatwork, were present in the bottom of the erosion gully. Additional areas of weakened soil, up to about 10 feet wide, are present locally along the side of the existing erosion gully and these are indicated by tension cracks in the soil. Based upon our observations, review of aerial photographs, and review available reports and maps, it appears that up to about 20 additional feet of fill material may be present beneath the area of failure. It should be noted that the area of ribbon gutter above the site did not reveal any significant indications for distress at the time of our site visit.

RECOMMENDATIONS

In order to produce an area of competent soils upon which to reconstruct the section of damaged storm drain, complete removal of all non-engineered fill materials below and adjacent to the improvements would be required. Considering the existing site conditions, the types of improvements and information provided by you, we understand that complete removal of the undocumented fill soils is not currently considered a viable solution from an economical or practical perspective. For these reasons, we have prepared the following recommendations which will do not include complete removal of the underlying, undocumented fill soils.

Following removal of the displaced pipe segments and concrete flatwork, loose soil and debris should be removed from the bottom and sides of the erosion gully to the extent deemed feasible and sufficient to the satisfaction of the client and the soils engineer. During excavation work, the nearby manhole structure and existing rip-rap energy dissipater areas should be protected as these items, in their existing condition, are suitable for re-use and incorporation into the repair construction work.

Subsequent to removal of loose materials as described above, rock material in the range of 3 to 24 inches in diameter should be placed within the excavation to form a sub-base for the replacement storm drain pipes and head wall, to a height of approximately 2 feet below invert elevation. One-inch minus crushed rock should then be place over the larger rock to fill voids and to create a bedding course for the storm drain pipe and head wall foundation. To minimize removals, the length of the storm drain can be shortened. However, proper erosion control must be provided at the outlet.

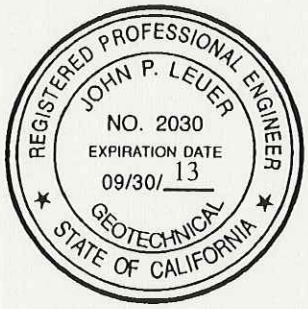
After installation of the replacement storm drain pipe segments and head wall, granular non expansive soil material may be used to backfill the majority of excavation with engineered and compacted fill. Where practical, the excavation should be benched into as the fill is placed and compacted. It may be desirable to use sand slurry backfill around the pipes and connections. The outlet structure and rip-rap areas should be adjusted as needed to allow for proper water flow out of the storm and onto

the rip-rap without the potential for erosion of areas adjacent to these features. We do not recommend grouted rip rap at the outlet because of the existing underlying undocumented fill condition. Non-grouted rip rap will also allow for the possible flow of groundwater in the area as groundwater is known to be shallow in the vicinity. Large rip rap 12 to 24 inches in size should be placed at the outlet. Once this has been installed, the condition of this rip rap should be monitored after storm events to evaluate it's performance. If settlement or movement of the rip rap should occur, affecting the stability of the outlet areas, additional rip rap should be installed to re-establish the outlet configuration.

CLOSURE

We thank you for the opportunity to be of service to you on this project. If you have questions or comments, please do not hesitate to contact us at your convenience.

Respectfully submitted,
LOR Geotechnical Group, Inc.



John P. Leuer, GE
President

RMM:JPL/amp

Distribution: Addressee (2)

REFERENCES

1. LOR Geotechnical Group, Inc., 2002, Preliminary Soils Investigation, Proposed Community Center, Planning Area 24, East Highlands Ranch, Highland, California, Project No. 40155.114, dated December 19, 2002.

2. LOR Geotechnical Group, Inc., 2003, Supplemental Subsurface Soils Investigation, Proposed Community Center, Planning Area 24, East Highlands Ranch, Highland, California, Project No. 40155A.114, dated April 7, 2003.

3. LOR Geotechnical Group, Inc., 2004, Compaction Report, Community Center, Planning Area 24, East Highlands Ranch, Highland, California, Project No. 40155G.8, dated May 28, 2004.

4. LOR Geotechnical Group, Inc., 2004, Compaction Report, Site Improvements, Community Center, Planning Area 24, East Highlands Ranch, Highland, California, Project No. 40155G.86, dated December 27, 2004.

Aerial Photographs Utilized
(San Bernardino County Flood Control and Water Conservation District)

Date	Flight No.	Photograph No.'s	Scale
1938	W-80	M-4, 2:3	1" = 1,000'
November 10, 1955	F-35	7:74-75	1" = 2,000'
October 15, 1972	C-194	26	1" = 2,000'
January 21, 1978	C-279	141-142	1" = 2,000'
February 25, 1986	C-450	118-119	1" = 2,000'
July 1, 1991	C-487	134-135	1" = 2,000'
April 20, 1996	F-528	199-200	1" = 2,000'
March 4, 2001	C-541	211-212	1" = 2,000'
February 12, 2005	F-553	14-49, 14-50	1" = 1,000'