Attachment 7. Economic Analysis – Flood Damage Reduction Costs and Benefits
Rancho Palos Verdes
San Ramon Canyon Stormwater Flood Reduction Project

The Future Without the Project vs. the Future With the Project

Quantitative and Qualitative

The following narrative is a comprehensive evaluation, both qualitative and quantitative, of the future without the proposed project versus the future with the proposed project. The narrative explains the computations found in the economic analysis tables (provided by the Division of the Integrated Regional Water Management) and is structured as requested in Exhibit C of the Proposal Solicitation Package. Backup documentation is provided in the Appendix and referenced accordingly either as a footnote or within the Appendices. Qualitative narrative is provided following the quantitative analysis.

Figure 1 - San Ramon Canyon looking down onto Palos Verdes Drive South/25th Street. 242 mobile homes with more than 500 senior citizens are directly below.

Figure 2 - "Mouth" of San Ramon Canyon looking down onto PVDS/25th Street. Stalled vehicles where traffic attempted to drive through.

Figure 3 – Flood waters across 25th Street (night).

Figure 4 – After the water recedes.

Introduction/Background

San Ramon Canyon is a natural, typically intermittent canyon streambed that sits directly above Palos Verdes South (PVDS)/25th Street in the City of Rancho Palos Verdes. It is surrounded by residential homes to the north, Friendship Park to the east, Palos Verdes Drive East (PVDE) switchbacks to the west, and 242 mobile homes/PVDS/25th Street to the south. Since the 2005 storm events, the canyon has been eroding at an accelerated and alarming rate. During moderate to severe rain events, the canyon conveys storm water runoff generated from the upstream tributary watershed approximately 3,300 feet downstream. It is then received by a storm drain inlet system at PVDS/25th Street, constructed over 50 years ago, that can now no longer accommodate the water and debris delivered to it. Mud and debris collect at the inlet and spill out onto 25th Street, often blocking traffic and requiring repeated efforts by the City of Rancho Palos Verdes and the City of Los Angeles to clean up the area. The mud and debris flows, and the resulting cleanup efforts, severely restrict access to the area for both motorists and safety/emergency personnel. Of greater concern is the potential for storm water, mud and debris to move completely across PVDS/25th Street and destroy a garden wall on the south side of the street, flowing into the mobile home park below. The resulting flooding may result in catastrophic losses to property and life for over 500 senior citizens living in 242 mobile homes directly below the canyon.

Figure 5 - San Ramon Canyon Project Area.

Figure 6 - Inadequate storm drain.

To address these serious threats, the City of Rancho Palos Verdes commissioned a Project Study Report (PSR) in March, 2010 by independent consultant, Harris & Associates (Appendix A). The purpose of the study was to research and report on the geotechnical requirements, hydrology and environmental issues affecting the area, and to develop a number of alternative storm drain design scenarios. The primary objective the storm drain designs had to address is the ***management of storm water runoff to reduce flood damage*** in the area along with other important objectives including:

1) ***Diminish erosion and undercutting in the canyon to protect PVDE switchbacks and adjacent sewer.***
2) ***Substantially reduce the amount of flow being delivered to the existing City of Los Angeles storm drain at 25th Street.***
3) ***Diminish erosion and minimize debris transport to allow "clear water" flows to reach the existing City of Los Angeles storm drain at 25th Street, which flows into the ocean.***
4) ***Better accommodate flow from the side slopes within the canyon.***
5) ***Restore and protect the existing streambed and the surrounding ecosystem.***
6) ***Provide the highest level of flood protection with the lowest amount of environmental impact.***

Project Description

Based upon the extensive analysis afforded by completing a Project Study Report (see Attachment 3, Appendix A for a copy of the PSR), a recommended alternative was presented to the RPV City Council and adopted on March 1, 2011. The proposed project consists of the construction of a mid-canyon inlet structure, located slightly upstream of the upper switchback. The inlet structure will be connected to an ocean outfall with a 3,900-foot long, 54-inch pipe in a "tunnel alignment" that outlets below the oceanfront bluffs. The entire length of this storm drain (SD) alignment falls within the City of Rancho Palos Verdes (RPV) allowing RPV sole jurisdiction and is almost entirely within City-owned land, requiring only construction easements on property owned by others. The inlet structure will be located in the "middle" of San Ramon Canyon, which will intercept flood waters north of the Tarapaca Landslide. The storm drain conveys flows from the inlet structure southwesterly through a tunnel approximately 1,900-feet in length to a point just south of PVDS. From there, the next 1,700-feet of the pipeline will be constructed, using the standard open trench (cut and cover) type of construction running parallel to the City boundary adjacent to Palos Verdes Shores Mobile Home Park, which is in the City of Los Angeles. The pipe will be installed within an existing dedicated 100-foot-wide utility easement within Palos Verdes Shoreline Park that was specifically set aside for utilities such as this proposed storm drain. The 100-foot-wide easement has less strict environmental impact requirements, serves as a firebreak for the adjacent mobile home park and is used as an informal hiking trail to the ocean. The final 300-feet of pipe from the bluff top to the beach will run in a 38 percent sloped "slant drain" tunnel to an outlet structure located at the base of the bluff. The portion of the canyon downstream of the mid-canyon inlet structure, which runs through the Tarapaca Landslide, will be filled with up to 30-feet of dirt in order to restore the stream bank to pre-development levels. This is proposed to eventually stabilize the canyon slopes and create an elevated creek bed with flatter side slopes. This portion of the canyon would convey nothing more than side slope run-off. An access road from PVDE along the westerly side of the canyon would be constructed to provide access for maintenance of the upstream inlet structure. Reference Figure 7 and Figure 8 on the next page for aerial overviews.

Project's Economic Costs

There are no future economic costs (i.e. no future opportunity costs) associated with this project. The land where the project is located is a deep canyon with no economic value for future development. The project site is also located adjacent to an active landslide which precludes any nearby development that would provide any economic value. In addition, there is no volunteer labor associated with this project.

Figure 7 – aerial overview of project site.

Figure 8 – aerial overview of proposed project.

Cost Details for the Project

The total project cost is estimated to be $18.929 million. The project cost was developed by Harris & Associates, Inc. as part of the development of a Project Study Report dated January 11, 2011. The City requests $9,464,727 in grant funding and will match the project with a 50% match of $9,434,728. Table 6 provides a summary overview as required by the PSP and the table on the following page provides a comprehensive line item summary of the construction costs and brief explanation for other line item costs. Please reference the Budget section (Attachment 4) of the application for a budget narrative.

Table 6 - Project Budget

Proposal Title: San Ramon Canyon Stormwater Flood Reduction Project

Project Title: San Ramon Canyon Stormwater Flood Reduction Project

	Budget Category	(a) Non-State Share* (Funding Match)	(b) Requested Grant Funding	(c) Other State Funds Being Used	(d) Total	(e) % Funding Match
(a)	Direct Project Administration Costs	$475,000	$475,000		$950,000	**50%**
(b)	Land Purchase/Easement	$53,300	$121,700		$175,000	**30%**
(c)	Planning/Design/Engineering/ Environmental Documentation	$1,358,400	$0		$1,358,400	**100%**
(d)	Construction/Implementation	$6,590,528	$6,590,527		$13,181,055	**50%**
(e)	Environmental Compliance/ Mitigation/Enhancement		$300,000		$300,000	**0%**
(f)	Construction Administration		$790,000		$790,000	**0%**
(g)	Other Costs		$200,000		$200,000	**0%**
(h)	Construction/Implementation Contingency	$987,500	$987,500		$1,975,000	**50%**
(i)	**Grand Total (Sum rows (a) through (h) for each column)**	**$9,464,728**	**$9,464,727**		**$18,929,455**	**50%**

***List sources of funding:** RPV has a very strong local match/financial plan including fee-based programs (e.g. storm drain fees), city reserves, and cash/in-kind contributions from Los Angeles City and the County of Los Angeles. The City has already expended $600,000 in local funds for the Project Study Report/Preliminary Engineering and has budgeted an additional $758,400 for Final Design and CEQA Compliance (line c above totaling $1,358,400).

City of Rancho Palos Verdes

San Ramon Canyon Storm Drain = ALTERNATE 1A
Tunnel Alignment Recommended
PRELIMINARY Opinion of Probable Construction Costs
January 11, 2011

Tasks	Description	Quantity	Unit	Unit Price	Total
1	Mobilization (5%)	1	LS	$620,000	$620,000
2	Clearing & Grubbing (includes ALL removals)	1	LS	$65,000	$65,000
3	Open Trench Shoring & Plating	1	LS	$65,000	$65,000
4	Traffic Control	1	LS	$30,000	$30,000
5	SWPPP	1	LS	$85,000	$85,000
6	Construction Survey	1	LS	$55,000	$55,000
7	Sewer Relocation (construction)	1	LS	$200,000	$200,000
8	Canyon Improvements - Fill / Grading Operations	44,770	CY	$65	$2,910,050
9	Canyon Improvements -12 inch Perforated Sub-drain	1,100	LF	$155	$170,500
10	RC Inlet Structure 54" Pipe (includes RC wing wall structure, **medium** debris basin) **U/S Tarapaca**	1	LS	$125,000	$125,000
11	Outlet Structure and apron onto beach (including decorative wall rock pattern / rock in invert / railing)	1	LS	$250,000	$250,000
12	80" Diameter "Slant Drain" Tunnel Installation - At Beach	295	LF	$3,670	$1,082,650
13	80" Diameter Tunnel - Steel Rib with Wood lagging 4' to 5' increments - north of South Rancho Palos Verdes Drive	1,900	LF	$2,170	$4,123,000
14	54" HDPE for Tunnel Installation (DR15.5)	2,195	LF	$249	$546,555
15	54" Pipe - Open Trench Installation (**in open space flat plain**) (DR-17)	1,900	LF	$340	$646,000
16	Annular Space backfill (light weight cellular grout between 54" HDPE and 80" Tunnel)	1,300	CY	$125	$162,500

Tasks	Description	Quantity	Unit	Unit Price	Total
17	Manhole Structures	5	EA	$25,000	$125,000
18	Lean Concrete Seepage Dam (with 8" PVC - Outlet System at each MH)	5	EA	$10,000	$50,000
19	Catch Basin Inlets	4	EA	$9,500	$38,000
20	Tunneling Spoil Haulage and Disposal	3,000	CY	$30	$90,000
21	Launch Pits	1	LS	$250,000	$250,000
22	Deep Vertical Ground Movement Monitoring Systems (Geokon MPBX Model # A3 Extensometer, etc.)	1	LS	$20,000	$20,000
23	Deep Horizontal Ground Movement Monitoring Systems (Geokon Inclinometer Casing, etc.)	1	LS	$20,000	$20,000
24	Temporary Bluff Rock Fall Barrier System (such as "Geobrugg") for Bluff Outlet Construction	1	LS	$50,000	$50,000
25	Temporary / permanent Bluff shoring and soldier pile system for Outlet Structure construction	100	VF	$990	$99,000
26	Beach Access Road / Trail	1	LS	$140,000	$140,000
27	Upper Inlet Access Road from Tarapaca Road (Flexible Pavement)	14,500	SF	$25	$362,500
28	Upper Inlet Access Road Retaining Wall	910	LF	$220	$200,200
29	Landscape Planting and Establishment (for Mitigation Measures)	200,000	SF	$2.50	$500,000
30	PCC Interceptor Drain adjacent to back of retaining wall	910	LF	$110	$100,100
		Construction Total = matches (d) from Table 6			**$13,181,055**

Table 7 - Summary Budget Proposal Title: San Ramon Canyon Stormwater Flood Reduction Project						
Individual Project Title		Non-State Share (Funding Match)	Requested Grant Funding (DWR Grant Amount)	Other State Funds Being Used	Total	% Funding Match
(a)	San Ramon Canyon Flood Reduction Project	$9,464,728	$9,464,727	$0	$18,929,455	**50%**
(i)	**Grand Total (Sum rows (a) through (h) for each column)**	**$9,464,728**	**$9,464,727**	**$0**	**$18,929,455**	**50%**

Table 10 illustrates the annual cost of the flood damage reduction project (factoring O&M and discount factors). The total present value of discounted costs is $18,949,752. Because of the simplicity of the completed project, operations and maintenance is estimated to be extremely minimal, at $1,200 annually. The estimated O&M costs were calculated by Mr. Alan Braatvedt, of KOA Corporation (an engineering consulting firm on retainer with the City of RPV) in March 2011.

Table 10- Annual Cost of Flood Damage Reduction Project (All costs should be in 2009 Dollars) Project: San Ramon Canyon Stormwater Flood Reduction Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 6 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	$18,929,455		$0	$1,200			$18,930,655	1.000	$18,930,655
2010			$0	$1,200			$1,200	0.943	$1,132
2011			$0	$1,200			$1,200	0.890	$1,068
2012			$0	$1,200			$1,200	0.840	$1,008
2013			$0	$1,200			$1,200	0.792	$950
2014			$0	$1,200			$1,200	0.747	$896
2015			$0	$1,200			$1,200	0.705	$846
2016			$0	$1,200			$1,200	0.665	$798
2017			$0	$1,200			$1,200	0.627	$752
2018			$0	$1,200			$1,200	0.592	$710
2019			$0	$1,200			$1,200	0.558	$670

Table 10- Annual Cost of Flood Damage Reduction Project
(All costs should be in 2009 Dollars)
Project: San Ramon Canyon Stormwater Flood Reduction Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 6 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2020			$0	$1,200			$1,200	0.527	$632
2021			$0	$1,200			$1,200	0.497	$596
2022			$0	$1,200			$1,200	0.469	$563
2023			$0	$1,200			$1,200	0.442	$530
2024			$0	$1,200			$1,200	0.417	$500
2025			$0	$1,200			$1,200	0.394	$473
2026			$0	$1,200			$1,200	0.371	$445
2027			$0	$1,200			$1,200	0.350	$420
2028			$0	$1,200			$1,200	0.330	$396
2029			$0	$1,200			$1,200	0.312	$374
2030			$0	$1,200			$1,200	0.294	$353
2031			$0	$1,200			$1,200	0.278	$334
2032			$0	$1,200			$1,200	0.262	$314
2033			$0	$1,200			$1,200	0.247	$296
2034			$0	$1,200			$1,200	0.233	$280
2035			$0	$1,200			$1,200	0.220	$264
2036			$0	$1,200			$1,200	0.207	$248
2037			$0	$1,200			$1,200	0.196	$235
2038			$0	$1,200			$1,200	0.185	$222
2039			$0	$1,200			$1,200	0.174	$209
2040			$0	$1,200			$1,200	0.164	$197
2041			$0	$1,200			$1,200	0.155	$186
2042			$0	$1,200			$1,200	0.146	$175
2043			$0	$1,200			$1,200	0.138	$166
2044			$0	$1,200			$1,200	0.130	$156
2045			$0	$1,200			$1,200	0.123	$148
2046			$0	$1,200			$1,200	0.116	$139
2047			$0	$1,200			$1,200	0.109	$131
2048			$0	$1,200			$1,200	0.103	$124
2049			$0	$1,200			$1,200	0.097	$116
2050			$0	$1,200			$1,200	0.092	$110
2051			$0	$1,200			$1,200	0.087	$104
2052			$0	$1,200			$1,200	0.082	$98
2053			$0	$1,200			$1,200	0.077	$92
2054			$0	$1,200			$1,200	0.073	$88
2055			$0	$1,200			$1,200	0.069	$83

Table 10- Annual Cost of Flood Damage Reduction Project
(All costs should be in 2009 Dollars)
Project: San Ramon Canyon Stormwater Flood Reduction Project

	Initial Costs	Operations and Maintenance Costs (1)						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 6 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2056			$0	$1,200			$1,200	0.065	$78
2057			$0	$1,200			$1,200	0.060	$72
2058			$0	$1,200			$1,200	0.058	$70
2059			$0	$1,200			$1,200	0.055	$66
2060			$0	$1,200			$1,200	0.053	$64
2061			$0	$1,200			$1,200	0.050	$60
2062			$0	$1,200			$1,200	0.048	$58
Project Life								...	
							Total Present Value of Discounted Costs (Sum of Column (i))		$18,949,752
							Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries		

Comments: Table 10 illustrates the annual cost of the flood damage reduction project (factoring O&M and discount factors). The total present value of discounted costs is $18,949,752. Because of the simplicity of the completed project, operations and maintenance is estimated to be extremely minimal, at $1,200 annually. The estimated O&M costs were calculated by Mr. Alan Braatvedt, of KOA Corporation (an engineering consulting firm on retainer with the City of RPV) in March 2011.

(1) The incremental change in O&M costs attributable to the project.

Project's Expected Flood Damage Reduction Benefits

Estimates of Historical Flood Damage Data

Historically, the Cities of Los Angeles and Rancho Palos Verdes have dealt with the storm water flood events through a combination of emergency road clearance, debris removal, and monitoring of erosion rates and landslide movement. On an annual basis, the City of Rancho Palos Verdes or the City of Los Angeles removes approximately 700 cubic yards of mud and debris from PVDS/25th Street on an emergency basis. This was verified by the City of Los Angeles through a staff report dated December 11, 2009, for authorization to submit a grant application to FEMA for their Pre-Disaster Mitigation Grant Program, (please reference Appendix C). This means either during or immediately after a rain and storm water event, one of the cities will need to get a crew onto PVDS/25th Street, provide traffic control, and then remove and haul mud and debris from the street. This effort may also include cleaning out the existing catch basin and flushing the pipes. This effort has been estimated to cost the cities approximately $165,875 annually for labor and machinery, and an additional $21,000 (estimated at $30 per cubic yard x 21,000 cubic yards per year) for hauling debris to the landfill (reference Table 1) for details on how these costs were calculated and verified). To date neither city has been fined for water

quality and sewage release violations, but the possibility does exist that such a fine may be levied in the event of a failure.

Figure 9
PVDS/25th Street is a principal arterial roadway, serving as a significant East-West route for the southern potion of the Palos Verdes Peninsula.

Figure 10
Mud, water, silt, and sludge coming out of the "mouth" of San Ramon Canyon on PVDS/25th Street. Annual cost for clean up and hauling is estimated to be $186,875 annually.

In preparation for this grant application, Mr. Lawrence Cuaresma, P.E., District Engineer for the City of Los Angeles, Department of Public Works (Bureau of Engineering at the Harbor District) provided real time cost estimates for a two-day storm water clean-up effort on December 20 and 21, 2010. Please see Appendix B for documentation of the costs provided by Mr. Cuaresma. For this application, the emergency cleanup costs are shown in full, up until the avoided retention basin is built. Assuming that the City's preferred project is not built and the avoided debris basin is developed, the City will no longer be required to support emergency cleanup and will schedule annual debris removal from the debris basin.

Table 1 **Estimated Storm Water Clean-Up Costs** **Per Two-Day Storm Event**			
City of Los Angeles *Source: City of Los Angeles, Department of Public Works* *Estimate provided by Lawrence G. Cuaresman, P.E., District Engineer*			
Department	**Assigned Personnel (Title)**	**Number Assigned**	**Total Cost (fully burdened)**
Sanitation	Equipment Operators Wastewater Collection Workers II	Three (3) Eight (8)	$21,200
Street Services	Equipment Operator Truck Drivers Lot Cleaning Supervisor	One (1) Three (3) One (1)	$5,800
Engineering	Sr. Civil Engineer Civil Engineering Associate (II)	One (1) One (1)	$1,625
		Sub-Total	$28,625
			x 3 events per year
		Total Los Angeles City Annual Labor Costs	**$85,875**
City of Rancho Palos Verdes *Source: Public Works/Engineering Department* *Estimate provided by Andy Winje, P.E.*			
Contractor Cost for Minimal Clean up (estimate one time per year)			$5,000
Contractor Cost for Comprehensive Clean up (estimate $30,000 x 2 times per year)			$60,000
City of RPV staff time (annual)			$15,000
		Total Rancho Palos Verdes Annual Contractor and Staff Labor Costs	**$80,000**
		Total Annual Labor (LA City and RPV)	**$165,875**

In addition to the labor costs cited above, the City of Los Angeles estimates the ***annual clean up of debris is 700 cubic yards)***. (Source: this estimate was cited in the City of Los Angeles' 2009 Pre-Disaster Mitigation Grant Program application submitted to the Federal Emergency Management Agency (FEMA) (please see Appendix C).

As illustrated in the photos below, the debris consists of mud, packed dirt, sedimentation, loose gravel, tree branches and other Canyon material. Generally this material is hauled to the BFI / Falcon Refuse center 12 miles away. The one way travel time is approximately 30 minutes. Each cubic yard of debris costs about $30 to haul and deposit at the facility (cost based on engineering estimates from public bids for debris removal) or $21,000 annually ($30 x 700 cubic yards = $21,000).

Figure 11 – Almost 120 dump truck trips are necessary annually because of storm water events at the project site.

Figure 12 – Another visual of heavy equipment to clean up mud, debris, etc. The City of Los Angeles estimates they clean up 700 cubic yards of debris annually.

Estimates of Existing "Without-Project" Conditions

As stated previously, San Ramon canyon is a natural intermittent dry streambed. During moderate to severe rain events, the canyon conveys storm water runoff generated from the upstream tributary watershed approximately 3,300 feet downstream. The storm water runoff currently flows down San Ramon Canyon and onto PVDS/25th Street and subsequently on to the ocean. Over time, the City of Rancho Palos Verdes has noticed damage to PVDS/25th Street, excessive stream wall erosion that will lead to subsequent failure of Rancho Palos Verdes Drive East (PVDE), and movement in a "garden" wall that appears to be serving as an impromptu flood diversion wall. The City is very concerned about the failure to the PVDE, a major roadway; the potential for erosive failure of the Tarapaca Landslide; and eventual failure of the garden wall leading to massive flooding of a 242-home mobile home park that serves as housing for over 500 senior citizens.

As part of this application, the City performed an estimate of the existing and potential future flood damage. To perform the flood loss estimations for this benefit / cost analysis, the City utilized the HAZUS-MH (HAZards – United States – Multi-Hazard) Flood Loss Estimation module. HAZUS-MH is a nationally applicable loss estimation tool developed by the National Institute of Building Sciences (NIBS) for the Federal Emergency Management Agency (FEMA) (see Appendix E for a sample HAZUS print out). The Flood Model within HAZUS-MH allows users to perform rigorous loss estimation analysis using nationally accepted and tested methodologies. For this analysis, the City utilized consultants familiar with the flood software, including the company that designed and implemented the software (ABS Consulting, Irvine, CA) and the individual who managed the development of the flood model (Neil Blais, Consultant).

The Flood Model was used to estimate losses associated with San Ramon for 10-year, 50-year, 100-year, 200-year, and 500-year flood events. The model was run using default data provided with the HAZUS-MH software and the National Elevation Dataset (NED) 1/3 arc-second Digital Elevation Model (DEM). When run in a Level 1 analysis, HAZUS-MH uses default data developed using nationally available data that includes Hydrologic Unit Codes (HUCS), Watersheds, and regression equations to determine the hydrology and hydraulics. The model was run using a draining area of 1/4 of a mile, and the model

picked up San Ramon Creek fairly accurately. Two sets of analysis were conducted. The first run was for the default storm water flow assuming the garden wall remained in place for all return intervals. These results were provided to the City's engineers as a reference check to ensure that HAZUS-MH was performing its analysis consistently with their historical field experience.

The default suite of the aforementioned return periods was run and the building damage analyzed using the baseline data developed from the U.S. Census and Dun and Bradstreet data. The model utilizes Federal Insurance Administration (FIA) credibility weighted and U.S. Army Corps of Engineers depth damage functions depending on the occupancy of the structures (e.g. single-family residential, retail sales, light industrial, etc.).

The analysis provided estimated damage results for building structure, building content, and business inventory. Losses were not only estimated for the capital building stock losses (building structure, contents, and inventory) but the income losses as well (relocation loss, capital related losses, wages, and rental income losses). When results were reviewed by City engineers, the general consensus was that HAZUS-MH was producing results that were consistent with historical impacts.

The following narrative provides information on the project area where damages are being computed and additional analysis that accompanies Table 11 – Event Damage.

Table 11 - Event Damage

Hydrologic Event	Event Probability	Damage if Flood Structures Fail	Probability Structural Failure		Event Damage		Event Benefit (Million $)
			Without Project	With Project	Without Project	With Project	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
					(c) x (d)	(c) x (e)	(f) – (g)
10-Year	0.1	$385,000	1	0	$385,000	$0	$385,000
50-Year	0.02	$1,560,000	1	0	$1,560,000	$0	$1,560,000
100-Year	0.01	$2,244,000	1	0	$2,244,000	$0	$2,244,000
200-Year	0.005	$3,027,000	1	0	$3,027,000	$0	$3,027,000
500-Year	0.002	$4,017,000	1	0	$4,017,000	$0	$4,017,000

Palos Verdes Shores Mobile Home Park

Lying just below the mouth of the San Ramon Canyon is Palos Verdes Shores Mobile Home Park (PVSMHP).[1] The senior living community has 242 mobile homes[2] with values ranging from $80,000 to $400,000.[3] The dense community is sandwiched between PVDS/25th Street and the Pacific Ocean on a slope that changes in elevation from 410 feet at PVDS/25th Street to mean sea level at the Pacific Ocean.

The only protection residents at the mobile home park are afforded is a cinder block "garden" wall that was likely designed as a "screen" wall that did not consider the effect of lateral earth pressures nor

[1] Palos Verdes Shores Mobile Home Park is located at 2275 West 25th Street, San Pedro, CA in Los Angeles County. One person in the household must be over the age of 55 to live in the community.

[2] Jim Webb, Manager of Palos Verdes Shores Mobile Home Park, confirmed total number of mobile homes. Telephone: (310) 547-4403. Email: palosv@vcmco.com. Interviewed Mr. Webb March 14, 2011.

[3] www.ehow.com/infor_7839505_mobile-near-san-pedro-ca.html; accessed Internet site March 11, 2011.

retaining water. This was confirmed via a visual site inspection and analysis by Ficcadenti & Waggoner (consulting structural engineers) on March 15, 2011 (see Appendix D for a full copy of their wall analysis and additional photos). According to Ficcadenti & Waggoner, screen walls have relatively narrow footings that would overload supporting soil if overturning loads were imposed on the wall. Walls that are designed to resist lateral earth pressures are considered "retaining" walls and have substantially larger footings than screen walls so that the "retaining walls" can properly resist overturning loads without overloading the supporting soil beneath the footing.[4]

Figure 13 – The cinder block wall is acting as an impromtu retaining wall although it was engineered as a garden wall with small footings.

Figure 14 – Visual "bow" in the block wall from years of holding back water and debris from the mobile home park. This photo is post-storm after water receded.

Consulting engineers for the City have determined that the garden wall was not designed to perform as a retaining wall with respect to dirt and water. As seen in Figure 13 and Figure 14, during heavy rain and water flow events, the wall actually acts as a dam protecting the homes below.

For purposes of the second HAZUS-MH economic analysis, the consensus of engineers working on this project concluded that it was fair and reasonable to expect the block wall to fail during a storm event that resulted in a flood between the 25-year flood and the 50-year flood. The engineers were unable to put an exact estimate on the probability of failure because they were unsure how the wall had been managing to retain the flood waters it had experienced to date. Because the wall acts as a dam for debris as well as water, it is assumed that water flowing into the neighborhood following a wall collapse will behave more like a heavily laden debris flow than typical storm water runoff.

As with other dam failures, the velocity of the released water and associated debris carried by the water amplifies the damages when compared to normal fresh water flooding. While the wave front tends to dissipate quickly, the debris flows can exacerbate damages to mobile homes, which typically do not have foundations designed to resist such lateral loading. In addition, the heavy level of debris and sedimentation could be further exacerbated by failure of the Tarapaca landslide upstream. To account for this high debris, higher velocity flow, the results of HAZUS-MH were increased by a conservative factor.

[4] Reference page 2 of Ficcadenti & Waggoner Report dated March 15, 2011 (see Appendix D).

To determine an appropriate damage escalation factor, research into comparisons of storm water flooding and debris flow impacts was conducted. A number of technical papers written throughout the engineering community focused more on ways to identify what areas are prone to storm water runoff and areas prone to debris flows. However, John Costas (USGS) developed a paper that looked at the overall difference between water flooding and debris flows. Although his paper does not directly assess the potential impacts on buildings and structures, it provided information on the density differential between debris flows and water flooding. This, along with a discussion on natural vegetation and erosion damage in the paper indicated that debris flows can substantially increase the damage. Flood experts involved in this project estimated that the density difference would be a reasonable indication of damage difference and a factor of three was used.

For this second analysis, the HAZUS river network was modified to assume that the wall did not impede flow into the developed area. The suite of return periods was again analyzed, and the results from the 50-year to the 500-year events were used in the benefit cost analysis (the 10-year analysis from the first baseline run was used since the garden wall has demonstrated the capacity to retain that level of flooding).

Flood experts felt that the HAZUS-MH results from the second run were somewhat underestimated because the flood model does not account for debris loading and velocity components. The flood experts estimated that flood damages, because of the sudden failure of the garden wall, could easily be magnified by a factor of four. Overall the damage ratio (percentage of building and content damage divided by the overall exposure) is comparatively lower than anticipated.

Overall, flood experts consulted for this specific analysis believe that the output from HAZUS-MH is underestimating the actual potential damages should the garden wall fail.

Again, Table 11 illustrates the event damages without the project per the following hydrologic events:

Table 11 - Event Damage

Hydrologic Event	Event Probability	Damage if Flood Structures Fail	Probability Structural Failure		Event Damage		Event Benefit (Million $)
			Without Project	With Project	Without Project	With Project	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
					(c) x (d)	(c) x (e)	(f) – (g)
10-Year	0.1	$385,000	1	0	$385,000	$0	$385,000
50-Year	0.02	$1,560,000	1	0	$1,560,000	$0	$1,560,000
100-Year	0.01	$2,244,000	1	0	$2,244,000	$0	$2,244,000
200-Year	0.005	$3,027,000	1	0	$3,027,000	$0	$3,027,000
500-Year	0.002	$4,017,000	1	0	$4,017,000	$0	$4,017,000

In addition, damage and clean up at the mobile home park is still necessary despite the garden wall protection. During the January 2010 storm event the following was documented per Mr. Jim Webb, the mobile home park manager:

- 12 – 14 inch boulders were rolling down streets that entered the mobile home park at the end of the wall. They travel down through the nature preserve and come up through a V-ditch, 30-40 feet below the wall.
- A water line lid popped off (8-10 pounds) and was rolling down the streets.
- Quote: "Residents are scared. We had an 80-year-old man (resident) scared because he got trapped in the water in the street; car was totaled because of water damage; he was in the car and the only reason he was able to get out is because a man in a big 4 x 4 truck came by and stopped and let him crawl out the window and into his truck. The car was totaled from water damage."
- Quote: "Every time the city has a meeting about San Ramon Canyon, I get tons of calls from residents asking me to attend the meeting and report back to them. There is a lot of concern in our community about the flooding and what ***could*** happen."

Figure 15 – Inside Palos Verdes Shores Mobile Home Park. Mud, water, debris, and large rocks find their way into the mobile home park by traveling through a V-ditch at one end of the block wall.

Figure 16 – Additional view of rocks and storm water debris. Mobile homes are in background. Notice elevation change.

Estimates of Existing "With-Project" Conditions

The proposed project (shown as red line in Figure 17) would substantially alleviate the following conditions within the San Ramon Canyon.

- Eliminate the continual cleanup and repair to PVDS/25th Street
- Significantly reduce erosion and potential failure of PVDE
- Eliminate the flood risk for the Palos Verdes Mobile Home Park
- Significantly reduce the risk of failure on the Tarapaca Landslide

The direct and indirect benefits are significant as can be demonstrated by the BCA and qualitative analysis.

The methodology to estimate the "with-project" condition follows closely the "without-project" approach. The fundamental difference is the assumption that the collection of water in the channel and subsequent routing to the ocean outfall will completely eliminate all runoff that threatens to overwhelm

the garden wall and has been damaging 25th Avenue. Additionally, geologic engineers and civil engineers who worked on the development of the alternative plan and the PSR indicate the overall impact reduction.

Figure 17 – proposed project (red line)

Description of Local and Regional Benefits

The benefits of the project are best demonstrated with a discussion of the tables within the BCA analysis. As each of these tables were developed, the definition of the local and regional benefits become clear.

Table 11: Event Damage

Table 11 (see page 16) showed the anticipated flood related losses for the "without-project" conditions assuming a collapse of the garden wall and subsequent debris laden flow into the Palos Verdes Mobile Home Park. These conditions exist today and the cities are concerned with the liability exposure associated with known conditions that present a potential hazard.

Table 12: Present Value of Expected Annual Damage Benefits

When provided on an annual basis with a coefficient to bring the annual benefits to the present value, Table 12 shows that the present expected annual damage benefits are approximately $1.82 million (rounded).

Table 12 - Present Value of Expected Annual Damage Benefits Project: San Ramon Canyon Storm Water Flood Reduction Project			
(a)	Expected Annual Damage Without Project (1)		**$115,309**
(b)	Expected Annual Damage With Project (1)		**$0**
(c)	Expected Annual Damage Benefit	(a) – (b)	**$115,309**
(d)	Present Value Coefficient (2)		**15.76**
(e)	**Present Value of Future Benefits Transfer to column (e) Table 20: Proposal Costs and Benefits Summaries.**	**(c) x (d)**	**$1,817,270**

Table 13: Minimum Seismic Failure Economics Data

Table 13 is not included in this analysis because there is no local or regional benefit from a seismic perspective. The project as designed is a pipe that will run underground and through cut and cover channel. This design, like the alternative designs are nominally vulnerable to seismic movement unless there is associated ground failure, in which case the pipeline will likely fail locally with the ground failure. The proposed HDPE pipe offers "give" in a pipeline and allows for normal seismic movement and the pipe will not have joints eliminating that mode of seismic failure.

Appendices for Attachment 7

Attachment 3 (Work Plan) Appendix ..... Project Study Report

Appendix B ..... City of Los Angeles Clean Up Estimate for December 2010 Event

Appendix C ..... City of Los Angeles Staff Report Referencing Annual Clean Up (Cubic Yards)

Appendix D ..... CMU Wall Analysis of March 11, 2011 Site Visit (Ficcadenti & Waggoner Consulting)

Appendix E ..... ***Sample*** HUZUS Run Printout

Appendix A

Project Study Report

Please reference Attachment 3, Appendix A (Work Plan) for a copy of the Project Study Report.

Appendix B

Confirmation of clean up costs provided by the City of Los Angeles.

From: Andy Winje
To: "Destin Blais"
Cc: "Ron Dragoo"
Subject: FW: FW: 25 Street photos
Date: Tuesday, February 08, 2011 4:39:24 PM

Destin – City of LA has provided their costs for the two day clean up event in December. Please note their costs do not include long distance hauling or disposal fees to their facility which could raise their costs by 50 to 100% or more.

Andy Winje
RPV Public Works
310-544-5249

From: Lawrence Cuaresma [mailto:lawrence.cuaresma@lacity.org]
Sent: Tuesday, February 08, 2011 4:24 PM
To: Andy Winje
Cc: Gordon Teuber; Ron Dragoo; Jones, Carlton; Shu, Susan
Subject: Re: FW: 25 Street photos

Thanks for the pics Andy and sorry for the delay in the cost estimate. I've received fully burdened cost information from Sanitation and Street Services for the two day cleanup effort on 12/20/10 to 12/11/10.

Sanitation cost = $21,200

Equipment Operators (3)
Wastewater Collection Workers II (8)

Street Services cost = $5800

Equipment Operator (1)
Truck Driver (3)
Lot Cleaning Supervisor (1)

Engineering = $1625

Sr. Civil Engineer (1)
Civil Engineering Associate III (1)

Total = $28,625 for a 2-day cleanup event

Please note that haul-route times were less thanks to your city allowing our crews to dispose of debris at Abalone Cove Park and this estimate does not show the disposal fees that would have been paid if Sanitation had transported the debris to the BFI transfer station in Wilmington.

On Tue, Feb 8, 2011 at 11:24 AM, Andy Winje <andyw@rpv.com> wrote:

Larry - here are some photos of the recently completed work at 25th Street and San Ramon Canyon crossing performed by our contracted crews. The basin is now empty (relatively) and ready for the next storm.

Also, one last request for your costs (ballpark is fine) to clean up. We need to get our economic study completed for our grant application. Thanks.

Andy Winje
RPV Public Works
310-544-5249
-----Original Message-----
From: Emilio Blanco [mailto:EmilioB@rpv.com]
Sent: Tuesday, February 08, 2011 11:09 AM
To: 'Andy Winje'
Subject: 25 Street photos

Attached are the 25 Street photos.

Note: To protect against computer viruses, e-mail programs may prevent sending or receiving certain types of file attachments. Check your e-mail security settings to determine how attachments are handled.

--
Lawrence G. Cuaresma, P.E.
District Engineer
City of Los Angeles, Department of Public Works
Bureau of Engineering, Harbor District
638 S. Beacon Street, Room 402
San Pedro, CA 90731
(310) 732-4663
(310) 732-4670, FAX

Appendix C

Confirmation of annual clean up (cubic yards) per year by City of Los Angeles (see 3rd page of staff report, highlighted in yellow).

Department of Public Works

Bureau of Sanitation
Bureau of Engineering
Joint Board Report No. 1
December 11, 2009

CD: 15

AUTHORITY TO APPLY FOR, ACCEPT, NEGOTIATE, AND EXECUTE AN AGREEMENT FOR GRANT FUNDING FROM THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) 2009 LEGISLATIVE PRE-DISASTER MITIGATION (LPDM) PROGRAM FOR THE 25TH STREET DRAINAGE IMPROVEMENT PROJECT

RECOMMENDATIONS

1. Approve and forward this report forthwith, with its transmittals, to the Mayor and the City Council, with the recommendation that the City Council, subject to concurrence of the Mayor, authorize the City Engineer of the Bureau of Engineering (BOE) and the Director of the Bureau of Sanitation (BOS), or their designees, to apply for and accept FEMA LPDM grant funding [as Subgrantee] of the State of California Emergency Management Agency (CalEMA) [Grantee] in an amount not to exceed $500,000; to conduct all negotiations; to provide additional information; and to execute and submit all documents, including, but not limited to, applications, agreements, or amendments through the City Administrative Officer [the City's Authorized Agent], which may be necessary to secure FEMA 2009 LPDM funding with respect to the 25th Street Drainage Improvement Project.

2. Instruct the BOE and BOS to coordinate with the City Administrative Officer (CAO), who is on file with CalEMA as the City of Los Angeles' Authorized Agent for disaster grants with respect to State and Federal disaster assistance pursuant to C.F. 02-2220, in executing and delivering any, and all, additional certificates, agreements, and other documents as may be required of the City in connection with obtaining the FEMA LPDM assistance for which the City is eligible to effect the design and construction of the 25th Street Drainage Improvement Project,.

3. Request the City Council and Mayor to approve the use of City's staff costs as the matching funds for the implementation and completion of the 25th Street Drainage Improvement Project

4. Request the City Council and Mayor to instruct the CAO to reimburse the Bureau of Sanitation's Stormwater Pollution Abatement Fund (SPAF), upon certification of eligible expenditures by BOS in an amount not to exceed $500,000, for the aforementioned project after processing all payments received from FEMA and CalEMA, after initial deposit into the City's Disaster Assistance Trust Fund (DATF).

Bureau of Sanitation
Bureau of Engineering
Joint Board Report No. 1
December 11, 2009

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FISCAL IMPACT STATEMENT

Acceptance of this funding will have no impact on the City's General Fund. The total project cost is estimated at $666,667.67, of which $500,000 (75%) in funding will be made available through a 2009 LPDM reimbursement grant by FEMA. The remaining project costs of $166,667,67 constitutes the City's twenty-five percent (25%) cost-share in the form of in-kind services for design, construction management and project management services. The salaries for the stated in-kind services provided by the City staff will be paid by the Stormwater Pollution Abatement Fund (SPAF). The total grant amount will also be front-funded through the SPAF. The City Administrative Officer will reimburse the SPAF from FEMA payments deposited to the (DATF) upon certification of expenditures by BOS.

TRANSMITTALS

1. A copy of the "Designation of Applicant's Agent Resolution", which designates the City Administrative Officer as the Authorized Agent for disaster grants with respect to State and Federal assistance for various disasters in the City of Los Angeles (Attachment 1).

2. A copy of Location Map (Attachment 2).

3. A copy of the 2009 LPDM Grant Application, submitted to FEMA electronically on September 24, 2009 (Attachment 3). In order to expedite processing and meet the application deadline, the CAO granted the BOE Project Manager temporary sign and submit rights to the FEMA e-grant application system for the 25th Street Drainage Improvement project.

DISCUSSION

The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) allocated funds to the State of California [the grantee] for eligible projects falling under the purview of its Pre-Disaster Mitigation (PDM) Grant Program. Funding is provided to projects that assist States and local governments [subgrantees] in implementing cost-effective hazard mitigation activities that complement comprehensive mitigation programs, reduce injuries, loss of life, and damage and destruction of property. The PDM Grant Program, administered in California by the California Emergency Management Agency (CalEMA), was created when the Disaster Mitigation Act of 2000 amended the Stafford Act to provide a funding mechanism that is not dependent on a presidential disaster declaration.

The proposed 25th Street Drainage Improvement Project is located in Council District 15 on the border of the Cities of Los Angeles and Rancho Palos Verdes along 25th Street at San Ramon Canyon. The 25th Street is classified as a principal arterial roadway, which serves as a regionally significant East-West access route for the southern portion of the Palos Verdes Peninsula.

Bureau of Sanitation
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Page 3

An existing 42-inch diameter corrugated metal pipe (CMP) located underneath 25th Street conveys the run-off water from the San Ramon Canyon downstream where it outlets to the Pacific Ocean. Flooding and sediment accumulation during rain events causing street closure is a reoccurring problem along 25th Street at this location. The approximate annual clean up of debris is 700 cubic yards.

The Project will mitigate flooding at 25th Street by constructing a new standpipe with a maintainable inlet structure and will rehabilitate the existing 42-inch CMP which collects and conveys storm water flow below 25th Street from the San Ramon Canyon. In addition, 120 feet of curb and gutter, as well as other drainage improvements, would be constructed. As a result of the project, downstream residents will be protected from channel overflows that may cause flooding and the safety of motorists will be maintained during the rainy season, allowing for safe passage along 25th Street to and from the Palos Verdes Peninsula. With the current condition of the inlet structure, extensive coordination between BOS, BOE, the Bureau of Street Services, the County of Los Angeles and the City of Rancho Pales Verdes is needed for removal of debris in order to continually ensure the inlet is open. By implementing this project, the City will also reduce the City's liability of flooding downstream of the project location.

The total project cost is estimated at $666,667.67, of which $500,000 in FEMA funding has been legislatively earmarked for the City of Los Angeles. The grant award will cover all phases of the project implementation. The remaining project costs of $166,667.67 constitutes the City's twenty-five percent (25%) grant cost-share in the form of in-kind services for grant administration, design construction management and project management services. The salaries of City staff for the stated in-kind services will be paid by the Stormwater Pollution Abatement Fund (SPAF).

Though the total grant amount will be front-funded by the SPAF, eligible expenditures will be reimbursed by the Legislative Pre-Disaster Mitigation (LPDM) Program under the Robert T. Stafford Emergency Assistance and Disaster Relief Act (Stafford Act). FEMA payments will be transferred to Bureau of Sanitation by the City Administrative Officer from the City's (DATF) upon certification of expenditures by BOS. Therefore, acceptance of this funding will have no impact on the City's General Fund.

Design is expected to be completed by August 2010 and construction is expected to be completed during Fiscal Year 2011-2012.

Ongoing debris catch basin maintenance costs will continue to be absorbed by the City unless other sources of funds are identified. The City of Rancho Palos Verdes and the County of Los Angeles fully support the project; however, neither entity can commit financial resources at this time. After completion, the project will be scheduled for routine catch basin cleaning.

Bureau of Sanitation
Bureau of Engineering
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STATUS OF FINANCING

Funds in the amount of $500,000 are available in Fund 511, Dept 50, Stormwater Pollution Abatement Fund. The Account number will be made available in future years through the budget process.

Respectfully submitted,

ENRIQUE C. ZALDIVAR, Director
Bureau of Sanitation

Gary Lee Moore

GARY LEE MOORE, P.E., City Engineer
Bureau of Engineering

Statement as to Funds Approved by:

for LYNDON O. SALVADOR, Director
Office of Accounting
Date 12/07/09

Prepared by:
Michael Scaduto, WPD
(213) 485-3981

Deborah Washington, FMD
(213) 485-2362

Appendix D

FICCADENTI & WAGGONER
Consulting Structural Engineers, Inc.

16969 Von Karman Avenue, Suite 240
Irvine, CA 92606

Tel: (949) 474-0502
Fax: (949) 474-1801

Seb J. Ficcadenti
Michael A. Waggoner
Thomas A. Castle
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Chad W.M.M. Sakai
Mario Giampa
Eric J. Freund
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Ann C. Towle
Bryan Cho
Andrew C. Weaver
Alexander V. Ravski
Rex M. Mananquil
Rui Kuroiwa
William T. Waggoner
Jenny L. Adams
Kristoffer K. Nicolaisen
Neil D. Paulsen
Charles H. Hamilton
David M. Payne
Kent C. Forsythe
Juan F. Garcia
Bradley Wilson
Sil H. Garcia

March 15, 2011

Mr. Randall Berry
Design Manager
Harris & Associates
34 Executive Park, Suite 150
Irvine, CA 92614

Subject: ***March 11, 2011 Site Visit***
Project: ***West 25th Street CMU Wall, Rancho Palos Verdes, CA (F&W Job #A11-045)***

Dear Mr. Berry,

This letter is to summarize the site visit we conducted on March 11, 2011. We were asked to investigate the apparent lean in the masonry wall between Catalina Way and West 25th Street, in Rancho Palos Verdes, CA.

Summary of Investigation

Ficcadenti & Waggoner Consulting Structural Engineers (F&W) has conducted an investigation, of the apparent lean of the subject wall. We measured the outward lean of the top of the wall from the base of the wall at several locations. A section of the wall also had loose caps that were removed to observe the CMU cells, and document the reinforcing.

Site Conditions

The walkway wall along W. 25th St. was observed (See attached photos). The wall was measured to lean outwards, towards the bottom of the hill, towards Catalina Way. The wall is on the south side of the road which lies at the downhill and south side of a ravine. The ravine has drainage inlet on the north side of W. 25th St. We have learned that due to poor drainage, during heavy rains, water and debris accumulates on W. 25th St. and accumulates behind this wall. One of the photos shows some debris in a vertical wall joint, which likely accumulated during the heavy storms. The visible distress and leaning condition of the wall indicate that deficient sub-surface conditions may exist and that some lateral pressure may be imposed on the wall.

A hole was dug on the south side of the wall to gain information on the footing design. The footing measured approximately 3 FT deep, and fairly vertical below the wall. It is probable that a standard plan for public works construction may have been used as a basis for this wall's construction.

Walnut Creek Office: **FICCADENTI WAGGONER & CASTLE** Consulting Structural Engineers
3100 Oak Road, Suite 390 Walnut Creek, CA 94597 Tel: (925) 280-0098 Fax: (925) 280-0096

Nevada Office: **FICCADENTI & WAGGONER** Consulting Structural Engineers, Inc.
235 E. Warm Springs Road, Suite 104 Las Vegas, NV 89119 Tel: (702) 617-4045 Fax: (702) 617-4047

Several cracks were noted along the length of the wall. Diagonal cracking near joints appear to indicate distress due to imposed lateral wall loads and movement. Horizontal cracking, observed at several locations along the wall, occurs at the bottom of the top course of blocks. This is likely due to rusting and expansion of the horizontal bars from moisture intrusion. As cracks form, additional moisture comes in contact with the reinforcing steel, exacerbating the problem.

Wall Lean

We conducted several independent wall measurements from the top of wall to determine wall lean. In general, the wall retained a maximum of about 1 FT of soil. The maximum lean measured was about 3 IN with a maximum wall height on the down-hill side of about 57 IN. These measurements were taken where W. 25th St. dips in elevation. At higher elevations, the lean was 1 ½ IN at the most and 0 IN or ½ IN in a couple of spots. Exact measurements were not conducted as part of this investigation.

The amount of wall lean measured at the low spot in the road, indicates that the wall is actively loaded on the up-hill (north) side. The amount of wall lean measured does not indicate that the wall is unstable or will collapseIn general, the wall has maintained its structural integrity and does not currently pose a falling hazard. Some of the cap pieces, however, are loose and can easily be removed.

Analysis

We prepared preliminary structural calculations to verify the adequacy of the wall. We checked a wall segment that retains 1 FT of soil with a level backfill. This portrayed the worst case condition in the area of greatest concern. We evaluated both drained backfill, and a fully saturated backfill (with water to the level of the walkway).

The excavation performed on the south side of the wall revealed red/brown dirt with gravel of all sizes. Based on Table 1610.1 of the 2010 California Building Code (CBC) an active pressure of 45 PSF/FT, for soil classification GC was chosen. 100 PSF passive pressure was used in accord with CBC table 1806.2.

Our calculations indicate that the wall stem and foundation can accommodate the design active soil pressures if the backfill is properly drained. However, when water is allowed to accumulate behind the wall, our calculations indicated that soil pressure behind the wall causes instability in the entire section. Should water be allowed to accumulate behind the wall, a greater soil capacity, or a different footing design would be required.

A continuous drainage system at the bottom of the slope and weep holes through the wall were not observed to be present during our site visit.

It is likely that the wall was originally designed as a "screen" wall that did not consider the effect of saturated lateral earth pressures. "Screen" walls have relatively narrow footings that would overload supporting soil if overturning loads were imposed on the wall. Walls that are designed to resist lateral earth pressures are considered "retaining" walls and have substantially larger footings than screen walls so that the "retaining walls" can properly resist overturning loads without overloading the supporting soil beneath the footing.

It is possible that the wall failed because of ongoing slope creep that gets exacerbated through cycles of drying and wetting. Wetting causes soil to swell. Upon drying the soil cracks and does not shrink back. Upon wetting again the soil pushes further down the slope. The wall moves along with subterranean expansion.

Recommendations

The leaning condition of the wall does not pose a current life safety hazard. It is possible for the wall to be replaced. However, it is recommended that the drainage conditions on West 25th Street be addressed prior to any work being done on this wall.

Hopefully these observations and recommendations are helpful to you. Please let us know if we can provide any additional information.

Very truly yours,

FICCADENTI & WAGGONER, INC.

Mark Schroeder, S.E.
Principal

Attachment: Site Visit Photos

Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job No: A11-045


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Job No: A11-045


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Job No: A11-045


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Job No: A11-045


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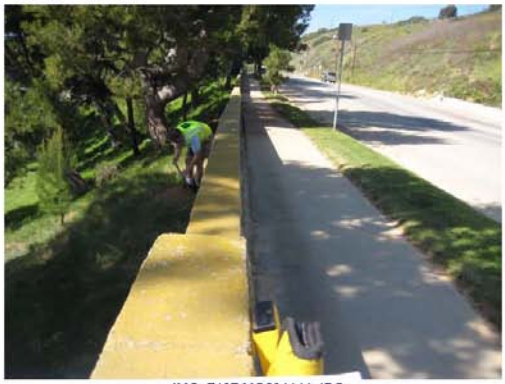
Job Name: PVDE Switchback Early Action Project
Job No: A11-045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Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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IMG_7156.MG031111.JPG

Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
Job No: A11-045

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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
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Job Name: PVDE Switchback Early Action Project
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Job Name: PVDE Switchback Early Action Project
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Job Name: PVDE Switchback Early Action Project
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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
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Job Name: PVDE Switchback Early Action Project
Job No: A11-045


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Job No: A11-045


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Job Name: PVDE Switchback Early Action Project
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Job Name: PVDE Switchback Early Action Project
Job No: A11-045

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Appendix D

Sample HAZUS Printout

Direct Economic Losses for Buildings

March 18, 2011

All values are in thousands of dollars

	Capital Stock Losses				Income Losses				
	Cost Building Damage	Cost Contents Damage	Inventory Loss	Building Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
California									
Los Angeles	142	86	0	0.1	0	0	0	0	228
Total	142	86	0	0.10	0	0	0	0	228
Scenario Total	142	86	0	0.10	0	0	0	0	228

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region: RanchoPalosVerdeCA_2
Scenario: Case5
Return Period: 10

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