LEONA QUARRY

Draft Subsequent Environmental Impact Report

ER 01-33-SUBSEQ
SCH No. 1999042052

October 22, 2003

Prepared for

City of Oakland
Community and Economic
Development Agency

ER 01-33-SUBSEQ
SCH No. 1999042052

ESA Environmental Science Associates

CITY OF OAKLAND
Community and Economic Development Agency, Planning & Zoning Services Division
250 Frank H. Ogawa Plaza, Suite 3330, Oakland, California, 94612

NOTICE OF AVAILABILITY – DRAFT SUBSEQUENT ENVIRONMENAL IMPACT REPORT FOR THE LEONA QUARRY PROJECT

TO:	All Interested Parties
SUBJECT:	**Notice of Availability** of Draft Subsequent Environmental Impact Report on the Leona Quarry Residential Project
CASE NO:	ER 01-33 (State Clearinghouse Number 1999042052)
PROJECT LOCATION:	The 128 acre site is located at 7100 Mountain Boulevard in the City of Oakland and is bounded by Edwards Avenue and I-580 to the south and west, Campus Drive to the north, and single family homes and open space to the east.
PROJECT APPLICANT:	DeSilva Group, 11555 Dublin Boulevard, Dublin, CA 94568

BRIEF DESCRIPTION OF PROJECT: The Oakland Community and Economic Development Agency, Planning Division, has prepared a Subsequent Environmental Impact Report (SEIR) for certain aspects of the Leona Quarry Project. The City previously certified an EIR for the Leona Quarry Project (SCH #1999042052) and approved a Zoning Boundary Adjustment (ZBA), Planned Unit Development (PUD) permit, Variances, Vesting Tentative Map (VTM) and Design Review approving the Modified Plan alternative for Leona Quarry, including 477 residential units and complete restoration of the quarry site. The Alameda County Superior Court ordered the EIR Certification, PUD Permit, Variances, VTM and Design Review "set aside until a subsequent EIR is prepared with regard to only that portion of the EIR dealing with hydrological issues." The court also ordered "as to the Geology segment of the EIR, additional review is ordered only if changes arising out of matters related to hydrology result in changes to the geology analysis in accord with standards set forth in CEQA Guideline 15162." The order also "stays the force and effect of [the ZBA] pending a showing that decisions arising from the subsequent EIR process require the Court to take further action." The City has now completed the Subsequent EIR to comply with this court order.

DRAFT SUBSEQUENT ENVIRONMENTAL IMPACT REPORT: The DSEIR identifies potentially significant environmental impacts dealing with hydrological issues related to increased stormwater runoff and water quality. The DSEIR provides further analysis of pertinent hydrology issues, as required by the court order. Copies of the Draft Subsequent Environmental Impact Report (DSEIR) are available for distribution to interested parties at no charge at the Community and Economic Development Agency, Planning Division, 250 Frank H. Ogawa Plaza, Suite 3330, Oakland, CA 94612, Monday through Friday, 8:30 a.m. to 5:00 p.m.

PUBLIC HEARING: The Oakland Planning Commission will conduct a public hearing on the DEIR on **Wednesday, November 19, 2003,** at City Hall, 1 City Hall Plaza, Hearing Room 1, Oakland, California. The City Planning Commission meeting will begin at 6:30 P.M. Members of the public are welcome to attend this hearing and provide comments focusing on the sufficiency of the DSEIR. All comments received will be considered by the City prior to finalizing the EIR and to taking any further action pertaining to the project. Comments must be received **no later than 4:00 p.m. on Monday, December 8, 2003**, and should be sent to the attention of **Claudia Cappio, Development Director at the City of Oakland Community and Economic Development Agency, Planning Division, 250 Frank H. Ogawa Plaza, Suite 3330, Oakland, CA 94612.** If you challenge the environmental document or other potential actions pertaining to the proposed project in court, you may be limited to raising only those issues raised at the City Planning Commission public hearing described above, or in written correspondence received by the Community and Economic Development Agency on or prior to December 8, 2003 at 4:00 p.m. For further information, please call Claudia Cappio, at (510) 238-2229 or ccappio@oaklandnet.com.

Claudia Cappio
Development Director

October 23, 2003

LEONA QUARRY

Draft Subsequent Environmental Impact Report

October 22, 2003

Prepared for

City of Oakland
Community and Economic
Development Agency

ER 01-33-SUBSEQ
SCH No. 1999042052

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CHAPTER I
INTRODUCTION

On December 17, 2002, the Oakland City Council certified the Leona Quarry EIR (SCH #1999042052) and issued various approvals for the Modified Plan of the Leona Quarry Residential Project pursuant to Ordinance No. 12457 C.M.S. The Modified Plan, herein referred to as the "Project," consists of 477 residential units, an approximately 2,300 square-foot community center, a 2-acre park and 3 additional tot lots, a Village Green area, and pedestrian trails on 128 acres of land located at 7100 Mountain Boulevard.

A. ENVIRONMENTAL REVIEW

The City of Oakland, acting as the Lead Agency, is preparing this Subsequent EIR to respond to a court order. In *Dorsey et al. v. City of Oakland*, Alameda County Superior Court Action No. RG 03077607, the court referred to a Subsequent EIR with regard to "only that portion of the EIR dealing with hydrological issues." In addition, the court ordered "as to the Geology segment of the EIR, additional review is ordered only if changes arising out of matters related to hydrology result in changes to the geology analysis in accord with standards set forth in CEQA Guideline 15162." Copies of the Amended Judgment and Second Amended Writ from the *Dorsey* litigation are included in Appendix A.

This Subsequent EIR (SEIR) is being prepared to comply with the writ. This SEIR discusses various parameters that may be used in modeling hydrological impacts and recommends use of a more conservative set of parameters than are reflected in the original Leona Quarry EIR. Several experts have addressed the hydrological impacts of this Project and agree upon the methodology to be used. They have conferred over differences in opinion regarding the values of certain parameters. The set of parameters recommended in this SEIR result from a consensus approach involving Philip Williams and Associates Ltd., City staff, Alameda County Flood Control and Water Conservation District, and Balance Hydrologics.

The Notice of Preparation published on August 18, 2003 is included as Appendix B of this document.

B. BACKGROUND

In general, the hydrology analysis in the original EIR was based upon an analysis that included a peer review conducted by the EIR authors of the analysis made by Balance Hydrologics (BH). As the EIR was being completed, the City retained Philip Williams & Associates Ltd. (PWA) to conduct a second peer review of BH's analysis. PWA found that the BH analysis was reasonable, but also suggested alternate parameters and made recommendations. PWA's initial recommendations were generally more conservative than BH's. This SEIR describes both the BH and PWA parameters. This SEIR concludes that both the BH and PWA analyses incorporate reasonable assumptions and use methodologies that are consistent with standard engineering and Alameda County Flood Control and Water Conservation District (ACFCWCD) practices, but represent different approaches for determining compliance with these standards.

City staff determined to adopt a more conservative set of parameters than is reflected in the original Leona Quarry EIR. Experts from PWA, BH, the City and Alameda County Flood Control and Water Conservation District (ACFCWCD) conferred and reached consensus on the best methodologies and parameters to use in implementing that decision. The results of this consensus approach are reflected in a report by PWA dated October 21, 2003. This SEIR recommends using the PWA parameters and recommendations referenced in that October 2003 report to design and evaluate the stormwater management system for the Leona Quarry project. This SEIR adopts these recommendations and employs these parameters. The result is an analysis more conservative than that reflected in the original Leona Quarry EIR.

C. ANALYSIS IN THIS SUBSEQUENT DRAFT EIR

The Project evaluated in this SEIR is the Modified Plan previously approved by the City, with some changes made to the stormwater management system recommended to mitigate impacts as a result of the more conservative analysis. This SEIR refers to the Modified Plan as the Project, and evaluates the stormwater impacts of the Modified Plan. In addition, while CEQA requires only that the Leona Quarry project mitigate the stormwater-related impacts of that project to a less-than-significant level where feasible, the City requested and the applicant agreed that the Leona Quarry stormwater management system also accommodate redirected stormflows from the existing Ridgemont subdivision. This SEIR accordingly includes those additional stormflows in the analysis. The conclusion of this SEIR, based on PWA and BH's analysis, is that a refined stormwater management system, which includes a proposed detention basin with 15.6 acre-feet of detention capacity, would accommodate the Leona Quarry stormwater flows and the redirected Ridgemont flows consistent with the applicable standards. The system would result in no increase in peak flows in comparison with existing conditions for the 25-year, 24-hour design storm; would not worsen conditions in the 39 inch pipe that passes under Highway 580; and would not fail during a 100-year, 24-hour design storm. The 15.6 acre-foot basin can be constructed without altering the Modified Plan project design.

This SEIR evaluates the hydrological impacts of the alternatives described in the Leona Quarry EIR. In addition, this SEIR evaluates an alternative stormwater management system that has a single, larger detention basin rather than an upper pond and a lower detention basin. For informational purposes, an oversized basin is also explored, although an oversized basin would not be required for the Project to maintain pre-project flows.

This SEIR also evaluates whether these revisions to the hydrology analysis result in any changes to the geology analysis; this SEIR concludes that they do not.

D. ORGANIZATION OF THE SUBSEQUENT DRAFT EIR

This Subsequent EIR (SEIR) replaces the hydrology analysis reflected in the original Leona Quarry EIR.

The SEIR begins with this Introduction (Chapter I), followed by a Summary (Chapter II), which describes the revised hydrology analysis, and whether those revisions require any changes to the geology analysis. The Summary concludes with Table II-1, Summary of Hydrology Impacts and Mitigation Measures. This table lists the identified hydrology impact, mitigation measures, and the level of significance after implementation of the mitigation.

The Background for this SEIR, Project Description, and Approval Process (Chapter III) describes the Modified Plan project for which this analysis is conducted. For ease of reference, it reiterates the project objectives, project location, project description, and anticipated phasing of the project with construction information from the Leona Quarry EIR. The phasing of the project is consistent with the previously adopted Conditions of Approval. This SEIR provides an overview of the City's process to consider this SEIR and reconsider the approvals ordered set aside in the *Dorsey* litigation.

The Hydrology Environmental Setting, Impacts, and Mitigation Measures (Chapter IV) contains a discussion of the revised hydrology analysis (included in Section F of the Leona Quarry Draft EIR). The revisions to the hydrology analysis did not result in revisions to the analysis in the geology section. Thus, no revision to the Geology analysis is required for the Subsequent Draft EIR. The Chapter V of this SEIR, Hydrologic Effects on Geologic Conditions, contains a detailed discussion of how the revisions in the hydrology analysis affect geologic conditions.

The Alternatives (Chapter VI) discusses revisions related to hydrology for the alternatives evaluated in the original Leona Quarry Draft EIR. These alternatives include the No Project Alternative, which is required by CEQA for all EIRs; a Lower Density Alternative; a Clustered Development Alternative; and a Solar Energy Plant Alternative. The No Project Alternative has three variants; an increased quarry operations scenario, a reduced quarry operations scenario, and a proposal consistent with adopted general plan densities. The chapter also contains a summary of the alternative's ranking in terms of environmental superiority.

The Oversized Detention Basin (Chapter VII) contains a discussion regarding options for increasing the detention pond and potential environmental effects for each option.

Report Authors (Chapter VIII) describes the authors of the SEIR and persons and documents consulted during preparation of the SEIR.

The NOP for this SEIR, as well as background and supporting documents and technical information, are presented in the Appendices at the end of the document.

CHAPTER II
SUMMARY

The scope of this SEIR is described in the court order in the *Dorsey* litigation. This SEIR replaces the analysis of hydrology impacts that appeared in the Leona Quarry EIR. This SEIR evaluates potential hydrological impacts of the Project and evaluates whether changes to the hydrology analysis result in changes to the geology analysis.

A. PROJECT DESCRIPTION

As described in more detail in Chapter III, Project Description, the proposed Project is the Modified Plan as identified and analyzed in the Leona Quarry Final EIR, Volume I. The Modified Plan is the "Project" in this Subsequent EIR. No changes to the description of the Modified Plan are proposed in the SEIR. A reiteration of the description from the Leona Quarry EIR is set forth here for easy reference purposes.

The proposed Project would construct 477 residential units, an approximately 2,300 square foot community center, a 2-acre park and 3 additional tot lots, a Village Green area, and pedestrian trails on 128 acres of land located at 7100 Mountain Boulevard. Nineteen (19) single-family detached homes would be constructed on about nine acres along Campus Drive, with a 100-foot rear building setback from the top of the slope. The remaining 458 units, consisting of 404 townhomes and condominiums and 54 affordable senior housing units, would be located in the Lower Development Area, on about a third (approximately 45 acres) of the Project site.

The proposed Project would also construct an approximately 2,300 square foot Community Center and a two-acre park near the center of the Lower Development Area. The park and Community Center would be improved with a tot-lot, picnic tables and kitchen facilities within the Community Center. Three additional tot-lots also would be provided in the Lower Development Area, and there would be a small Village Green area that provides open space between residential units. Development in the Lower Development Area would gradually step up the slope and would be landscaped between the buildings. The proposed Project would also improve the pedestrian trail system envisioned by the City and link the development and the natural restored features of the Project site.

The steep, barren and denuded slopes would be stabilized, restored and landscaped. The site would be reconstructed to provide a sustainable medium for trees, shrubs, and groundcover. Historic conditions will be replicated in order to provide an optimum growing environment for new landscaping and approaches for landscape installation.

The Project would incorporate the Gateway emergency vehicle access ("Gateway EVA") in accordance with state and local fire department standards for a secondary emergency vehicle assess. (The primary emergency vehicle access would still be by way of the development's primary roadway network.) The Gateway EVA would enter the site from Mountain Boulevard, wrap around the Gateway senior housing and connect to "A" Street. Access would be restricted to emergency vehicles and buses only; no public access or parking will be allowed.

In addition, the proposed Project would incorporate two supplemental emergency accesses requested by the Oakland Fire Department and agreed to by the Project sponsor for redundancy and to improve and enhance emergency access to and from adjacent neighborhoods. Supplemental access and egress would be provided to Altura Place (Altura access) and to Leona Street (Northwestern access). The Altura access would connect "I" Street with Altura Place within the City's existing right of way. The Northwestern access would follow the existing fire access easement along the I-580 right of way (located on the Project site), across the City's right of way on Edan Place, back on to the Project site and connect with Leona Street via an existing easement over the Suchan property. No other improvements or widening are suggested by the Fire Department or proposed along Leona Street.

The reclaimed quarry slopes would have intermittent benches to capture and control surface water runoff and erosion. These benches would accommodate revegetation, open space, wildlife habitat enhancement, and potential pedestrian access. There have been some changes to the stormwater management system proposed for the Modified Plan as it was described in the Leona Quarry Final EIR, Volume I. The stormwater management system has been further developed and refined, and now includes many attributes not typically found until the final design stage. The stormwater management system is proposed to include two detention facilities: a small existing upper pond with a detention capacity of approximately 3.2 acre feet, and a larger lower detention basin with a detention capacity of 15.6 acre feet.

The Project sponsor anticipates the Project would be developed in phases over 6 to 10 years, with site preparation and regrading occurring first. Major earthmoving operations would occur over a period of up to 25 months. The Project sponsor proposes to start building construction at the earliest appropriate time after Project approval; site preparation would be expected to occur from 7:00 a.m. to 7:00 p.m., five days a week. Thereafter, about 150 units would be constructed for occupancy by the year 2005. The rest of the development (remaining 327 residential units, park areas/trails, and community space) would be constructed in subsequent phases over the following six to seven years.

B. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

This SEIR discusses various parameters that may be used in evaluating the hydrologic impacts of the Project. Several experts have participated in evaluating the hydrologic impacts of this Project: PWA, City Staff, ACFCWCD and BH. All employ a standard, tested methodology. This methodology employs the SCS unit hydrograph and the U. S. Army Corps of Engineers HEC computer model. The experts differ regarding input parameters. This SEIR concludes that the approaches taken by all experts are reasonable and consistent with standard engineering practices, City standards, and ACFCWC standards. The PWA parameters generally reflect the more conservative approach. Please refer to Chapter IV, Hydrology Environmental Setting, Impacts, and Mitigation Measures for a detailed discussion of the differences between the parameters.

This SEIR recommends using the parameters developed as the result of a consensus approach in which PWA, City staff, ACFCWCD and BH participated. The results of this consensus approach are reflected in PWA's October 21, 2003 report. Table II-1, presented at the end of this chapter provides a summary of the revised hydrology impact and mitigation measures. This table lists the only potentially significant hydrology impact: that development of the Project site could increase storm water flow to exacerbate existing flooding. This impact is discussed and a stormwater management system is proposed to fully mitigate this impact. Please refer to Chapter IV, Hydrology Environmental Setting, Impacts, and Mitigation Measures, for a complete discussion of the impact and associated mitigation. The changes to the hydrology analysis reflected in the SEIR do not require any revisions to the geology in the original EIR. Please refer to Hydrologic Effects on Geologic Conditions (Chapter V).

C. ALTERNATIVES

Chapter VI of this SEIR summarizes the hydrological impacts of the alternatives that were presented in the Leona Quarry EIR. No changes to the descriptions of the alternatives are proposed in this Draft SEIR. The descriptions from the Leona Quarry EIR are reiterated here for easy reference purposes.

These alternatives include the No Project Alternative (required by the California Environmental Quality Act for all environmental impact reports); a Lower Density Alternative; Clustered Development Alternative; and a Solar Power Plant Alternative. This SEIR also considers the hydrological impacts of three variants of the No Project Alternative presented in the Leona Quarry EIR. The No Project Alternative, Variant One, describes a heightened operation of the quarry as entitled under the existing approved reclamation plan. Hydrological impacts would be similar to those of the Project, as there would be little change from existing hydrologic circumstances. Another variant of the No Project Alternative would be that the quarry operations would not be heightened and quarry operations would continue at levels similar to the past five years of activity. Hydrologic impacts would be similar to those of the Project, as there would be little change from existing hydrologic circumstances, similar to Variant One. The revisions to the hydrology analysis do not result in any changes to the geology analysis for this alternative.

A third variant of the No Project Alternative is analysis of General Plan buildout for the Project site. This involves a more intensive residential development project of 1,519 units. Hydrology impacts of such a project would be expected to be similar in nature to those of the proposed Project, with the potential of more intensive impacts, subject to the density proposed and whether the project would incorporate measures to address existing environmental impacts. The revisions to the hydrology analysis do not result in any changes to the geology analysis for this alternative.

The Lower Density Alternative would entail the construction of 236 units while implementing the proposed Project's revised reclamation plan (including grading) and landscape plan. This alternative would provide a stormwater detention basin similar to the proposed Project, resulting in similar hydrology impacts. The revisions to the hydrology analysis do not result in any changes to the geology analysis for this alternative.

The Clustered Development Alternative would entail the construction of 373 units and create more open space on site by grouping higher density structures together. This alternative would also implement the proposed Project's revised grading and landscaping plan. Regrading and construction activities would be similar to the proposed Project. Hydrology impacts of this alternative would be expected to be similar in nature to or proportionally lower than the proposed Project depending on the elements of the alternative. The revisions to the hydrology analysis do not result in any changes to the geology analysis for this alternative.

The Solar Power Plant Alternative was included in the original EIR to respond to the community's request to consider a solar power plant for the site. This alternative assumes the development of about a 100-acre solar power plant that generates solar power from photovoltaic (PV) panels with crystalline silicon. This alternative includes 19 single-family detached homes along Campus Drive similar to the proposed Project. This alternative would entail the construction and operation of a manufacturing plant to produce the PV panels required for this solar power plant. Ancillary structures such as multiple inverter facilities and maintenance buildings would be required to convert the collected sunlight to energy and transfer it through the power grid system. This alternative would result in less than significant impacts regarding flooding by providing the stormwater detention basin similar to the proposed Project. The revisions to the hydrology analysis do not result in any changes to the geology analysis for this alternative.

TABLE II-1
SUMMARY OF HYDROLOGY ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Environmental Impact	Mitigation Measures	Significance After Mitigation
<u>SIGNIFICANT BUT MITIGABLE IMPACTS</u>		
Hydrology		
F.1: Development of the Project site could increase storm water flow to create localized flooding and contribute to existing flooding downstream.	**Mitigation Measure F.1a:** The Project sponsor shall be required to construct a stormwater management system, that includes a detention basin and outlet works capable of maintaining peak flows from the 24-hour, 25-year design storm at or below pre-project levels, and that will not fail structurally during a 100-year storm, as determined using the parameters resulting from the consensus process discussed in this SEIR. The basin shall be lined with an impermeable material to minimize leakage and contributions to local groundwater flow. The stormwater management system reviewed in this SEIR, with the 15.6 acre-foot lower detention basin, meets these performance standards. **Mitigation Measure F.1b**: The Project sponsor shall modify the existing Ridgemont Sub-watershed pond (Pond 4). Improvements to the pond outflow structure shall include the following elements (or design elements that achieve an equivalent discharge rating curve using the parameters resulting from the consensus process discussed in this SEIR equivalent to that achieved by the following elements): replacing the existing 30-inch outlet pipe with a 42-inch outlet pipe, adding a single drop box with one rectangular orifice, and constructing an emergency spillway. The perimeter of the drop box would be comparable to a 36-inch riser and the rectangular orifice would be 2.75 feet by 2.0 feet in size. The replacement of the outlet pipe shall be consistent with standard engineering practice. A geotechnical evaluation of the existing detention basin levees and proposed modifications shall be completed to assess the overall integrity of the pond and recommendations from the evaluation shall become part of the Project design and be implemented as directed by a registered geotechnical engineer.	LS

TABLE II-1 (continued)
SUMMARY OF ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Environmental Impact	Mitigation Measures	Significance After Mitigation
	Alternate Mitigation Measure F.1a: The Project sponsor shall be required to construct a stormwater management system that will maintain peak flows from the 24-hour, 25-year design storm at or below pre-project levels, and not fail structurally during a 100-year storm, as determined using the parameters resulting from the consensus process discussed in this SEIR. The basin shall be lined with an impermeable material to minimize leakage and contributions to local groundwater flow. The stormwater management system reviewed in this SEIR, with a single basin with 20.5 acre-feet of detention capacity, meets these performance standards. **Alternate Mitigation Measure F.1b:** The Project sponsor shall modify the existing Ridgemont Sub-watershed pond (Pond 4) by installing a 42" flow-through pipe system to minimize the detention capabilities of that existing pond.	LS

SU = Significant and Unavoidable
LS = Less than Significant

CHAPTER III

BACKGROUND FOR THIS SEIR, PROJECT DESCRIPTION, AND APPROVAL PROCESS

A. BACKGROUND

This SEIR evaluates not only the stormflows generated as a result of development of the Project, but also redirected stormflows from 4.5 acres of the adjacent, existing Ridgemont subdivision. The applicant for the Leona Quarry Project has agreed, at the City's request, to help correct existing drainage deficiencies relating to these 4.5 acres. The stormflows from 4.5 acres of the existing Ridgemont subdivision are not an impact of the Project, but are included in the hydrologic analysis in the SEIR because of this arrangement.

The hydrology analysis of the original EIR was based in part on an analysis conducted by the applicant's consultant, Balance Hydrologics (BH). A qualified hydrologist and other environmental experts on the staff of ESA peer reviewed the BH analysis and performed further analyses. The analysis of the Project in the Leona Quarry EIR (using the BH parameters) resulted in a 14 acre-foot basin.

As the Final EIR was being completed, the City retained PWA to conduct a second peer review of the BH analysis. PWA's scope of work included reviewing the hydrologic analysis performed by BH, coordinating with the Alameda County Flood Control and Water Conservation District (ACFCWCD), and providing input to the City as requested. PWA issued its initial report in November 2002, which is attached as Appendix C to this SEIR.

After PWA completed its initial peer review, City staff recommended that the applicant work with PWA and ACFCWCD. PWA, BH, ACFCWCD, and City Public Works Agency conferred extensively and reached consensus on how best to refine the model runs and the analyses to achieve this goal.

During the PWA peer review process, City staff also updated its project approval recommendations to reflect the standards PWA recommended. Staff revised proposed Condition of Approval 23 – the condition that addressed hydrology and other issues – to ensure compliance with the requirement that 25-year, 24-hour peak flow from the site be equal to or less than existing peak flow, and noted that doing so may have required increasing the size of the proposed detention basin to provide additional capacity and/or refinements to the proposed outlet structure design.

On December 17, 2002, the Council approved the Modified Plan and imposed Condition of Approval 23, which required the project applicant to implement all the mitigation measures described in the hydrology portion of the Mitigation Monitoring Program. Condition 23a stated as follows:

> *A master site drainage and grading plan that incorporates a minimum of 14 acre foot detention basin as set forth in the Modified Plan, meets the published design criteria set forth in the Alameda County publication entitled "Hydrology and Hydraulic Criteria Summary for West Alameda County" (1989) and is consistent with the information, standards and requirements as set forth in the MMRP [listing mitigation measure numbers]. The final design for the stormwater system may include an increase in the on-site capacity and/or refinement of the outflow structures.*

The City's approval of the Project and certification of the EIR were then challenged in the *Dorsey* litigation. As the *Dorsey* litigation was pending, BH continued refining its plans to meet the criteria referenced in Condition 23 and proposed a 15.6 acre-foot detention basin. PWA had commenced its peer review of this latest refinement to the stormwater management system when the court issued its initial decision in the *Dorsey* litigation.

The *Dorsey* litigation eventually resulted in a writ. The provisions of the writ pertaining to preparation of this SEIR direct the City and City Council to do as follows:

> 1. Set aside the certification of the EIR until a subsequent EIR is prepared with regard to only that portion of the EIR dealing with hydrological issues. As to the Geology segment of the EIR, additional review is ordered only if changes arising out of matters related to hydrology result in changes to the geology analysis in accord with standards set forth in CEQA Guideline 15162. (See also *Temecula Bank of Luiseno Mission Indians v. Rancho Cal. Water Dist.* (1996) 43 Cal. App. 4th 425, 437 [discussion of new baseline].) The subsequent EIR shall be given the same notice and public review as required under CEQA Guideline 15087;
>
> 2. Set aside the approvals issued pursuant to Resolution 77544 until a subsequent EIR is prepared with regard to only that portion of the EIR dealing with hydrological issues. As to the Geology segment of the EIR, additional review is ordered only if changes arising out of matters related to hydrology result in changes to the geology analysis in accord with standards set forth in CEQA Guideline 15162. (See also *Temecula Bank of Luiseno Mission Indians v. Rancho Cal. Water Dist.* (1996) 43 Cal. App. 4th 425, 437 [discussion of new baseline].) The subsequent EIR shall be given the same notice and public review as required under CEQA Guideline 15087

Since the court issued its decision, the stormwater management system has continued to undergo refinements. Designing a stormwater management system is typically a lengthy process, and the design is continuously refined at several stages. Typical engineering practice is to develop a preliminary design for a stormwater management system, then refine the fundamental design and add details as the Project progresses. BH continuously refined and revised its analysis and preliminary basin design to accommodate the results of the consensus approach as issues were identified and resolved. PWA peer-reviewed various aspects of the revised analysis as they were completed. PWA issued another report, dated October 21, 2003, which summarizes the entire review and contains the final recommendations PWA makes at the end of this consensus process.

B. PROJECT OBJECTIVES

The Project objectives are not revised by this Draft SEIR. The following description is a reiteration of the description of the Project objectives in the Leona Quarry EIR and is presented for easy reference purposes.

The Project sponsor, The DeSilva Group, proposes to redevelop an active rock quarry into a residential neighborhood on 128 acres of land located at 7100 Mountain Boulevard. The Project would regrade the existing slopes to less steep slopes consistent with a revised grading plan, provide appropriate drainage for slope stabilization, and return the site to seminatural conditions. The Project sponsor proposes to build 477 residential units; an approximately 2,300-square-foot community center; a 2-acre park and 3 additional tot lots; a Village Green area; and pedestrian trails. The Project is proposed in response to increasing demand for residential space in Oakland and neighborhood commercial space in the Project vicinity. This Project is intended to fulfill the City of Oakland’s goals of creating an affordable housing supply and providing uses on the Project site that are more compatible with nearby residential neighborhoods than the existing quarry. The Project sponsor proposes to stabilize existing slopes; establish a basin for stormwater detention and treatment that may also enhance wildlife habitat opportunities; develop a residential neighborhood with a variety of housing types; provide adequate parking for the proposed new uses; provide new open space and a pedestrian trail system; and revegetate/reintroduce trees, shrubs, and groundcover on disturbed areas of the site to help stabilize the slopes as well as improve the visual quality of the hillside. Long-term slope stabilization would be maintained by the existing Geologic Hazard Abatement District (GHAD).

Specifically, the Project seeks to:

- Fulfill the objectives of the Land Use and Transportation Element of the General Plan (Oakland Community and Economic Development Agency Planning Department, 1998) and promote “smart growth” planning principles. Major objectives include reclamation of the site for the provision of “opportunities for open space, housing, and commercial uses” as well as reuse of the site “with residential development that is sensitive to the low density, residential character of the area [that] serves the needs of the Central Oakland communities.”

- Replace the current industrial use of the site as an active aggregate quarry with an attractive and visually identifiable residential community with architectural styles and a site plan design that would be compatible with the surrounding setting, land use patterns, densities, and intensities

- Provide an economically feasible, integrated, and cohesive residential development project that will enable timely reclamation of the site
- Improve the City's jobs/housing balance and help the City accommodate its fair share of housing needs by providing a mix of housing types and sizes that will be available to a wide range of income levels and will meet the needs of a variety of different household sizes
- Alleviate a regional (Bay Area) housing shortage by providing housing that is close to urban job centers and major transportation corridors
- Protect the health, safety, and welfare of City residents by repairing landslide-prone areas and ensuring long-term soil stability
- Foster more environmentally sensitive modes of transportation, such as public transit, walking, and bicycling
- Provide a significant amount of permanent open space and expand local recreational opportunities in open spaces and parklands to meet the passive and active recreational needs of local residents
- Preserve, protect, and enhance riparian corridors and biological resources

C. PROJECT LOCATION AND CHARACTERISTICS

The Project location and characteristics are not revised by this SEIR. The following Project description is a reiteration of the description of the Modified Plan in the Leona Quarry EIR and is presented for easy reference purposes.

The Project would include the construction of 477 residential units, an approximately 2,300 square foot community center, a 2-acre park and 3 additional tot lots, a Village Green area, and pedestrian trails. The steep, barren and denuded slopes would be revegetated and reengineered.

Nineteen (19) single-family detached homes would be constructed on about nine acres along Campus Drive, with a 100-foot rear building setback from the top of the slope. The remaining 458 units, consisting of 404 townhomes and condominiums and 54 affordable senior housing units, would be located in the Lower Development Area, on about a third (approximately 45 acres) of the Project site. A majority of the townhomes and condominiums would have two-bedrooms (194 units) and three-bedrooms (176 units) and the remaining 34 units would have four-bedrooms. The affordable senior housing units would have 53 one-bedroom units and 1 two-bedroom unit. The Gateway affordable senior housing would be built on the most level and easily accessible part of the site, which is near Mountain Boulevard. The Project sponsor anticipates 54 units (53 one-bedroom and 1 two-bedroom) would be constructed.

Multiple clusters of differing home designs would be integrated on the site with access from "A" street. A cluster design of condominiums would surround the Village Green creating a network of pedestrian connections. Above and below the Village Green would be stepped townhomes and condominiums three to four stories tall. Townhomes would be situated above the park and continue up the slope to the Terrace condominiums. They would be up to five stories in a stepped configuration. The Gateway affordable senior housing would be 3 to 4 stories above a garage.

The roadway network in the Lower Development Area, as shown in Figure III-1, would consist of a main, curved-shaped roadway ("A" Street) that would start at the Mountain Boulevard entrance and continue generally through the middle of the Lower Development Area in a northerly direction. From "A" Street, other streets ("B," "C," "D," "G," and "H") would provide access to the west and northwestern portions of the development area. "A" Street would terminate with a round-about and would connect to other roadways ("I," "J," and "K" Streets) in the eastern portion of the Lower Development Area.

The Project would incorporate the Gateway emergency vehicle access ("Gateway EVA") as well as limited, supplemental emergency access and egress to Altura Place and Leona Street. The Gateway EVA would enter the site from Mountain Boulevard, wrap around the Gateway senior housing and connect to "A" Street. Supplemental access and egress would be provided to Altura Place (Altura access) and to Leona Street (Northwestern access). It would connect "I" Street with Altura place within the City's existing right of way. Internal EVAs would be included that connect "A" Street with "I" Street as well as "H" Street with "C" and "B" Streets. They would be 20-feet wide (unobstructed) and capable of supporting 65,000 pounds. Additional pedestrian routes would be included throughout the site that also would provide supplemental access for both recreational and emergency usage.

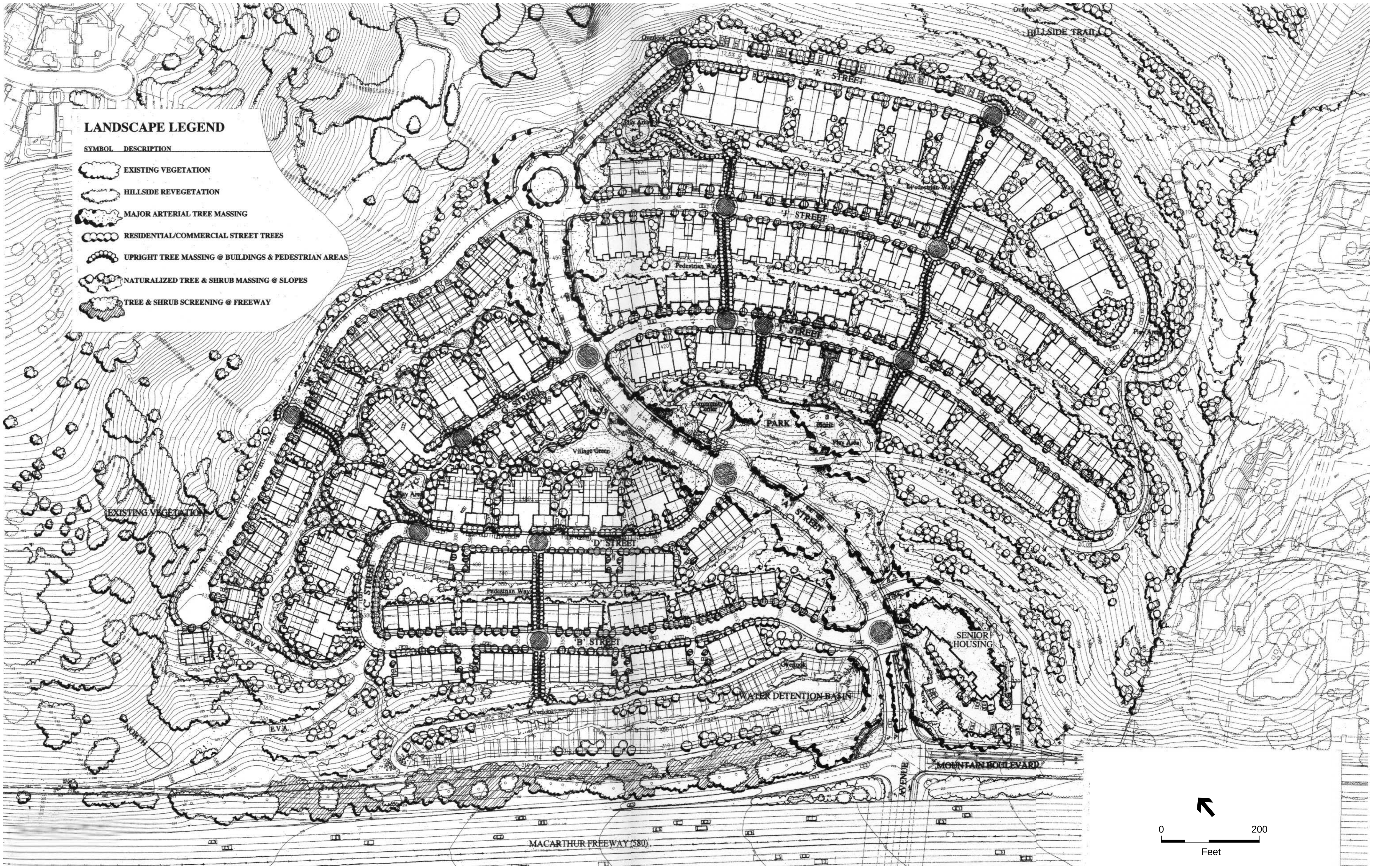
The Project would also include the construction of an approximately 2,300 square foot Community Center and a two-acre park near the center of the Lower Development Area (see Figure III-1). The park and Community Center would be improved with a tot-lot, picnic tables and a kitchen area in the Community Center. Three additional tot-lots also would be provided in the Lower Development Area and there would be a small Village Green area that provides open space between residential units. Development in the Lower Development Area would gradually step up the slope, as described in the Leona Quarry EIR, and would be landscaped between the buildings (see Figure III-I and Figure III-2). The Project would improve the proposed pedestrian trail system and link the development and the natural restored features of the Project site (see Figure III-3). Characteristics of the Project are outlined in Table III-1.

The Project includes the proposed regrading of the slopes and slope stabilization. The proposed slopes would have intermittent benches to capture and control surface water runoff and erosion and these benches would accommodate revegetation, open space, wildlife habitat enhancement, and potential pedestrian access. This SEIR recommends a mitigation measure requiring a lower area detention basin with 15.6 acre-feet of detention capacity to mitigate hydrologic impacts.

The Project would provide additional on-site parking (See Table III-1, above.) The site would be reconstructed to provide a sustainable medium for trees, shrubs, and groundcover. Native trees and shrubs are thriving in some of the disturbed and undisturbed areas in and around the quarry

SOURCE: Carlson, Barbee, and Gibson Inc.

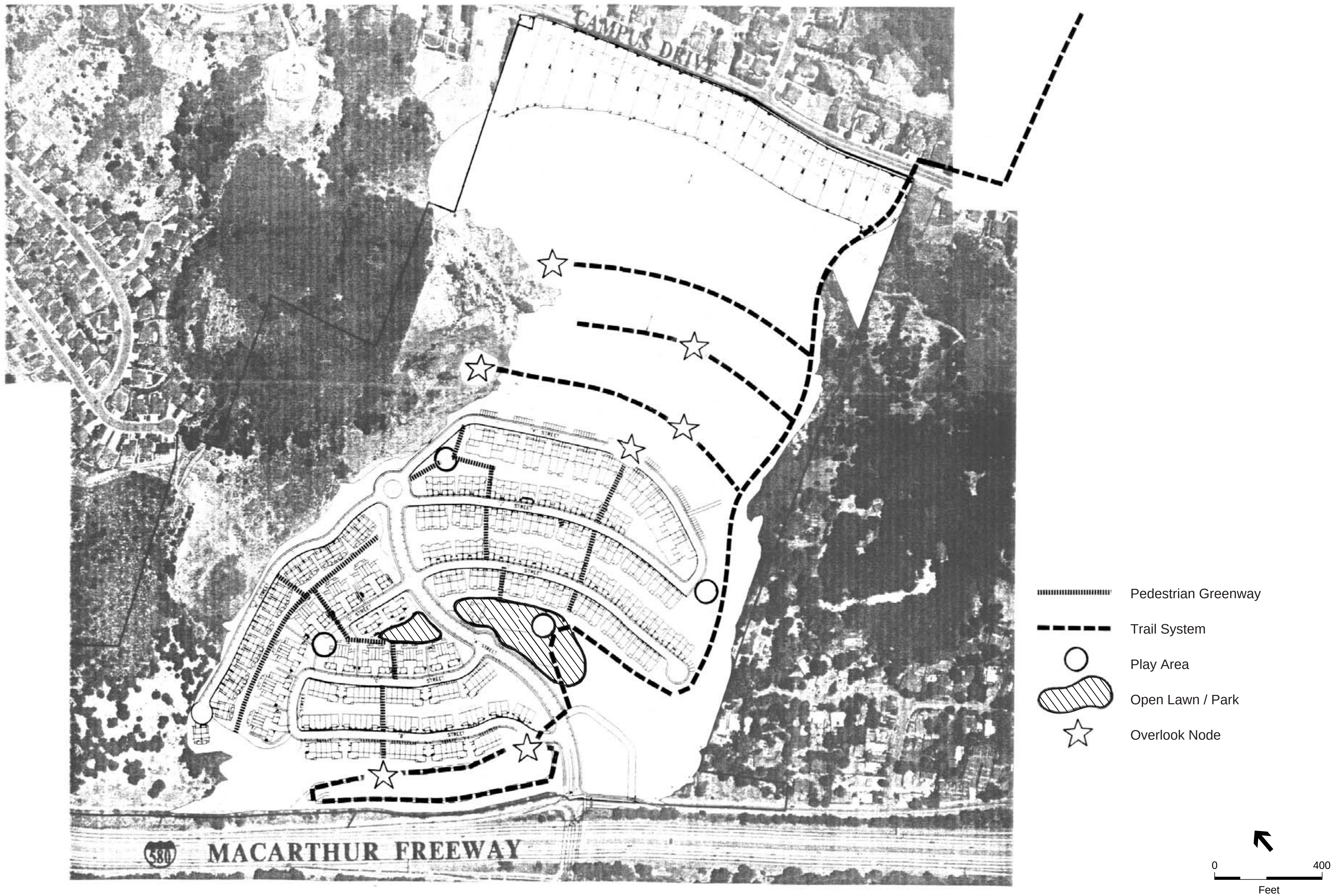
Figure III-1
Modified Plan, Site Plan



SOURCE: Bradanini & Associates

Figure III-2

Modified Plan, Landscape Plan



SOURCE: Bradanini & Associates

Figure III-3
Modified Plan,
Pedestrian Trails and Pathways

TABLE III-1
PROJECT CHARACTERISTICS

		Lower Development Area					
	Campus Drive	Village Green Condos	Condos	Townhomes	Terrace Unit Condos	Gateway Affordable Senior	Totals
Single Family	19						19
1 Bedroom						53	53
2 Bedroom		57	39	68	30	1	195
3 Bedroom		27	27	92	30		176
4 Bedroom		10		24			34
TOTAL	19	94	66	184	60	54	477[a]
Residential Parking	57-76	C	C	c	c	b	1,300-1,333

a Approximately 805,654 square feet of residential use.
b The Gateway affordable senior housing will have 23 garage spaces and 19 open spaces (totaling 42 parking spaces)
c Most of the parking will be garage spaces.

site. Historic conditions would be replicated where feasible to provide an optimum growing environment for new landscaping and approaches for landscape installation.

The Project sponsor anticipates the Project would be developed in phases over 6 to 10 years, with site preparation and regrading occurring first. Major earthmoving operations would occur over a period of up to 25 months. The Project sponsor proposes to start building construction at the earliest appropriate time after Project approval; site preparation is expected to occur from 7:00 a.m. to 7:00 p.m., five days a week. Thereafter, about 150 units would be constructed for occupancy by the year 2005. The rest of the development (remaining 327 residential units, park areas/trails, and community space) would be constructed in subsequent phases over the following six to seven years.

D. APPROVAL PROCESS

The City of Oakland is the Lead Agency responsible for preparation of this Subsequent EIR (SEIR) (CEQA Guidelines Section 15051). The writ in the *Dorsey* litigation is directed to the City of Oakland and its City Council. Accordingly, the Planning Commission will make recommendations to the Council regarding both the proposed certification of this SEIR and re-adoption of the approvals previously issued pursuant to Resolution 77544, which were ordered set aside in the *Dorsey* litigation. The Council will then review the Planning Commission's recommendation and decide whether to certify this Subsequent EIR and whether to re-approve the Project approvals that were ordered set aside by the Court in the *Dorsey* litigation. If approved, the Project would then proceed as described in the Leona Quarry EIR.

CHAPTER IV

HYDROLOGY

A. INTRODUCTION

This chapter of the SEIR describes both existing hydrology at the Project site, and conditions during implementation of the proposed Project. Unless otherwise noted, the setting information, surface water data, and hydrologic modeling results pertaining to Leona Quarry and the vicinity are provided by the Balance Hydrologics (BH) reports entitled, *Analysis of Hydrologic Opportunities and Constraints at Leona Quarry, City of Oakland, California* (July 2001a) (Appendix E) and Balance Hydrologics, Inc., memorandum (October 2001b) (Appendix F); and two Philip Williams and Associates (PWA) reports entitled *Leona Quarry Hydrologic Review* (November 2002) (Appendix C) and *Leona Quarry Hydrologic Review – Phase Two* (October 21, 2003) (Appendix D).

B. SETTING

Leona Quarry is located within the upper headwaters of Chimes Creek east of I-580 in the Oakland Hills. Surrounded to the north, east, and south by residential neighborhoods, historic quarry activities have removed vegetation from the majority of the Project site, and significantly altered surface topography through cut and fill operations. Portions of the site are underlain by up to 70 feet of uncompacted fill, while other areas contain hollows formed by rock removal. Overall, quarry activity has resulted in steep and sometimes unstable slopes juxtaposed with flat surfaces used for quarry equipment storage and site operations.

The San Francisco Bay Area has a Mediterranean climate with cool, wet winters and dry, hot summers. The majority of precipitation (95 percent) falls as rain from October through April. Average annual rainfall at the Project site is approximately 26 inches per year. Approximately 5-inches of precipitation are anticipated within a 24-hour period during a 25-year storm event, while in a 100-year storm event approximately 6.3 inches of precipitation falls within a 24-hour period[1]. During severe winter storms, the Project site can receive relatively large volumes of precipitation in a short time period.

[1] A 25-year storm event has a one in 25 (or 4 percent) probability of occurring in any given year. A 100-year storm event has a one in 100 (or 1 percent) probability of occurring in any given year.

SURFACE WATER HYDROLOGY

WATERSHED BOUNDARIES

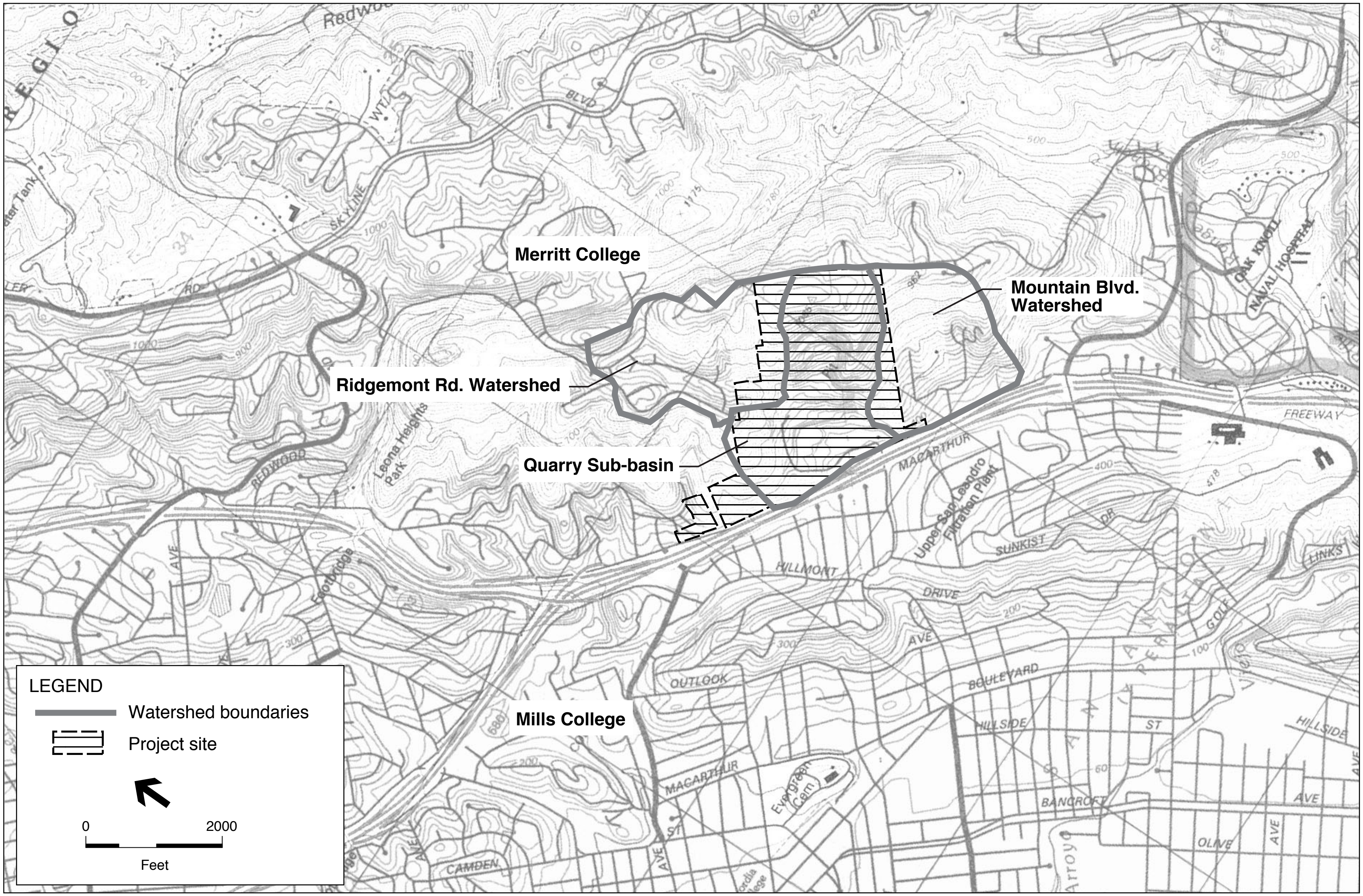
The Leona Quarry and surrounding property form an upstream catchment area for surface water flow referred to as a watershed. The term watershed describes an area of land that drains down-slope to a common lowest point. Surface water moves through a network of drainage pathways, which converge into creeks and streams, and become progressively larger as the water flows downstream. East of Leona Quarry, water flows in streams or lined channels over the East Bay Plain, eventually reaching the San Francisco Bay. Watersheds can cover a large area or be confined to localized drainages. Every stream and tributary has an associated watershed. In developed areas, manmade features such as roadways, drainage facilities, and impervious areas control the flow of water. Hydrologic analysis often requires that a larger watershed be divided into smaller drainage areas, referred to as sub-watersheds, based on similar characteristics such as topography and ground cover. Sub-watershed divisions can provide a more detailed method of assessing site drainage patterns and help generate flow estimates at particular locations.

For purposes of hydrologic analysis, the watershed that includes the Leona Quarry and surrounding area can be separated into four major sub-watersheds based on topography (Figure IV-1). The Ridgemont Road sub-watershed is north of the proposed development area and includes runoff from the Ridgemont neighborhood. The Leona Quarry sub-watershed includes all the areas of the Project site that have been mined and/or are proposed to be developed. Storm water within the Leona Quarry sub-watershed flows down-slope as surface flow, which is then collected and conveyed into three ponds in the Lower Development Area (ponds 1, 2 and 3).[2] Drainage from the Leona Quarry sub-watershed also flows to concrete sediment traps located generally adjacent to I-580.

The I-580 sub-watershed is located southeast of the quarry. The Mountain Boulevard sub-watershed borders the quarry and occupies the area to the south. Runoff from the Mountain Boulevard sub-watershed travels northwesterly in a storm drain under Mountain Boulevard. All four of these sub-watershed areas ultimately drain to a 39-inch pipe at the base of the Project site adjacent to I-580.

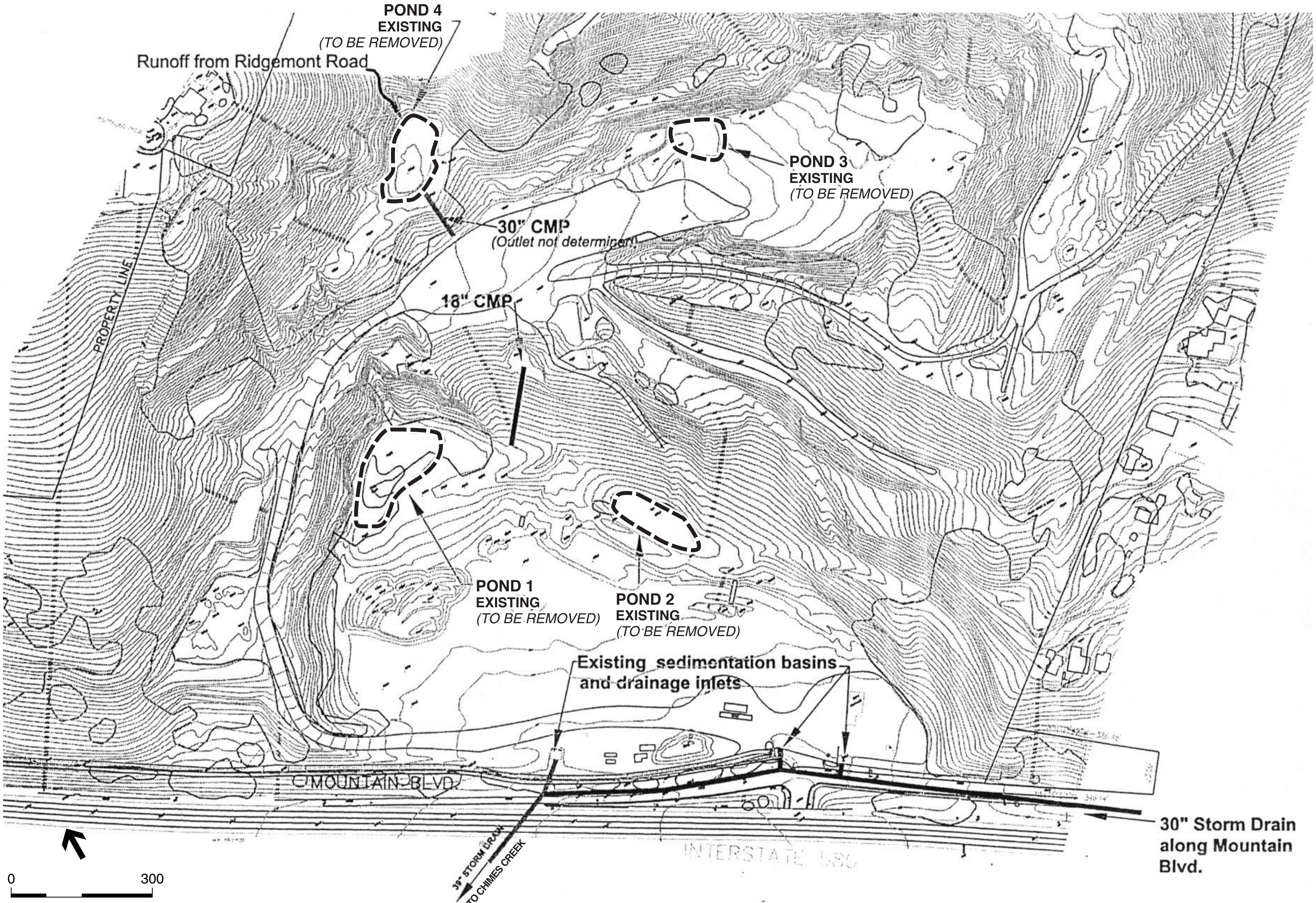
Storm water runoff from the Ridgemont Road sub-basin first passes through the Leona Quarry sub-watershed before reaching the I-580 storm drain pipe. Surface water from the Ridgemont sub-basin is channeled through drainage pipes into a fourth pond located on the Leona Quarry Project site near the northeastern property boundary in the Undeveloped Area, as shown on Figure IV-2. Storm water from this pond subsequently discharges into the Leona Quarry sub-watershed. Therefore, storm water runoff from a large portion of the Ridgemont neighborhood is discharged onto the Project site and combines with runoff originating in the Leona Quarry sub-watershed.

2 Subarea locations are identified in the Project Description.



SOURCE: Balance Hydrologics, Inc.

Figure IV-1
Upper Headwaters of Chimes Creek and
Watershed Boundaries



SOURCE: Balance Hydrologics, Inc.

Figure IV-2
Existing Site Drainage Features

Hydrologic analysis further divided the four major sub-watersheds into smaller sub-basins to enable a more detailed analysis of the potential impacts to hydrology resulting from the project. The Leona Quarry sub-watershed was divided into six sub-basins to represent existing drainage patterns and detention facilities on the quarry site. The Ridgemont Road sub-watershed was divided into two smaller sub-basins to reflect differences in land use. Approximately 4.5 acres of additional land was added to the Ridgemont Road sub-watershed to account for a portion of the storm water flows generated from the Ridgemont subdivision. In the post-project condition, all stormwater is proposed to drain to a lower detention basin. Accordingly, in the analysis of proposed future conditions, the Leona Quarry sub-watershed was considered a single sub-watershed draining to the proposed detention basin.

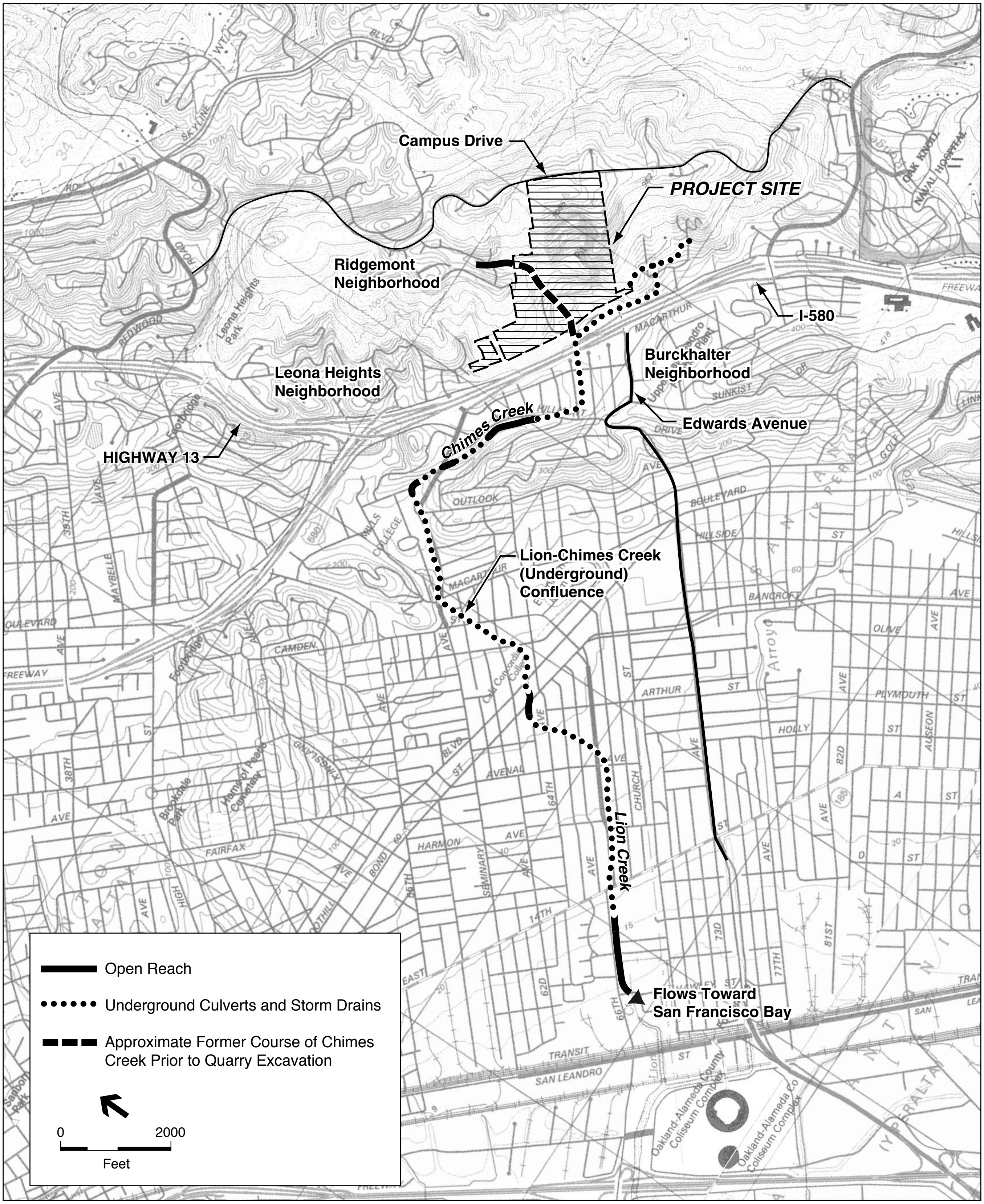
EXISTING STORMWATER DRAINAGE FACILITIES

The existing storm drainage system conveys stormwater beneath I-580 in a 39 inch pipe which connects to a series of large pipes. ACFCWCD estimated capacity is on the order of 180 cubic feet per second (cfs) in the 39-inch line under the I-580 freeway (Balance Hydrologics, 2001b). BH performed a full pipe flow analysis based on updated survey information, and estimated capacity at approximately 172 cfs. (Balance Hydrologics, 2001b). The storm drainage system eventually surfaces in open channels of Chimes Creek approximately 1,400 feet downstream of I-580. Chimes Creek also receives drainage from watershed areas outside the sub-watersheds described above. The majority of Chimes Creek has been enclosed in underground storm drains; only three open-channel reaches remain, for a combined length of approximately 1,300 feet. The longest of these reaches parallels Hillmont Drive and is roughly 900 feet in length. A shorter, open-channel stretch of Chimes Creek flows along the southeastern boundary of Mills College prior to its confluence with Lion Creek near MacArthur Boulevard (see Figure IV-3). Lion Creek flows southwest from this culverted confluence, largely in underground storm drains, approximately 2.6 miles before discharging into Damon Slough north of the Network Associates Coliseum.

GROUNDWATER

Depth to groundwater across the Project site varies with location and season. Geotechnical exploratory soil borings installed during January and February 2000 revealed groundwater ranging in depth from 160 feet below ground surface to artesian conditions (Berlogar, 2000).[3] The variability in groundwater depth may be a result of inconsistent surface water infiltration rates across the Project site due to historic quarry operations. Steep slopes of exposed rock characterize the eastern portion of the Project site. In contrast, other areas of the quarry contain deep layers of uncompacted fill. Groundwater depth may therefore rise significantly following a precipitation event in areas that more readily percolate rainwater and are located downslope of areas with more impermeable surfaces. Refer to Geology, Seismicity, and Mineral Resources

3 Artesian groundwater conditions occur when groundwater, confined under pressure, rises and is released to the ground surface.



SOURCE: USGS, Environmental Science Associates

Figure IV-3
Chimes Creek Drainage Area

(Section IV.D of the Leona Quarry Draft EIR) for a further discussion of the groundwater conditions underlying the Project site. Exploratory borings and field observations indicate that groundwater surfaces in the Lower Development Area and Restored Slope Area of the quarry. Field observations noted a significant flow in the 18-inch corrugated-metal pipe that descends from the Lower Development Area to the lower level of the quarry (see Figure IV-2). The flow rate is estimated to be in excess of 10 gallons per minute (gpm) at all observation times over two summers of field visits.

Conductivity[4] of this water ranged from 1,200 to 1,500 micromhos, which can indicate a groundwater source, possibly originating from springs exposed by quarry operations or percolated rainwater. Chimes Creek was also noted to have a significant flow rate near Seminary Avenue and at various locations in the Burckhalter neighborhood in summer 2001. Flow was estimated to range between 20 and 90 gpm, and measured specific conductance was about 600 micromhos. Based upon the low conductivity levels and significant flow volumes observed during periods when precipitation has not occurred, the upper reaches of Chimes Creek appear to be perennial and fed by groundwater inflows, percolated rainwater, and/or urban return flows in addition to flows provided by storm water runoff.

FLOODING

PROJECT SITE FLOODING

The lack of vegetation and disturbed steep slopes that characterize the majority of the Project site contribute to increased volume and rate of storm water flows. The perimeter of the site has been left relatively undisturbed by previous quarry operations and is relatively well vegetated. However, soils in these areas are relatively shallow in depth, and rapid stormwater runoff can create a high potential for soil erosion.

Flooding of I-580 occurred in December 1996 when onsite ponds failed during heavy winter storm conditions. Gallagher & Burke, Inc. subsequently implemented modifications consisting of reinforcing the existing berms, channeling surface water flow with low, concrete barriers (K-rails) in the Lower Development Area, and installing various devices to filter surface water flows(Geomatrix Consultants, 2000). These modifications were intended primarily to reduce erosion, and have a minimal impact on existing peak stormflow amounts.

EXISTING PONDS

There are four existing ponds on the project site. While these ponds do provide some detention capacity, they were constructed primarily to facilitate sediment trapping desired for quarry

[4] Conductivity (also referred to as specific conductance) is a measure of the ability of water to conduct an electrical current. It is highly dependent on the amount of dissolved solids (such as salt) in the water. Pure water, such as distilled water, has a very low specific conductance, and sea water has a high specific conductance. Rainwater often dissolves airborne gases and airborne dust while it is in the air, and thus often has a higher specific conductance than distilled water. Specific conductance is an important water quality measurement because it gives a good idea of the amount of dissolved minerals in the water.

operations. Although not designed as detention facilities, ponds can have the effect of reducing the rate of discharge from one point in the watershed to the next point further downstream. Pond size and outlet structure configuration, among other factors, control the discharge rate. Ponds can be used to offset the impact of flooding by reducing peak discharge rates to levels below those that could damage downstream structures and/or facilities.

Ponds 1 and 2 are existing ponds located in the lower, southwestern portion of the proposed development site and would be removed under the proposed Project design. Both ponds are not equipped with emergency spillways or drainage pipes, and therefore have limited capacity to reduce peak-flow rates. Pond 1 has a maximum volume of 3.35 acre-feet, and Pond 2 has a maximum volume of 4.38 acre-feet. Previous reconnaissance did not identify engineered outlet structures at either pond. Pond 1 outflows via a non-engineered spillway, below which the pond retains 0.95 acre-feet of storage. Similarly, pond 2 discharges via a non-engineered spillway and retains 2.35 acre-feet of storage below the spillway.

Pond 3 is the existing pond located in the east-central portion of the proposed development site. Pond 3 would be removed under the proposed Project design. Pond 3 has a maximum capacity of 14.27 acre-feet and is connected to an 18-inch pipe, which drains to Pond 1.

Pond 4 is the existing pond located below the Ridgemont neighborhood at the west-central corner of the proposed development site. The Ridgemont pond (pond 4) has an existing storage capacity of 3.1 acre-feet. Pond 4 currently drains through a 30-inch corrugated-metal pipe to the Leona Quarry sub-watershed, but has no device to inhibit blockage of the pipe by debris. The Leona Quarry operators constructed Pond 4 at some time in the past but did not have engineering design plans, construction plans, or specifications to document the construction practices (PWA, 2003). Initial hydrologic analysis indicates that this existing pond is inadequate to manage storm water flows resulting from a 25-year storm event and may experience structural failure during a 100-year storm event.

EXISTING DEFICIENCIES IN DOWNSTREAM STORM DRAINAGE SYSTEM

The existing storm drainage system downstream of the Project site, which conveys stormflows from the sub-watersheds described above and from other watersheds outside the Project site is inadequate to handle existing peak flows during very large rainfall events. (ACFCWCD, in Balance Hydrologics, 2001a). Flooding of streets in the residential areas west of I-580 has occurred on several occasions.

Most stretches of Chimes Creek not enclosed by storm drains have unstable creek banks. Existing flows in the creek have led to erosion problems that degrade the creek environment, affect adjacent property owners, and contribute sediment that may interfere with downstream storm drain facilities. The ACFCWCD stabilized a portion of the creek directly above Seminary Avenue using an underground bypass channel and surface low-flow channel. However, channel sections immediately upstream of the stabilized area continue to exhibit indications of bank instability and failure. These existing deficiencies of the downstream storm drainage system extend throughout the area. It is therefore not feasible for the project site to accommodate facilities that would remedy the existing deficiencies.

RIDGEMONT ROAD

The 84-acre Ridgemont sub-watershed is upstream of the Leona Quarry sub-watershed and receives storm water runoff from a portion of the Ridgemont neighborhood. Detailed maps of the Ridgemont storm drainage system indicate that flows from portions of the Ridgemont development are currently directed into outfalls that discharge to a ravine above Leona Street. Under existing conditions properties in Leona Heights downslope of this ravine may be exposed to substantial risks of flooding, in part from storm water flows being discharged from these outfalls (Balance Hydrologics, 2001a).

C. REGULATORY FRAMEWORK

Responsibility for maintaining drainage facilities in Oakland is shared between the ACFCWCD and the City of Oakland's Office of Public Works. The Project site is under the jurisdiction of the City of Oakland. Some of the downstream drainage facilities are under the jurisdiction of the ACFCWCD.

CITY OF OAKLAND

The City of Oakland requires projects to adhere to the published standards of ACFCWCD as set forth in *Hydrology and Hydraulics Criteria Summary for Western Alameda County* (Alameda County Public Works Agency, 1989).

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

ACFCWCD published criteria require that proposed primary drainage systems (draining watersheds between 50 acres and 10 square miles) in the City of Oakland be designed with adequate capacity to accommodate a 25-year storm event, and that all detention facilities be designed not to fail structurally in the event of a 100-year storm (Alameda County Public Works Agency, 1989).

SIGNIFICANCE CRITERIA

The CEQA Guidelines establish that a significant hydrology impact would be expected to occur if the Project would:

- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion on- or off-site;

- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
- Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems;
- Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
- Place within a 100-year flood hazard area structures which would impede or redirect flood flows;
- Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of failure of a levee or a dam; or
- Inundation by seiche, tsunami, or mudflow.

Due to the location of the Project site, certain impacts are not anticipated. The nearest reservoir to the Project site is Chabot Reservoir, approximately four miles south of the Project site. Based upon the quarry's location relative to the reservoir and topographic elevation, drainage from the Project site will not result or contribute to inundation by seiche in the event of Chabot Reservoir failure (California Office of Emergency Services, 1975) Located 2.5 miles from the San Leandro Bay, the Project would not cause or contribute to a tsunami. In addition, the Project site is not located within the 100-year floodplain, or within any area mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map (ESRI, 2001).

The City of Oakland uses the performance standards published by the ACFCWCD to establish compliance with the CEQA significance criteria. These standards stipulate that post-construction peak flows (runoff) from the Project should not exceed the pre-construction peak flows from the Project for the 25-year design storm, and that the basin should not fail structurally during a 100-year storm. The following analysis demonstrates that with mitigation, the Project will comply with the CEQA criteria. It also demonstrates that even with the additional redirected runoff from approximately 4.5 acres of the existing Ridgemont subdivision, the Leona Quarry stormwater management system will meet these standards.

D. IMPACTS AND MITIGATION MEASURES

Impact F.1: Development of the Project site could increase storm water flow to create localized flooding and contribute to existing flooding downstream. (Potentially Significant)

The Project site currently consists of fill material placed over large excavations from which rock was extracted during quarry mining operations between 1904 and the present. The steep slopes and lack of vegetation that characterize the majority of the Project site cause rapid runoff of storm water flows.

The proposed Project would include removal of existing ponds 1, 2 and 3 in the Leona Quarry sub-watershed (Lower Development Area). The Project would modify the existing pond 4, which currently receives runoff from the 84-acre Ridgemont sub-watershed, to improve its stormwater management functions.

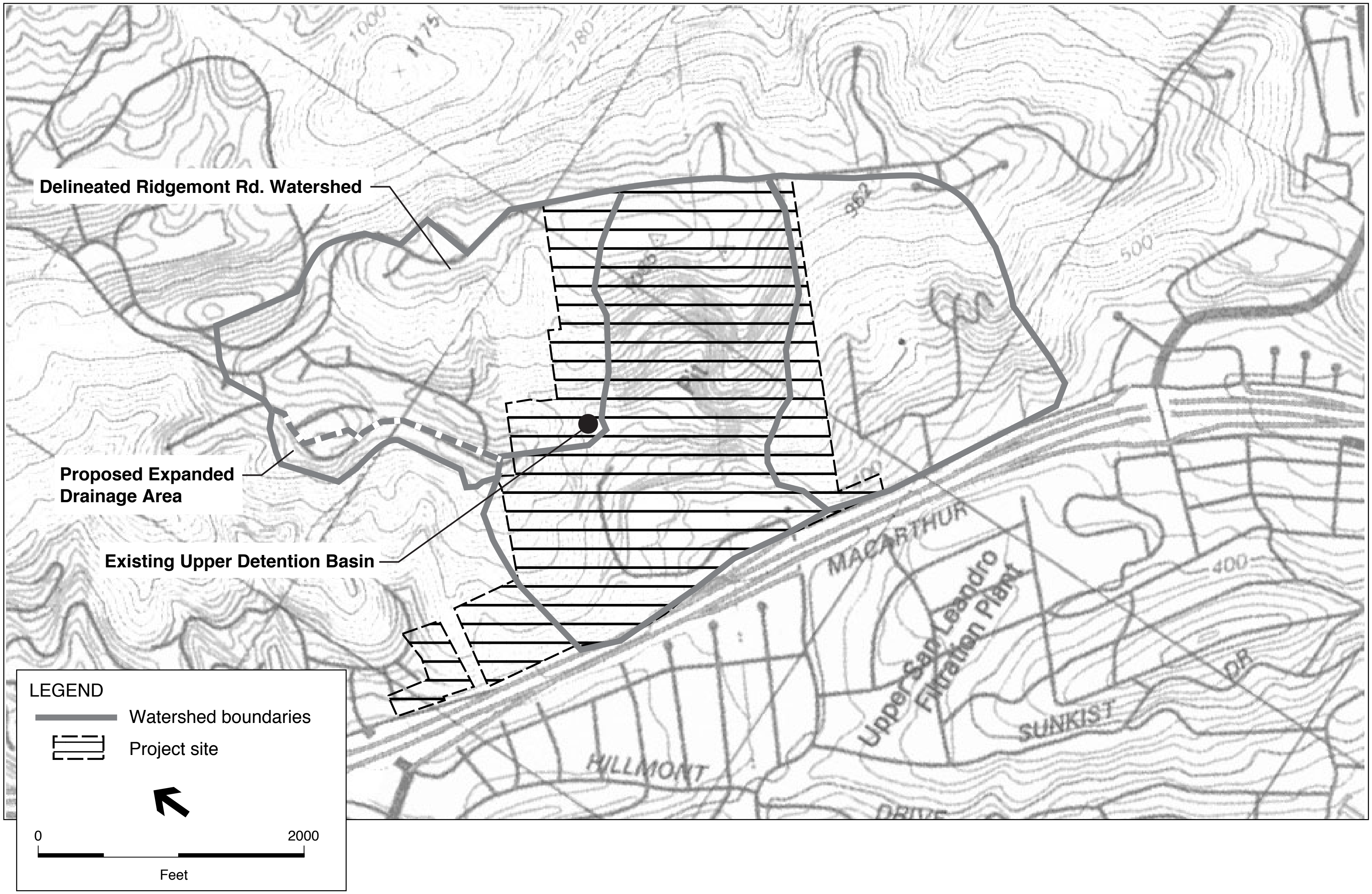
As part of the Project and in consultation with the City, the applicant agreed that storm water runoff from 4.5 acres west of Ridgemont Road would be redirected into the Leona Quarry storm drain system. The boundaries of the existing Ridgemont sub-watershed and the area which are proposed to be added by rerouting storm water flows are shown on Figure IV-4. Accepting the stormflows from this 4.5-acre area west of Ridgemont Road exceeds the requirements of CEQA. It is not a required mitigation for the proposed Project.

Development of the proposed Project site would include the construction of roads and buildings. Streets, parking lots, and rooftops prevent the natural drainage and infiltration of storm water through the soil. Surface water runoff volumes and rates generated from undeveloped, unpaved areas can therefore increase significantly when the site is paved, and the capacity for surface water infiltration is reduced or eliminated. Although impervious surface area would increase as a result of the proposed Project, landscaping and revegetation of existing bare, steep slopes would compensate by reducing surface water runoff rates in other areas of the Project site.

HYDROLOGIC MODELING AND ANALYSIS

As explained more fully in Chapter III, Background, various parameters were employed to analyze the hydrologic impacts of the Project and the redirection of stormflows from the Ridgemont subdivision. Analysis of the hydrologic impacts of the proposed Leona Quarry development involved a hydrologic modeling and constraints analysis (July 2001). This assessment was conducted by Balance Hydrologics (BH) and peer-reviewed by a hydrogeologist and environmental consultants on the staff of the EIR preparer. The BH analysis formed the basis for the hydrological analysis in the Leona Quarry EIR. As the Final EIR was being completed, the City retained Philip Williams and Associates, Ltd. (PWA) to conduct a technical peer review of the BH analysis and conduct additional surface water modeling.[5] PWA reported its initial peer review at the October 2, 2002 Planning Commission hearing. PWA concluded that there were differences between some parameter values used by BH and those recommended by ACFCWCD. City staff then determined to adopt a more conservative set of parameters to analyze hydrology impacts. PWA and BH, in consultation with ACFCWCD and City staff, worked to arrive at a consensus on which parameters should be used in the analysis. BH revised its input parameters to reflect the consensus approach as issues were identified and resolved, and BH presented revisions to PWA as they were made. PWA continuously peer-reviewed those revisions. PWA issued a report in November 2002, as this consensus process was still ongoing. The November 2002

5 Balance Hydrologics conducted the initial modeling effort and presented their results in the report entitled *Analysis of Hydrologic Opportunities and Constraints at Leona Quarry, City of Oakland, California*, July 2001a, and a memorandum from Balance Hyrdologics, Inc. to David Chapman and Grant Gibson, dated October 23, 2001b. That is the analysis reviewed in the Leona Quarry EIR and initially peer-reviewed by PWA.



SOURCE: Balance Hydrologics, Inc.

Figure IV-4
Proposed Addition to Ridgemont Sub-Basin

PWA report reflects PWA's original peer review, and it contains a peer review of the revised analysis BH had presented by that point. The hydrologists continued with the consensus process, and BH continued to revise the input parameters as issues were identified and resolved. PWA issued its phase two written report in October 21, 2003.[6]

The sections below discuss and compare the various values of the parameters and the resulting impact of the technical peer review on the hydrologic modeling results. This SEIR concludes that both the BH and PWA parameters are reasonable, and that they are consistent with or are more conservative than standard engineering practices and published ACFCWCD criteria and standards. This SEIR recommends using the parameters that resulted from the consensus approach, because that set of parameters reflects a more conservative analysis and the recommendations of several experts in the field (PWA, BH, ACFCWCD, and City Public Works).

HYDROLOGIC MODEL

Predictive mathematical hydrologic models are commonly used to characterize existing surface water and flow conditions at proposed development sites and can evaluate surface water conditions after development. These predictive models rely on the standard, proven mathematical formulas and can efficiently calculate flow conditions at several locations under many conditions. As is often the case, however, developing dependable and useable output data from a predictive mathematical model relies on review and refinement of the modeling parameters and assumptions.

Evaluation of the existing and proposed hydrologic characteristics of the Leona Quarry site used a predictive hydrologic model to estimate runoff rates and volumes and to assess the effects of the proposed development. This type of modeling is commonly conducted with software developed by the U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC). The HEC-1 Flood Hydrograph software provides a well-proven, reliable technical standard for assessing peak rates of runoff and developing hydrographs for large watersheds. HEC-1 is approved by ACFCWCD for this type of analysis. Based on the estimated runoff, the model can also be used to estimate storage volume requirements for detention facilities. In addition, it is the standard rainfall-runoff model approved for use by the federal government in conducting Federal Emergency Management Agency (FEMA) flood studies.

BH and PWA both used the HEC-1 modeling program and followed the ACFCWCD hydrology guidelines as presented in their *Hydrology and Hydraulics Criteria Summary*, dated 1989, to complete their hydrologic modeling for the Leona Quarry development project. HEC-1 hydrologic modeling considers existing soil types, vegetative cover, and slopes at the Project site compared with proposed regraded slopes, additional areas of impervious surfaces, and proposed

6 Philip Williams and Associates performed peer review of the model and assumptions and provided recommendations from Fall 2002 to August 2003. Phillip Williams presented their findings in reports entitled *Leona Quarry Hydrologic Review* (November 2002) (which reflects PWA's peer review of the revised BH analysis) and *Leona Quarry Hydrologic Review – Phase Two* (October 21, 2003) (which reflects PWA's peer review of the storm management system analyzed in this SEIR).

landscaping and revegetation plans. The HEC-1 model is designed to simulate the surface water runoff response of a basin to precipitation by representing the basin as an interconnected system of hydrologic and hydraulic components. Each component of the model represents an aspect of the precipitation-runoff process within a portion of the watershed, commonly referred to as a sub-basin.

Hydrologic processes are represented by model parameters which reflect existing and proposed conditions within a sub-basin. Model input parameters include basin dimensions and flow lengths, precipitation amount (rainfall), and precipitation losses. Precipitation losses include factors such as interception and infiltration that are computed using a Soil Classification System (SCS) curve number. Additional parameters are used to assess how excess rainfall is routed downstream, and hydraulic parameters to simulate storage and drainage features within the sub basin.[7]

PRIMARY HYDRAULIC MODELING PARAMETERS

The following sections discuss key parameters used in the hydrologic analyses. The technical peer review used the HEC-1 hydrologic analysis to evaluate the original input parameters for conformance with the ACFCWCD procedures. The City has determined to use published ACFCWCD standards and criteria for evaluating hydrology and designing drainage facilities.

Design Storm

The type of rainfall event to which a drainage facility must be designed is referred to as the design storm. The ACFCWCD hydrology manual recommends using the 24-hour, 25-year design storm for drainage areas between 50-acres and 10-square miles (6,400 acres). The watershed area for the 39-inch pipe at the base of the Project site adjacent to I-580 falls in this range at approximately 250 acres. The 24-hour, 25-year storm is a storm that produces an amount of rainfall over 24 hours that has a 4 percent chance of occurring in a single year or theoretically occurs, on average, once every 25 years. However, 25-year storm events can occur in consecutive years. BH applied the 25-year, 24-hour storm to its analysis in July 2001. BH likewise analyzed the 24-hour, 100-year storm. BH also evaluated the 2-year storm to model the circumstances that are likely to occur with more frequency. PWA concurred that use of these three design storms was appropriate. During the consensus review that followed PWA's initial peer review, the 5-, and 10-year events[8] were also modeled to provide an even wider range of storm events, and to model the circumstances believed responsible for existing flooding problems that downstream residents have experienced in recent years. This task was undertaken in part to provide a more accurate picture of how the drainage at the site would perform in more frequent design storm conditions.

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7 The SCS curve number is used to characterize rainfall infiltration and is approved by ACFCWCD for hydrologic analysis. The time lag calculations estimate the time required for runoff to reach the point where peak flows are estimated or measured.

8 The 2-year storm event has a 50 percent chance of occurring in a single year, the 5-year storm has a 20 percent chance of occurring in a single year, and the 10-year storm has a 10 percent chance of occurring in a single year.

Rainfall

Representative rainfall depth is a basic parameter in hydrologic modeling, and requires evaluation for refinement of the hydrologic model. The ACFCWCD manual provides a method for estimating the depth of rainfall for a range of design storms based on the mean annual precipitation for a given location. The method provides a factor that is applied to the annual precipitation depth to calculate the design storm depth. ACFCWCD provides maps that show lines of equal rainfall depth within Alameda County (referred to as isohyetal maps) and that show mean annual precipitation for all of western Alameda County.

ACFCWCD maps show a mean annual rainfall of approximately 25 inches at the Project site. (Alameda County Public Works Agency, 1989). BH compared the map data against data from the EBMUD Upper San Leandro Filter Plant rain gage, located approximately 0.5 miles from Leona Quarry. BH calculated the long-term average rainfall measured by that range gauge at 25.6 inches per year. BH projected that rainfall at the site would be higher than that measured at the gauge, since the site is at a higher elevation.

PWA determined that the rain gauge reflected a mean annual rainfall of 25.4 inches. PWA recommended using a mean annual precipitation of 26 inches per year, and rainfall depths of 5.05 inches for the 25-year storm, and 6.27 inches for the 100-year storm. Because it is reasonable to assume that rainfall may be slightly higher at the site than is reflected in the data from the rain gauge, and because the PWA recommendations are based upon extensive historic data from a rain gauge measuring actual rainfall, the consensus was to incorporate the PWA recommendations into the modeling. The HEC-1 modeling completed by BH for the stormwater management system reviewed in this SEIR uses the PWA-recommended numbers for the 25-, and 100-year storms, and uses the same methodology to project rainfall for the 2-, 5-, and 10-year storms.

Drainage Area

HEC-1 applies the design storm rainfall to the area of the watershed in order to estimate runoff over the area of interest. The boundaries of the watershed area are determined by topography and drainage infrastructure contributing runoff to the area. Watershed areas are often sub-divided into sub-watersheds in order to provide a more detailed reflection of site drainage patterns and/or to generate peak flow estimates at particular locations (such as drainage infrastructure or stream confluences).

Using proposed development plans supplied by City Staff, topographic data provided by BH , aerial photos from ACFCWCD, USGS topographic data, and information from site visits, PWA assessed the appropriateness of the watershed boundaries identified by BH for use in the HEC-1 model. PWA concluded that the selection of sub-watersheds was generally appropriate to represent site topography, drainage patterns and facilities. The BH sub-watershed delineations are similar to ACFCWCD delineations except in the case of the Mountain Boulevard sub-watershed. Evaluation of the sub-watershed delineations showed that the ACFCWCD delineation of the Mountain Boulevard sub-watershed included 10 additional acres along the eastern edge of the study area that were not included in BH's original sub-watershed delineations. PWA conducted site reconnaissance to further refine this parameter. Based on that reconnaissance, PWA and BH reached consensus that an additional 3.2 acres should be included in the sub-watershed delineations.

Because doing so represented a more conservative approach, the consensus was to run the hydrologic model to include the additional 3.2 acres of the Mountain Boulevard sub-watershed. The hydrologic modeling reviewed in this SEIR (that indicates a 15.6 acre-foot basin is appropriate) includes this additional acreage. The inclusion of a larger area in the sub-basin results in a larger peak discharge for the Mountain Boulevard area and therefore more conservatively estimates total runoff.

SCS Curve Number

The SCS (U.S. Department of Agriculture, Soil Conservation Service; now called Natural Resource Conservation Service) curve number is used to characterize the tendency of soil and land use types to generate runoff, and is approved by ACFCWCD for hydrologic analysis.

The US Department of Agriculture (USDA) has instituted a soil classification system for use in soil survey maps across the country, which assigns letter classifications to soil types. Based on experimentation and experience, the USDA has related drainage characteristics of soil groups to a curve number. The SCS (now the NRCS) provides information enabling scientists to relate soil group type to the curve number as a function of soil cover, land use type, and antecedent moisture conditions.

BH calculated SCS curve numbers based on existing and potential land use categories, and using both the class B and class D soils as indicated in the most current USDA survey for the area. ACFCWCD assigned curve numbers that assume less runoff potential using different assumptions about soils, land uses and vegetative cover. Using aerial photographs, the proposed development plans, and site reconnaissance, PWA determined how sensitive the hydrologic modeling was to the differences between the BH curve numbers and the ACFCWCD curve numbers. It concluded that the different curve numbers made no material difference in peak discharge for most of the sub-watersheds. However, the difference did result in an increase to total watershed peak discharge when the Mountain Boulevard sub-watershed curve number was changed from the curve number estimated by BH to that estimated by ACFCWCD.

PWA then used the USDA National Engineering Handbook (1985) (per ACFCWCD guidelines) to independently estimate a curve number for the Mountain Boulevard residential area. PWA initially calculated a composite curve number for the Mountain Boulevard sub-watershed of 80. Using a curve number of 80 resulted in a slight increase in the design storm total watershed peak discharge over the BH estimate for both existing and post-project conditions. Consequently, as part of the consensus approach, BH conducted a more detailed land use and soil type analysis of the Mountain Boulevard sub-watershed that established curve numbers at 85.3 for existing conditions and 85.7 for proposed conditions. These numbers were higher than PWA’s composite curve number, but lower than the ACFCWCD estimate of 87. PWA, BH and the ACFCWCD concurred that the adjustment BH had made represented a more refined assessment of actual site conditions, based on the Alameda County Soil Survey (1981) and site reconnaissance. However, the consensus was also that the HEC-1 model results did not change significantly regardless of whether the number 85.3, 85.7 or 87 was used. Because the ACFCWCD curve number estimates, including the Mountain Blvd. sub-watershed estimate of 87, represent a more conservative approach, the consensus was to use the ACFCWCD numbers in the modeling. The ACFCWCD curve numbers are used in the HEC-1 model analysis reviewed in this SEIR.

Initial Loss

The initial loss parameter is a representation of precipitation losses including initial surface moisture storage at the start of the model event. There was no difference of opinion regarding the initial loss parameter. The BH analysis and the PWA analysis both used the HEC-1 default method to quantify this parameter. This practice conforms to ACFCWCD methodology.

Time Lag

The time lag is the time required for runoff to reach the point where peak flows are measured. The time lag is quantified in the HEC-1 model using a time-lag parameter. Inputs required to determine time lag include overland flow components such as flow length, slope, surface roughness, and percent of basin represented by the overland flow.

PWA determined that BH and ACFCWCD estimated different time lag factors. However, it also conducted a sensitivity analysis which concluded that the differences did not significantly impact the model results. Because the ACFCWCD estimates were more conservative, the consensus was to use ACFCWCD inputs in determining time lag. In April 2003, ACFCWCD staff confirmed that the time lag estimates used by BH in its 2002 analysis reflected current ACFCWCD guidelines, with the exception of effects caused by the difference in opinion regarding the Mountain Boulevard sub-watershed, which were addressed as explained above.

Stage-Discharge Curve

The depth of water in a pond is termed “stage.” A stage-discharge curve indicates the amount of water (“discharge”) that will be leaving the pond when the water level is at any given stage. The stage-discharge curve is based on standard hydraulic equations for pipes, weirs and orifices and is a computation of the amount of water flowing out of the pond at a given stage. The storage capacity represents the amount of water each pond can hold, and is determined from surveyed topographic data. The storage capacity and calculated stage-storage relationship were established in the 2001 Leona Quarry hydrologic study conducted by BH and were determined appropriate in the subsequent peer review. PWA concurs that BH’s pond volume and stage-storage relationship estimations for each pond appear reasonable based on the surveyed footprint.

Ponds Initially Empty

The BH analysis projected that, because 25-year storms are not likely to occur as the first storm of the season, that existing ponds would be full up to the spillway at the beginning of a 25-year storm. BH projected that ponds 1 and 2 would be full of water up to the spillway crest elevations, retaining 0.95 acre-feet and 2.35 acre-feet, respectively, at the onset of a 25-year storm.

ACFCWCD expressed concern that projecting the ponds as initially full would result in higher existing peak flows, which would in turn mean that the peak flows the Project would have to maintain in post-Project conditions would be higher. ACFCWCD recommended that the ponds be considered initially empty, and that the full pond storage volume below the spillway be considered available to store water from the design storm.

PWA concurred with the ACFCWCD approach that Ponds 1 and 2 should be considered initially empty. The consensus was that assuming that the ponds are initially empty results in a more conservative characterization of existing site conditions and storm water flows. The revised HEC-1 model reviewed in this SEIR reflects that assumption.

No Material Dispute Regarding Ponds 3 and 4

There is no material dispute between the parameters used to model the operations of existing pond 3, which is proposed for removal by the project. Although the exact details of the existing outlet structure are not known because much of the structure is covered by rock, BH and the ACFCWCD assume that the pond outlet structure can be modeled as an 18-inch riser with a 12-inch circular orifice, whereby flow is limited to 22 cubic-feet per second by the 18-inch corrugated metal outlet pipe. PWA concurs that the limiting flow parameter (22 cfs) appears reasonable based on the assumed outlet dimensions and the rating curve.

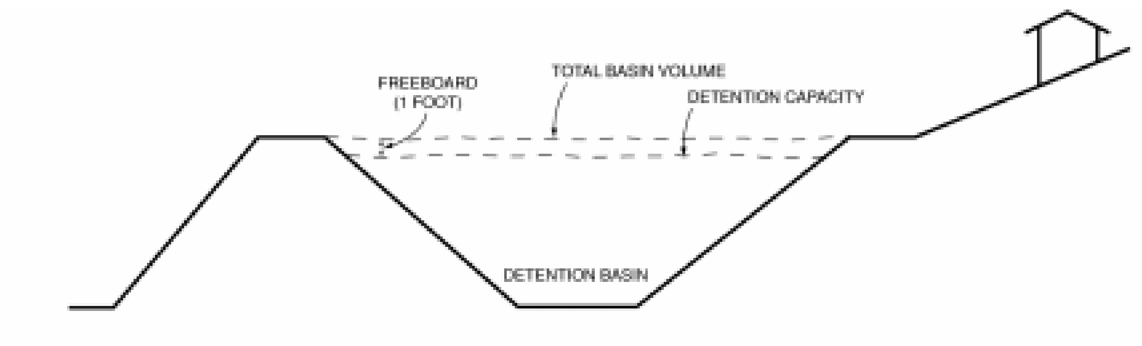
Pond 4 is also referred to as the Ridgemont sub-watershed detention basin and is located in the west-central corner of the site. Under the proposed Project design, this pond would remain in place. HEC-1 model results indicate this pond is currently inadequate to handle storm water flows resulting from 25-year and 100-year storm events. BH and PWA concurred on estimates of the storage volume, associated stage-storage relationship of Pond 4, and estimates of storage capacity and stage-storage curves. PWA and BH also concurred in the stage-discharge relationship using standard equations for pipe hydraulics based on and assuming a 15-foot weir spillway if the pond overtops. The rating curves generated by PWA during their peer review were generally consistent with those developed by BH. There are no material differences of opinions regarding input parameters for analysis of this pond.

CONCLUSIONS OF ANALYSIS

There is a potential for the Project to increase existing flooding on and off the Leona Quarry site during large storms such as a 25-year event.

The Project sponsors propose to mitigate hydrology impacts with a stormwater management system designed both to maintain peak flows from the 24-hour, 25-year storm at or below pre-project levels, and to function in a 100-year storm without failing structurally. The stormwater management system includes modifying the upper pond (Pond 4) and constructing a lower detention basin. The proposed lower detention basin would be constructed within the same footprint as the basin studied in the Leona Quarry EIR, and would require no modifications to the density, proposed open space, road layout or site plan of the Modified Plan. The proposed lower basin would have 15.6 acre-feet of detention capacity, with one foot of freeboard equating to 17.6

acre-feet of total detention volume when full (see Figure IV-5). The basin would have 3:1 (horizontal to vertical) internal side slopes, bottom and top elevations at 296.0 and 315.5 feet, respectively, a single outlet box with a perimeter comparable to that of a 42-inch riser with a rim elevation of 313.5 feet, and two orifices (lower orifice 2 ft by 2 ft with flowline elevation at 299.0 ft, and upper orifice 1.75 ft by 2 ft with flowline elevation at 307.0 ft). The design assumes that the lowermost three feet of the proposed detention basin would be reserved for water quality improvement, and the 15.6 acre-feet detention capacity of the pond does not include these bottom three feet. The basin is already subject to a geotechnical mitigation measure required by the Leona Quarry EIR that the proposed detention basin be lined with an impermeable material to reduce infiltration to the subsurface.



SCHEMATIC ONLY - NOT TO SCALE

SOURCE: DeSilva Group

Leona Quarry Draft Subsequent EIR / 201088

Figure IV-5
Freeboard Relationship

The proposed stormwater management system will fully mitigate the hydrology impact. PWA concurs in this conclusion. Pre- and post-Project flows after mitigation are shown below in Table IV-1.

TABLE IV-1
PROJECTED PRE-PROJECT AND POST-PROJECT FLOWS

Design Storm	Existing Flow (cfs)	Post-project Flow (cfs)
2-year	71	70
5-year	112	112
10-year	139	137
25-year	168	163
100-year	224	224

SOURCE: PWA, October 2003

Both the BH and PWA parameters are reasonable, and they are consistent with or are more conservative than standard engineering practices and the requirements of the City and the published standards of the ACFCWCD. Because the set of parameters resulting from the consensus process reflects a more conservative approach, this SEIR uses those parameters to model hydrology. The HEC-1 analysis reviewed for this SEIR adopts the parameters that resulted from the consensus process. The hydrologic parameters used to simulate surface water flows at the Leona Quarry Project site are in conformance with ACFCWCD standards, and standard engineering practice. The analysis confirms that the proposed stormwater management system would reduce Project impacts to pre-project levels, and would maintain pre-project levels even with the inclusion of redirected flows from the Ridgemont subdivision. Post-Project 24-hour, 25-year peak flows would be equal to or less than existing peak flows from a 25-year storm. The stormwater management system would operate during a 100-year, 24-hour storm without structural failure. In fact the stormwater management system studied in this SEIR would maintain peak flows from the 100-year storm at pre-project levels.

MITIGATION MEASURES

Mitigation Measures F.1a and F.1b shall be included as part of the proposed Project.

Mitigation Measure F.1a: The Project sponsor shall be required to construct a stormwater management system, that includes a detention basin and outlet works capable of maintaining peak flows from the 24-hour, 25-year design storm at or below pre-project levels, and that will not fail structurally during a 100-year storm, as determined using the parameters resulting from the consensus process discussed in this SEIR. The basin shall be lined with an impermeable material to minimize leakage and contributions to local groundwater flow. The stormwater management system reviewed in this SEIR, with the 15.6 acre-foot lower detention basin, meets these performance standards.

Mitigation Measure F.1b: The Project sponsor shall modify the existing Ridgemont Sub-watershed pond (Pond 4). Improvements to the pond outflow structure shall include the following elements (or design elements that achieve an equivalent discharge rating curve using the parameters resulting from the consensus process discussed in this SEIR equivalent to that achieved by the following elements): replacing the existing 30-inch outlet pipe with a 42-inch outlet pipe, adding a single drop box with one rectangular orifice, and constructing an emergency spillway. The perimeter of the drop box would be comparable to a 36-inch riser and the rectangular orifice would be 2.75 feet by 2.0 feet in size. The replacement of the outlet pipe shall be consistent with standard engineering practice. A geotechnical evaluation of the existing detention basin levees and proposed modifications shall be completed to assess the overall integrity of the pond and recommendations from the evaluation shall become part of the Project design and be implemented as directed by a registered geotechnical engineer.

Significance After Mitigation: Less than Significant.

ALTERNATE STORMWATER MANAGEMENT SYSTEM TO MITIGATE THE HYDROLOGY IMPACT

The performance standards described in Mitigation Measure F.1a could also be met with the alternative stormwater management system. While refining the stormwater management system design, BH determined that it would be possible to transfer the detention capacity currently provided in the upper Ridgemont Subwatershed pond 4 to the proposed lower detention basin if the capacity of the lower basin were increased. Under this alternative, pond 4 would not be designed to detain flow and stormwater would flow through a drainage pipe. The single basin would include capacity beyond that required for stormwater detention to implement the water quality mitigation measures already required by the Leona Quarry EIR.[9]

This alternative could improve the drainage system. A single basin would reduce maintenance requirements. This alternative stormwater system would also eliminate the need to install all the proposed improvements to pond 4 (as described in Mitigation Measure F-1b), which is in environmentally sensitive areas of the Project site. Increasing capacity for water quality treatment would have the additional benefit of further reducing peak stormwater flows below pre-project levels during the most frequent storms (less than 1.5 inches of rain in 24 hours) and which create the majority of annual runoff.

Hydrologic analysis for this single-basin system utilizes a basin configuration that includes various individual design modifications intended to increase the potential detention volume while maintaining the same basin footprint as that proposed for the Project (see Chapter VII, Oversize Detention Basin). The design modifications include steepening interior basin slopes to 2.5:1 (Horizontal:Vertical), constructing a 3-foot high interior wall, and raising the top of berm 3 feet, to 318.5 feet. Other combinations of design option elements could also be used with similar results.

The resulting alternate single basin would accommodate 20.5 acre-feet of detention capacity, and an additional 3 acre-feet of water quality treatment capacity, while maintaining one foot of freeboard. The total volume of this basin, including freeboard, would be 25.4 acre-feet at an elevation of 318.5 feet. The single basin would be constructed within the same footprint as the basin studied in the Leona Quarry EIR, and would require no modifications to the density, building footprints, proposed open space, road layout or site plan of the Modified Plan. Modifications to pond 4 under this single basin proposal would include replacing the outlet pipe with a 42” drain pipe equipped with a trash rack to inhibit debris from obstructing the outlet.

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9 The Leona Quarry EIR provides that water quality impacts will be mitigated through selection of mitigation measures from a menu of structural and treatment BMPs. These could include increasing the water volume capacity of the basin to allow for water treatment, grassy swales, small detention basins beneath large parking areas, or other listed measures. The basin studied in the Leona Quarry EIR proposed to implement this measure in part by reserving the lowermost three feet of the basin (0.1 acre-feet of water volume) for water quality treatment. The alternative single basin studied in this SEIR proposes to implement this existing mitigation measure by locating more water treatment functions in this single basin, reserving three acre-feet of water volume capacity for this purpose.

A hydrologic analysis was performed on this single-basin system using the parameters that resulted from the consensus approach following PWA's initial peer review, and employing the same methodology used by all experts to study Leona Quarry hydrologic impacts. The analysis determined that detention capacity of 20.5 acre feet would be sufficient to accommodate the detention capacity lost by eliminating the need for pond 4. The single-basin system would meet stormwater management performance standards by not increasing peak flows for the 25-year design storm, and not failing structurally during a 100-year event.

The change to a single basin system would not result in any other significant environmental impacts. The single basin system would further reduce the already less-than-significant disturbance of environmentally sensitive areas below that proposed for implementation of Mitigation Measures F.1a and F.1b. Visually, this alternate basin would not result in significant changes because the only major change would be the increased height of the berm (3 feet), which would be obscured by vegetation and trees. The alternate basin would occupy the same footprint as the Project basin considered in the SEIR. Because the single basin would be constructed within the same footprint as the basin studied in the Leona Quarry EIR, and would require no modifications to the density, building footprints, proposed open space, road layout or site plan of the Modified Plan, it would not change the impacts of the Modified Plan.

The alternate mitigation measures required for the alternate stormwater management system would be as follows:

Alternate Mitigation Measure F.1a: The Project sponsor shall be required to construct a stormwater management system that will maintain peak flows from the 24-hour, 25-year design storm at or below pre-project levels, and not fail structurally during a 100-year storm, as determined using the parameters resulting from the consensus process discussed in this SEIR. The basin shall be lined with an impermeable material to minimize leakage and contributions to local groundwater flow. The stormwater management system reviewed in this SEIR, with a single basin with 20.5 acre-feet of detention capacity, meets these performance standards.

Alternate Mitigation Measure F.1b: The Project sponsor shall modify the existing Ridgemont Sub-watershed pond (Pond 4) by installing a 42" flow-through pipe system to minimize the detention capabilities of that existing pond.

Significance After Mitigation: Less than Significant.

Either Mitigation Measures F.1a and F.1b or this alternate stormwater management system will reduce hydrology impacts to less than significant levels. The environmental consequences of imposing one set of measures or the other are essentially the same.

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CHAPTER V

HYDROLOGIC EFFECTS ON GEOLOGIC CONDITIONS

A. INTRODUCTION

This section of the SEIR considers whether revisions to the analyses of hydrologic impacts require revisions to the geologic analysis of the Leona Quarry EIR. The *Geology, Seismicity and Mineral Resources* section of the Leona Quarry EIR discusses the geologic setting and provides analyses of surface fault rupture, earthquake ground motion, slope instability and failure, settlement, soil erosion, effects to groundwater resources, and impacts to mineral resources and sulfur-bearing mineral ores.

No revisions to the geology analysis are required. The revisions to the hydrology analysis stem from use of the parameters that resulted from the consensus approach following PWA's initial peer review. Use of those parameters resulted in a larger detention basin than was studied in the Leona Quarry EIR. The following sections discuss whether the enlargement of the detention basin could affect the earlier geology impact analysis. The stormwater management systems studied in this SEIR still propose to collect stormflows and convey them through pipes into detention facilities. Accordingly, the revisions to the hydrology analysis do not indicate any changes to slope or soil stability over what was studied in the Leona Quarry EIR. Similarly, the revisions to the hydrology analysis do not indicate any changes in the analysis of how the geotechnical aspects of the site might affect the operation of the stormwater management system. The following sections evaluate the geological aspects of the proposed larger basins, reiterate the Leona Quarry EIR analysis of geologic and seismic issues related to the Modified Plan, and discuss whether revisions to the hydrology analysis affect each potential geologic or seismic impact analyzed in the Leona Quarry EIR. No other geologic conditions raised new issues or indicate a need to complete further geologic analysis.

B. GEOLOGICAL ASPECTS OF ENLARGED DETENTION BASINS

This SEIR refers to a 15.6 acre-foot basin (detention capacity) in Mitigation Measure F.1a, and a 23.5 acre-foot basin (detention capacity and water quality treatment capacity) in Alternate Mitigation Measure F.1a. The 15.6 acre-foot basin includes interior slopes of 3:1 (Horizontal:Vertical) and a berm height of 315.5 feet. The 23.5 acre-foot basin includes interior slopes of 2.5:1 (Horizontal:Vertical), a 3-foot high interior wall, and raising the top of berm 3 feet, to 318.5 feet.

The geotechnical evaluation of the design modifications addressed in Chapter VII includes a slope stability analysis. The analysis utilized the UTEXAS3 slope stability model to evaluate combinations of design options. To ensure a comprehensive assessment of all factors that might contribute toward a possible slope failure, slope stability was modeled under static, seismic and rapid draw-down conditions. The model then determined the factors of safety for the slopes under these conditions. The resulting factors of safety[1] indicated that all slope configurations were well within standard engineering design parameters for stability. The 15.6 acre-foot and 23.5 acre-foot basins embody designs that would have higher factors of safety than the combinations of design options analyzed (such as less steep slopes). Accordingly, the 15.6 acre-foot and 23.5 acre-foot basins are projected to be stable.

C. SURFACE FAULT RUPTURE DURING AN EARTHQUAKE

The Leona Quarry site is not located within an Alquist-Priolo Fault Rupture Hazard Zone as designated through the Alquist-Priolo Earthquake Fault Zoning Act. Previous studies identified shear zones on the project site that, although not likely related to activity on the Hayward fault, could experience minor sympathetic offsets in the event of a major Bay Area earthquake. The Leona Quarry EIR provided appropriate mitigation for hazards related to minor sheer zone offsets and determined that rupturing of the surface during an earthquake was less than significant. This seismic condition, as analyzed in the original Leona Quarry EIR, does not change due to the revisions to stormwater impact mitigation which used the more conservative hydrology analysis in this SEIR. The potential for surface fault rupture depends upon the presence or absence of an active fault, not the presence or size of a detention facility. Accordingly, changes to the hydrology analysis do not require any revisions to the original geology analysis relating to surface fault rupture.

D. EARTHQUAKE GROUND SHAKING IMPACTS

The subject site is located near the Hayward fault and could experience extreme ground shaking for an extended duration. Although the materials underlying the project site are composed of bedrock materials and have a relatively low capacity to amplify seismic waves, ground shaking could cause significant damage to the engineered fills, structures, and roadways of the completed residential development. The Leona Quarry EIR provides mitigation to ensure that impacts related to earthquake ground shaking would remain less than significant. Impacts relating to earthquake ground shaking depend upon the seismic condition existing at the site. This seismic condition, as analyzed in the original Leona Quarry EIR, does not change due to the revisions to stormwater impact mitigation, including larger basins, which used the more conservative hydrology analysis in this SEIR. No revision to the original geology analysis is required for this SEIR.

[1] Stability is determined by the resulting "factor of safety" as determined through slope stability modeling. *Static* conditions refer to non-seismic forces acting on a slope such as gravity, *seismic* conditions refer to earthquake ground motions affecting slope stability, and *rapid draw down* conditions refer to changes in the slope stability caused by the rapid removal of the hydrostatic pressures, which occur when water presses against a saturated slope.

E. SLOPE INSTABILITY

The Leona Quarry site includes high, relatively steep slopes, composed of bedrock in varying stages of weathering. Bedrock contacts, fractures, and shear zones provide areas of weakened rock. Colluvium, slope wash, and landslide debris cover many areas within the quarry, including the slopes on the north and northeast slopes. Many of the existing slopes are over-steepened due to quarry operations or to previous slope failures. The proposed grading plan would reconfigure the slopes and quarry pit areas, thereby stabilizing the majority of the slopes by reducing the current slope gradient, controlling groundwater and surface water, and removing much of the landslide and other loose fill materials. As analyzed in the original Leona Quarry EIR, proposed improvements to stormwater management would control drainage compared to existing drainage conditions and reduce the potential for related slope instability hazards. This slope stability condition, as analyzed in the original Leona Quarry EIR, does not change as a result of revisions to stormwater impact mitigation which used the more conservative hydrology analysis in this SEIR. The stormwater management systems studied in this SEIR still proposes to collect stormflows and convey them through pipes into one or two engineered detention ponds, leaving slopes unaffected by the changes in the hydrology analysis. The slope stability of the proposed basins is addressed at the beginning of this Chapter. No revision to the original geology analysis is required for this SEIR.

F. SETTLEMENT AND RELATED GEOLOGIC HAZARDS

Given the large quantity and the design depths of the proposed fills, the potential for settlement of both the existing fills and those to be placed or imported as part of the project is an important consideration for the proposed development. This geologic hazard, as analyzed in the original Leona Quarry EIR, does not change as a result of revisions to stormwater impact mitigation which used the more conservative hydrology analysis in this SEIR. The EIR already requires that all fill (including fill underneath the basin) be engineered to avoid settlement hazards. No revision to the original geology analysis is required for this SEIR.

G. SOIL EROSION

Soil erosion hazards could occur during preliminary stages of construction, especially during initial site grading and stripping, when many piles of loose soil and rock materials would be present; during importation of fill and recompaction; and prior to construction of final building pads and resurfacing of streets and sidewalks. The majority of soil erosion on construction sites is caused by precipitation and stormwater runoff, although wind erosion can increase erosion rates, especially in loose, fine-grained materials. In addition to causing sedimentation problems in storm drain systems, rapid water and wind erosion can create deep gullies that increase in size and undermine engineered soils beneath foundations and paved surfaces. This potential geologic hazard condition, as analyzed in the original Leona Quarry EIR, does not change as a result of revisions to stormwater impact mitigation which used the more conservative hydrology analysis in this SEIR. The construction of the 15.6 acre-foot basin or the 23.5 acre-foot basin will not significantly increase the amount of soils exposed to erosion. After construction, neither stormwater management system will present a greater risk of erosion than was studied in the Leona Quarry EIR. No revision to the original geology analysis is required for this SEIR.

H. GROUNDWATER EFFECTS ON PROPOSED DETENTION BASIN

The analysis in the original Leona Quarry EIR determined that localized groundwater levels could be affected if the detained water were allowed to infiltrate into the subsurface sediments. Potential impacts to groundwater flow related to infiltration of surface water include groundwater mounding, a condition that results in locally high water levels as surface water migrates vertically downward. Groundwater mounding could affect groundwater flow both upgradient and downgradient of the detention pond and could redirect flows or cause groundwater levels to rise behind the mounded area. A mounded groundwater condition could increase volume gradients and flow gradients, resulting in shallower groundwater that could potentially lead to seepage onto the surface or into underground structures in downgradient neighborhoods. Short and long-term effects of infiltration could also include saturation and eventual failure of native hillside materials and non-native engineered fills underlying the basin. The original Leona Quarry EIR identified mitigation to reduce this condition to a less than significant level consisting of lining the basin. Although the detention basin proposed under the project would have a larger capacity than the basin analyzed in the original Leona Quarry EIR, the basin will still be lined. The potential for groundwater impacts would not change and therefore, no revision to the original geologic analysis is required under this SEIR.

I. MINERAL RESOURCES

The Leona Quarry EIR determined that development of a residential community at the Leona Quarry site would permanently restrict the ability to quarry the Leona Rhyolite aggregate source, which is considered of prime importance because it is a known economic mineral deposit. However, the impact of the proposed project on the overall available aggregate reserves in the South San Francisco Bay P-C Region is insignificant, because the overall aggregate reserves would remain in deficit despite the inability to extract aggregate from Leona Quarry. The proposed development alone would not trigger a shortage in the aggregate reserves. This analysis is unrelated to surface hydrology and drainage, or to the configuration of the stormwater management system, and therefore, no revision to the geology analysis is required for the SEIR.

J. SULFUR-BEARING MINERAL ORES

The Leona Quarry EIR evaluated whether development of a residential community at the Leona Quarry site could result in exposing sulfur-bearing mineral ores to oxygen and water, potentially causing stormwater runoff quality issues. Although the local bedrock geology can contain veins of mineralized sulfur-bearing ores, Leona Quarry operations have not exposed sulfur-bearing ores that can result in sulfur-affected runoff. The analysis concluded that potential impacts from surface water contact with sulfide ore-bearing geologic materials is not likely and does not require implementation of mitigation measures. This analysis would not change due to the changes made to the mitigation of stormwater impacts as a result of the more conservative analysis. Because the basin would be constructed within the same footprint, there would be no greater risk of exposure to sulfur-bearing minerals. No revision to the original geology analysis is required for the SEIR.

CHAPTER VI
ALTERNATIVES

A. INTRODUCTION

The following four alternatives were evaluated in the Leona Quarry EIR: (1) a No Project Alternative; (2) a Lower Density Alternative; (3) a Clustered Development Alternative; and (4) a Solar Power Plant Alternative. The Leona Quarry EIR also evaluated the Modified Plan, which is the proposed Project in this SEIR. It should be noted that the No Project Alternative, Variant One, is evaluated in more depth than the other alternatives and variants, as it is reasonable to assume that quarrying operations would likely continue in the event that the Project were not approved.

This SEIR does not revise any project descriptions for the alternatives addressed in the Leona Quarry EIR. The following descriptions are reiterations of the descriptions of the Modified Plan t and alternatives in the Leona Quarry EIR, and are presented for easy reference purposes.

B. ALTERNATIVE 1: NO PROJECT

There are three variants of the No Project Alternative, each of which represents a different, reasonably foreseeable scenario that may be expected to occur if the proposed project is not approved. Under the No Project Alternative, the proposed Project and the revised reclamation plan would not be implemented. Under this alternative, the adopted reclamation plan including the approved grading plan, would be implemented. The extent of grading under the adopted reclamation plan is that approximately 90 acres would be reclaimed (about half of the site for slope treatment and half for development).

VARIANT ONE – QUARRY OPERATIONS

DESCRIPTION

Under this variant, the existing rock quarry operation would continue and the proposed Modified Plan would not be developed. This variant would heighten current operations of the quarry as entitled and would implement the existing approved reclamation plan. As the nature of mineral production is dependent on the local and regional demand for construction materials, the level of quarrying activity would vary. This alternative assumes that the project sponsor would continue mining at a rate of between 200,000 and 500,000 tons annually. The projected life of the quarry would be from 11 to 28 years under the current mine design. Approximately 90 acres of the 128-

acre site would be actively mined, with about 15 acres to be used for the plant and processing area.

HYDROLOGY IMPACTS

The impacts of Variant One, as analyzed using the parameters resulting from the consensus process, are projected to be as follows. Storm water management under Variant One of the No Project Alternative would continue to be managed according to the SWPPP developed for Leona Quarry (Geomatrix Consultants, 2000). The four existing sedimentation basins and storm water control structures (i.e., concrete barrier (K-rails), hay bails, gravel bags, fiber rolls, and settlement ponds) on the Project site would remain. Quarrying activities would continue to remove rock and distribute excess fill material across the Project site.

During the life of the quarry, the quarry activities would not be anticipated to alter storm water facilities or storm water runoff rates at the Project site, avoiding both the impacts and the mitigation storm water management system of the Modified Plan. This means that flooding problems associated with inadequate capacity on and off the Project site would be expected to continue. For example, the detention basin located within the Ridgemont sub-basin could fail during a 100-year storm event. Episodic flooding of residential neighborhoods east of I-580 would be expected to continue, as downstream drainage facilities currently contain insufficient capacity to handle peak flows during periods of substantial precipitation, such as a 25-year storm event. Similarly, degradation of streambanks along the open water channel of Chimes Creek would likely persist. In addition, the approximately 4.5 acres of the Ridgemont Road sub-basin would continue to drain toward the outfalls that discharge into the adjacent ravine. Thus, the hydrologic conditions during this period would be similar to current conditions, and flooding is projected to continue to occur onsite and downstream.

At the end of the projected quarry life, reclamation of Leona Quarry would occur as set forth in the adopted Reclamation Plan, and as required by the California Surface Mining and Reclamation Act (SMARA). After reclamation, storm water would likely be better-managed. The approved reclamation plan does not include a finalized storm water facility design. The quarry operator would continue to meet with the City of Oakland and Alameda County Public Works regarding allowable discharge flow rates, potential downstream mitigation measures, and design storm events. Preliminary plans include a system of concrete-lined ditches, corrugated-metal pipes, catch basins, and detention facilities to control surface water flows. After reclamation, this alternative would incorporate drainage control structures and systems to accommodate additional runoff and control downstream discharges, thereby reducing the potential for flooding. The contribution towards existing downstream flooding would be decreased.

VARIANT TWO – REDUCED QUARRY OPERATIONS

DESCRIPTION

Another variant of the No Project Alternative is to continue quarry operations at a production level that reflects an average of the past five years of activity, or about 100,000 tons annually. This variant assumes that the slopes of the current site would remain, and the overall conditions would be as described in the existing setting.

HYDROLOGY IMPACTS

With continued quarry operations, issues related to hydrology would remain unresolved and flooding problems associated with current conditions (inadequate capacity on and off the Project site) would be expected to continue. Under Variant Two, storm water runoff rates are not expected to be additionally controlled or reduced from existing conditions. Because there would be no increase over existing conditions, continued quarry operations would not contribute to a cumulative impact. After reclamation, storm water flows would decrease from existing conditions due the implementation of storm water controls. The contribution towards existing downstream flooding would remain essentially the same.

VARIANT THREE – GENERAL PLAN DEVELOPMENT

DESCRIPTION

A third variant of the No Project alternative assumes that a more intensive residential development project might be proposed later if the proposed Project were not constructed. The site's general plan land use classification of Mixed Housing Type Residential could allow up to 3,840 units (30 units per gross acre) for this 128-acre site. However, balancing the overall needs and constraints of the site, this variant assumes a total of 1,519 residential units. About 50 acres, or generally the Lower Development Area, would accommodate up to 1,500 residential units; also, about 19 single-family homes, similar to the Project, would be built along Campus Drive. All 1,500 units in the Lower Development Area would be built within 13 multifamily-type structures, averaging about 115 units per building.

This alternative would include two smaller superpad areas, which would accommodate the multifamily structures.

HYDROLOGY IMPACTS

Environmental effects related to hydrology would be similar to those of the Project with implementation of similar mitigation measures, a revised reclamation plan, and an onsite stormwater detention basin. The contribution of this alternative towards existing flooding would remain essentially the same due to the onsite detention basin.

C. ALTERNATIVE 2: LOWER DENSITY

DESCRIPTION

The Lower Density Alternative would have about 236 units. Of the 217 units in the Lower Development Area, 145 units would be single-family detached homes; 72 units would be a variety of housing types and would be located above a 10,000-square-foot commercial space near the entrance on Mountain Boulevard. The remaining 19 units would be single-family detached homes in the Campus Drive Area.

This alternative would implement the same approved reclamation plan and the same site preparation work, including grading and superpad construction, as the proposed Project. The revegetation of the hillside would be the same, the landscape plan would be similar, and a landscaped stormwater detention basin would be incorporated on site. With implementation of the same reclamation plan, slopes would be less steep and more stable and would include intermittent benches, similar to the proposed Project.

HYDROLOGY IMPACTS

This alternative provides a similar stormwater detention basin as the proposed Project, and impacts related to hydrology would be less than significant with implementation of identified mitigation measures, as under the proposed Project. The contribution of this alternative towards existing flooding would remain essentially the same because of the onsite detention basin.

D. ALTERNATIVE 3: CLUSTERED DEVELOPMENT

DESCRIPTION

The Clustered Development Alternative would provide a greater amount of open space by clustering the units on the site. A larger area of open space would be created in the Lower Development Area between the two superpad areas. Another large area of additional open space would be created adjacent to the Restored Slope Area. This alternative would have about 373 units. The Lower Development Area would include 72 townhomes; 210 three- and four-bedroom multifamily units; and 72 units above a 10,000-square-foot commercial space near the entrance on Mountain Boulevard. As with the proposed Project, 19 single-family detached homes would be located in the Campus Drive Area. This alternative would have two superpad areas (larger areas than those of Variant Three). The revegetation of the hillside and an onsite landscaped stormwater detention basin would be similar to the proposed Project.

HYDROLOGY IMPACTS

Although this alternative would construct slightly different superpads for development, environmental effects related to hydrology would be similar to those of the proposed project with the implementation of similar mitigation measures. The contribution of this alternative to existing flooding would remain essentially the same, because of the onsite detention basin.

E. ALTERNATIVE 4: SOLAR POWER PLANT

DESCRIPTION

Under this alternative, the quarry operation would be terminated and the project site would be reclaimed and developed as a solar power plant as described in "A Feasibility Analysis for a Solar Energy Plant at the Leona Quarry in Oakland, CA," prepared by CRC Business Solutions, Inc., July 29, 2001. This alternative assumes that 19 single-family units would be built along Campus Drive.

This alternative assumes the solar power plant would generate energy through solar PV panels of crystalline silicon design, which are more easily adapted to varied terrain. Approximately 100 acres of the site would accommodate south-facing PV panels. The PV panels would be mounted on the hillside with racks and frames built into the hill face at 30-degree angles (relative to horizontal) to gain optimal positioning.

This alternative would implement grading consistent with the current reclamation plan, which would generally result in slopes with a 1:1 ratio. The PV panels would be mounted on a metal structure arranged in racks within the intermittent graded benches on the hillside slopes formed by site regrading. Revegetation of the hillside would differ from and likely be less than that of the proposed Project, as the PV panels would need to be clear of any vegetation that could block sunlight and clear of any hindrance to maintenance of the panels and system.

This alternative would require the construction of on site ancillary structures, multiple inverter facilities, and maintenance buildings to convert the collected sunlight to energy and transfer it through the grid system. With the assumption that one megawatt of power would require two to five inverters (BP Solar, 2001), the project would require up to 200 inverters for a 40-MW project. The PV panels would be linked with utility connections to the power grid, either via underground power lines or with overhead lines, assuming the interconnection requirements would be met and the line load would have capacity to receive the additional power. This alternative would therefore require extensive off-site infrastructure improvements involving numerous state and regional agencies.

The landscape plan would not be implemented, in order to accommodate panels in the Lower Development Area. The stormwater detention basin, however, would be incorporated to address the hydrologic issues of the site. This stormwater detention basin would likely be less landscaped than that proposed for the Project, depending on the grade elevations, to avoid blocking sunlight to the PV panels on the Lower Development Area.

HYDROLOGY IMPACTS

Environmental impacts to hydrology would also be similar to those of the proposed project with implementation of similar mitigation measures and the provision of a stormwater detention basin. The contribution of this alternative to existing flooding would be essentially the same because of the onsite detention basin.

F. RANKING OF ALTERNATIVES

The revised hydrology analysis appearing in this SEIR does not trigger any changes to the ranking of alternatives in terms of their environmental superiority. The Lower Density Alternative remains the environmentally superior alternative since it would result in less environmental impacts than those of the proposed Project and other alternatives. Table VI-1, presented at the end of this chapter for easy reference purposes, summarizes the revised hydrology impacts and reflects a reiteration of the environmentally superior alternative from the Leona Quarry EIR.

REFERENCES – Alternatives

BP Solar, telephone interview, November 1, 2001.

CRC Business Solutions, Inc., A Feasibility Analysis for a Solar Energy Plant at Leona Quarry in Oakland, CA, July 29, 2001.

Geomatrix Consultants, Revised Storm Water Pollution Prevention Plan: Leona Quarry, April 2000.

Golder Associates Inc., Leona Quarry Reclamation Plan Amendment, November 1995.

Millennium Energy, Colorado, telephone interview, November 1, 2001.

Sunlight & Power, telephone interview, November 1, 2001.

1987 Leona Quarry EIR.

TABLE VI-1
SUMMARY OF HYDROLOGY IMPACTS: PROPOSED PROJECT AND ALTERNATIVES

		Alternative 1			Alternative 2	Alternative 3	Alternative 4
Impact[a]	**Modified Plan**	**No Project**			**Lower Density**[b]	**Clustered Development**	**Solar Power Plant**
	477 Residential units	**Quarry Operations**	**Reduced Quarry Operations**	**General Plan Density 1,519 units**	**236 units & 10,000 s.f. Commercial**	**373 units & 10,000 s.f. Commercial**	**PV Panels on 100 acres**
F. Hydrology							
F.1: Increase in storm water flow to create localized flooding and contribute to existing flooding downstream.	LS	LS	LS	LS	LS	LS	LS

All alternatives would not increase stormwater runoff over existing conditions. Therefore, all of the alternatives would result in less than significant hydrology impacts, and would not contribute towards flooding beyond existing levels. However, none of the alternatives would significantly reduce existing flooding.

Comparisons to Setting

- SU Significant and unavoidable adverse impact after mitigation
- PSU Potentially significant and unavoidable adverse impact after Mitigation
- LS Less-than-significant adverse impact after mitigation
- N No impact or negligible impact

[a] Significance levels for the project and the alternatives reflect the levels of significance after mitigation. Symbols indicate maximum impact during buildout and operation, unless otherwise specified.

[b] Alternative 2, Lower Density, is the environmentally superior alternative.

CHAPTER VII

OVERSIZED DETENTION BASIN

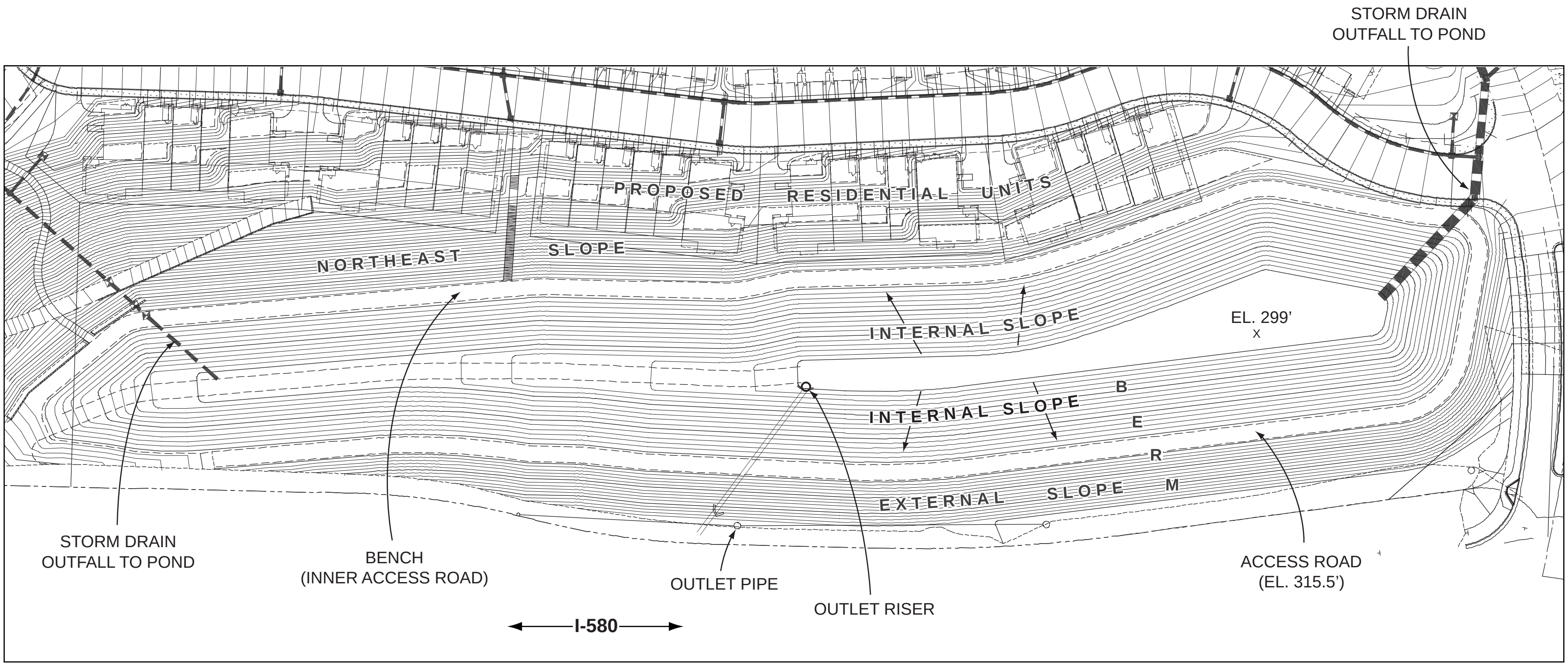
A. INTRODUCTION

In response to the Notice of Preparation for this SEIR, commenters requested consideration of an oversized basin to help further correct existing offsite drainage deficiencies caused by existing development. It is important to note that existing offsite deficiencies are not impacts of the Project. As there is no nexus, project approval could not be conditioned upon such a basin, and an oversized basin cannot be considered an alternative way to mitigate Project impacts. Further, neither the City of Oakland, the ACFCWCD, nor any other public or private entity has indicated interest in funding an oversized facility. However, if an entity were to pursue an oversized facility, the following environmental assessment has been provided for informational purposes.

In order to evaluate an oversized basin, certain assumptions have been made regarding the description of an oversized basin. It was also assumed that a sponsor of an oversized basin would want to avoid effects on the Modified Plan, and thus minimize the costs of condemning or otherwise acquiring an interest in any land needed to implement an oversized basin. Accordingly, methods of enlarging the detention capacity of the 15.6 acre-foot basin proposed for the Modified Plan (Modified Plan basin shown as Figure VII-1 and VII-2) were explored to determine the ways to expand basin capacity within the footprint of the Modified Plan basin, without affecting the design or layout of the Modified Plan.

As shown on Figures VII-1 and VII-2, a constructed berm forms the southwest side of the proposed Modified Plan basin paralleling I-580, and a benched slope forms the northeast side. The southeast berm slopes would have 2:1 (Horizontal:Vertical) outboard slopes and 3:1 interior slopes with a 10-foot wide horizontal crest. The northeast side of the Modified Plan basin is a 3:1 slope with a 10-foot wide bench. Above the bench and below the house lots, the slope steepens to 2:1. The Modified Plan basin capacity is 15.6 acre feet.

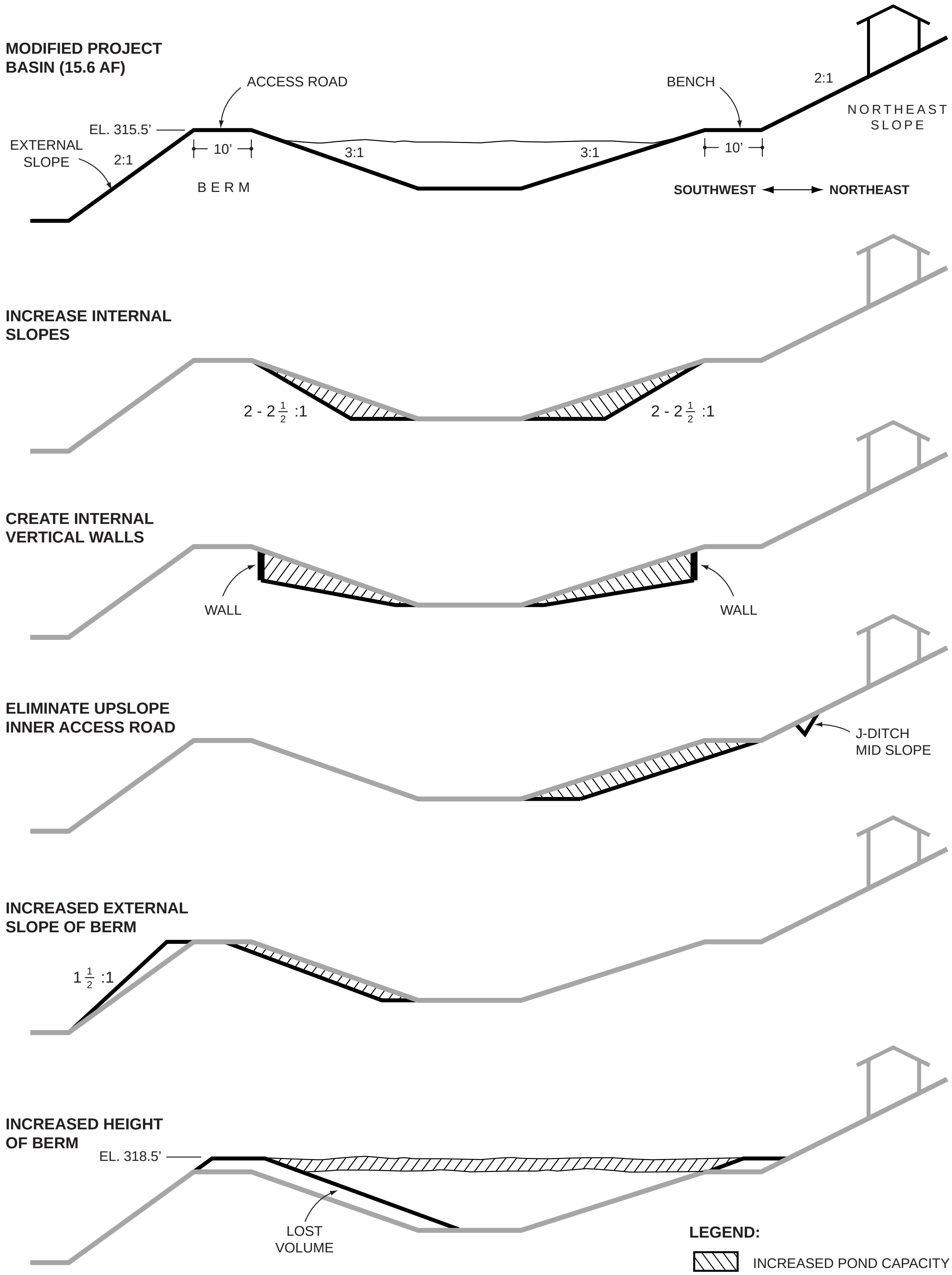
Five design modifications were identified for expanding the capacity of the Modified Plan basin. The following is a description of each modification followed by a discussion of whether changing the Modified Plan basin to include such a modification would result in any new or more severe significant environmental impacts beyond those already studied in the Leona Quarry EIR.



APPROXIMATE SCALE: 1" = 100'

SOURCE: Carlson, Barbee and Gibson, Inc.

Figure VII-1
Detention Basin



ELEVATIONS APPROXIMATE - SCHEMATIC ONLY - NOT TO SCALE

SOURCE: DeSilva Group

Figure VII-2
Design Modifications for Increased Basin Capacity
Cross Section Schematic

B. DESIGN MODIFICATION 1: INCREASE INTERNAL SLOPES

DESCRIPTION

Design Modification 1 would steepen interior slopes of the Modified Plan basin from 3:1 to between 2 and 2.5:1 (Figure VII-2). Other basin features (berm height, bench width, adjacent slopes) would remain the same. This design modification could increase detention volume up to 8-acre feet over that of the Modified Plan basin.

IMPACTS

Slope stability analysis indicates that the steeper slopes would remain stable under static, seismic, and rapid drawdown conditions and therefore, would not expose people or property to slope instability hazards (BGC, 2003).[1] Achieving the steeper interior slopes would require standard grading practices similar to those employed under the Modified Plan basin although excavated soil quantities would be greater. The soil excavated to develop the steeper slopes and the deeper basin would remain onsite and be incorporated into the quantities of fill needed to construct the project under the Modified Plan. None of the excavated soil and rock material would leave the property. Design Modification 1 would not change the physical appearance of the Modified Plan basin because outboard slopes, berm dimensions, the southwest berm road, and the northeast bench and slopes would not change. This degree of slope change would not represent a safety hazard especially considering that entry would be restricted by a 6-foot fence.

C. DESIGN MODIFICATION 2: CREATE INTERNAL VERTICAL WALL

DESCRIPTION

Option 2 would include 3 to 6 foot vertical walls on the interior of the basin. (Figure VII-2). Other features of the basin would remain the same as the Modified Plan basin. This option could increase detention volume up to 9 -acre feet over that contained by Modified Plan basin.

IMPACTS

Slope stability analysis indicates that the proposed internal vertical walls would remain stable under static, seismic, and rapid drawdown conditions and therefore, would not expose people or property to slope instability hazards (BGC, 2003). Construction of the basin under Design Modification 2 would require construction of the vertical wall structures, which could include additional excavation for wall foundations, construction of concrete forms, installation of

[1] Stability is determined by the resulting "factor of safety" as determined through slope stability modeling. *Static* conditions refer to non-seismic forces acting on a slope such as gravity, *seismic* conditions refer to earthquake ground motions affecting slope stability, and *rapid draw down* conditions refer to changes in the slope stability caused by the rapid removal of the hydrostatic pressures, which occur when water presses against a saturated slope.

concrete forms and steel reinforcement, and concrete placement. These operations are standard construction procedures that would be typical of the operations conducted for other elements of the Modified Plan and would not result in unique adverse environmental impacts. Compared to the Modified Plan basin, utilizing vertical walls in this option would remove a greater volume of rock and soil material. The soil excavated to install the vertical slopes would remain onsite and be incorporated into the large quantities of fill needed to construct the project under the Modified Plan. None of the excavated soil and rock material would leave the property. The incorporation of vertical walls represents a minor physical change that would not significantly alter the aesthetics of the basin. The outboard slopes, the southwest berm road width, and the northeast bench and slopes would not change. The proposed six-foot fence surrounding the basin would restrict entry into the stormwater management facility and reduce potential safety concerns related to vertical walls and steep interior slopes.

D. DESIGN MODIFICATION 3: ELIMINATE UPSLOPE (INNER) ACCESS ROAD

DESCRIPTION

Design Modification 3 would remove the interior road bench proposed for the northeast, upslope side of the Modified Plan basin. (Figure VII-2). Other features of the basin, including the steepness of the slopes above and below the former location of the road, would remain the same as the Modified Plan basin. This Design Modification could increase detention volume of the basin up to 2 acre feet over that contained by Modified Plan basin.

IMPACTS

Slope stability analysis indicates that slopes remaining after the bench is removed would remain stable under static, seismic, and rapid drawdown conditions and therefore, would not expose people or property to slope instability hazards (BGC, 2003). Incorporating Design Modification 3 into the basin would involve standard excavation and grading practices typical for this type of project. The soil excavated to remove the bench would remain onsite and be incorporated into the quantities of fill needed to construct the project under the Modified Plan. None of the excavated soil and rock material would leave the property. The removal of the inner bench would eliminate the upslope portion of the access road, remove a potential hiking and biking trail and eliminate a small observation area. The remaining downslope portion of the road would be adequate to carry out maintenance activities for this long and narrow basin. These are minor losses of recreational opportunities. The removal of the inner road berm would also result in minor physical changes that would not significantly alter the aesthetics and use of the basin. Because this Design Modification would create a relatively high inboard slope, a concrete-lined ditch is recommended by the project geotechnical engineers to intercept the slope runoff and reduce erosion potential. The outboard slopes, the berm road width, and the northeast bench and slopes would not change.

E. DESIGN MODIFICATION 4: INCREASE EXTERNAL SLOPE OF BERM

DESCRIPTION

Option 4 would steepen the exterior slope of the berm from 2:1 to 1.5:1. This would allow the berm to be shifted west, thereby increasing the interior volume of the basin (Figure VII-2). Other basin features would remain the same as the Modified Plan basin. This Design Modification could increase detention volume up to 4 acre feet over that contained by Modified Plan basin.

IMPACTS

Slope stability analysis indicates that steepening the exterior slope of the berm to 1.5:1 would not affect the stability of the slope, provided the slope is constructed with reinforcement. The reinforcement would consist of a high-density plastic mat or a "geo-grid", placed horizontally within the slope, with about 3-feet of mechanically compacted soil over each "geo-grid" layer. This mat would improve soil strength and provide the required stability for a 1.5:1 slope. Even though this option requires placement of a "geo-grid", the construction of the basin would involve standard excavation and grading practices typical for this type of project. The soil excavated to implement this Design Modification would remain onsite and be incorporated into the quantities of fill needed to construct the project under the Modified Plan. None of the excavated soil and rock material would leave the property. Other elements of the detention pond such as interior slopes, the southwest berm road width, and the northeast bench and slopes would not change.

F. DESIGN MODIFICATION 5: INCREASE HEIGHT OF BERM

DESCRIPTION

Design Modification would increase the height of the berm by three feet (elevation of 318.5 feet) while maintaining 2:1 exterior slopes of the berm and 3:1 interior slopes of the berm (Figure VII-2). Other features of the basin would remain the same as the Modified Plan basin. The wider base required to support a higher berm would essentially offset the additional capacity gained from increasing the berm. This Design Modification could increase detention volume up to one half of an acre foot over that contained by Modified Plan basin.

IMPACTS

Slope stability analysis indicates that the exterior and interior slopes of the berm would remain stable under static, seismic, and rapid drawdown conditions and therefore, would not expose people or property to slope instability hazards (BGC, 2003). Construction of the option 5 basin would involve standard excavation and grading practices typical for this type of project. The outboard slopes, the berm road width, and the northeast bench and slopes would not change.

G. COMBINING VARIOUS OPTIONS

DESCRIPTION

It is not possible to combine all Design Modifications together in one basin for engineering reasons. For example, steeper exterior slopes cannot be combined with internal vertical walls, because the resulting berm would not meet slope stability requirements.

However, various other Design Modifications could be combined together. For example, Design Modifications 1, 2 and 5 could be incorporated into a single basin. This could yield 13 acre-feet of additional capacity.

IMPACTS

The impacts of the individual pond configuration options are discussed above. Slope stability analysis has been completed for the individual scenarios and indicates that the various slope configurations are within acceptable factors of safety. Overall, the primary impacts are related to short-term grading and construction. Construction of the combination referenced above (incorporating Design Modifications 1, 2 and 5) would involve standard excavation and grading practices typical for this type of project. No significant impacts would be anticipated from a combined option configuration.

REFERENCES – Oversized Basin

Berlogar Geotechnical Consultants, Letter from BGC to David Chapman regarding slope stability of the lower pond at Leona Quarry, September 26, 2003.

Carlson, Barbee, and Gibson, Inc. Detention Basin Alternatives, Preliminary Drawings, Leona Quarry Tract, City of Oakland, California, September 12, 2003.

CHAPTER VIII

REPORT PREPARATION

A. SEIR PREPARERS

REPORT AUTHORS

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APPENDICES

LIST OF APPENDICES

APPENDIX A

AMENDED JUDGMENT AND SECOND AMENDED WRIT

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Attorneys For Petitioners

ENDORSED
FILED
ALAMEDA COUNTY

AUG 5 - 2003

CLERK OF THE SUPERIOR COURT
By SARA DALLESKE
Deputy

SUPERIOR COURT OF CALIFORNIA, COUNTY OF ALAMEDA

MAUREEN DORSEY, BURCKHALTER NEIGHBORS and CITIZENS FOR OAKLAND'S OPEN SPACE, INC.,

Plaintiffs and Petitioners,

vs.

CITY OF OAKLAND, OAKLAND CITY COUNCIL, DOES 1 through 20,

Defendants and Respondents,

THE DeSILVA GROUP, INC., GALLAGHER PROPERTIES, INC. and DOES 1 through 20,

Real Parties in Interest, Defendants and Respondents.

No. RG03077607

~~PROPOSED~~ AMENDED JUDGMENT GRANTING PETITION FOR WRIT OF MANDATE

Hearing Date: May 8, 2003
Time: 9:00 a.m.
Dept: 512

The Petition for Writ of Mandate brought by Maureen Dorsey, Burckhalter Neighbors, and Citizens for Oakland's Open Space came on regularly for hearing on May 8, 2003 in Department 512 of the above-entitled court, the Honorable Bonnie L. Sabraw, Judge presiding.

Leila H. Moncharsh appeared as attorney for petitioners Maureen Dorsey, Burckhalter neighbors, and Citizens for Oakland's Open Space. Heather Lee appeared as attorney for respondent City of Oakland and the Oakland City Council. Stephen L. Kostka appeared as counsel for real party in interest The DeSilva Group, LLC. Deborah L. Kartiganer appeared as counsel on behalf of real party in interest Gallagher Properties, Inc.

After considering the administrative record, all pleadings on file in this action, the briefs submitted and oral arguments made by counsel, the Court on June 3, 2003 granted Petitioners' Petition for Writ of Mandate in part.

Respondents' motion for reconsideration, new trial, vacation of judgment and objections to the statement of decision and Petitioners' proposed writ came on for hearing on July 24, 2003, in Department 512 before the Honorable Bonnie Lewman Sabraw. All parties appeared through their counsel. The Court considered the papers and pleadings filed in that matter, reviewed the record, considered oral argument and granted the motion in part. On the Court's own motion and for good cause shown, the document entitled "Order and Statement of Decision On Petition For Writ of Mandate" filed June 3, 2003 is amended to incorporate the remedy set forth below, and the documents entitled "Final Judgment Granting Petition For Writ of Mandate" and "Peremptory Writ of Mandate" filed on June 17, 2003 are vacated or amended to read as follows:

The Court having made its rulings as set forth above and good cause appearing therefrom:

IT IS HEREBY ORDERED, ADJUDICATED AND DECREED as follows:

1. Judgment on the first cause of action granting a peremptory writ of mandate shall be issued for all petitioners.

2. A peremptory writ of mandate shall issue under the seal of this court commanding respondents, including all of its agencies, departments, subdivisions, officers, employees, agents, and all others acting on respondents' behalf, in concert with respondents, or pursuant to respondents' authority, within the time specified for a return to the writ, to:

(a) Set aside the certification of the EIR until a subsequent EIR is prepared with regard to only that portion of the EIR dealing with hydrological issues. As to the Geology segment of the EIR, additional review is ordered only if changes arising out of matters related to hydrology result in changes to the geology analysis in accord with standards set forth in CEQA Guideline 15162. (See also *Temecula Band of Luiseno Mission Indians v. Rancho Cal. Water Dist.* (1996) 43 Cal. App. 4th 425, 437 [discussion of new baseline].) The subsequent EIR shall be given the same notice and public review as required under CEQA Guideline 15087;

(b) Set aside the approvals issued pursuant to Resolution 77544 until a subsequent EIR is prepared with regard to only that portion of the EIR dealing with hydrological issues. As to the Geology segment of the EIR, additional review is ordered only if changes arising out of matters related to hydrology result in changes to the geology analysis in accord with standards set forth in CEQA Guideline 15162. (See also *Temecula Band of Luiseno Mission Indians v. Rancho Cal. Water Dist.* (1996) 43 Cal. App. 4th 425, 437 [discussion of new baseline].) The subsequent EIR shall be given the same notice and public review as required under CEQA Guideline 15087;

(c) Stay the force and effect of Ordinance 12457 pending a showing that decisions arising from the subsequent EIR process require the Court to take further action;

(d) Comply with this judgment in connection with any further actions relating to the Project;

(e) Complete, prior to any future Project approval, a subsequent Environmental Impact Report that fully complies with this Amended Judgment;

(f) File and serve a return to the writ of mandate by December 5, 2003 detailing what actions have been taken to comply with the Writ and Judgment.

3. Petitioners shall recover legally allowable costs.

4. The Court reserves the question of Petitioners' entitlement to attorney fees and the amount of attorney fees, if any, to be awarded to Petitioners.

5. The Court retains jurisdiction pursuant to Public Resources Code Section 21168.9 to enforce the peremptory writ of mandate and amended judgment issued in this action. This Court further retains jurisdiction over respondents' proceedings by way of a return to the peremptory writ until the Court has determined that respondents have fully complied with all of the terms of the peremptory writ of mandate issued pursuant to this amended judgment, and to take such further actions as may be appropriate consistent with the Court's ruling.

6. Under Public Resources Code § 21168.9 (c), the Court specifically does not direct Respondents to exercise their lawful discretion in any particular way.

Dated: August 5, 2003

Bonnie Sabraw

Bonnie L. Sabraw
Judge of the Superior Court

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Attorneys for Real Party In Interest
THE DESILVA GROUP, LLC

ENDORSED
FILED
ALAMEDA COUNTY

AUG 29 2003

CLERK OF THE SUPERIOR COURT
By SARA DALLESKE
Deputy

SUPERIOR COURT OF THE STATE OF CALIFORNIA

COUNTY OF ALAMEDA, HAYWARD DIVISION

MAUREEN DORSEY, BURCKHALTER NEIGHBORS and CITIZENS FOR OAKLAND'S OPEN SPACE, INC., Plaintiffs and Petitioners, v. CITY OF OAKLAND, OAKLAND CITY COUNCIL, DOES 1 through 20, Defendants and Respondents. THE DESILVA GROUP, LLC, GALLAGHER PROPERTIES, INC., DOES 1 through 20. Real Parties In Interest, Defendants and Respondents.	No. RG-03077607 ~~PROPOSED~~ SECOND AMENDED PEREMPTORY WRIT OF MANDATE Date: October 2, 2003 Time: 9:30 a.m. Dept.: 512 Judge: Hon. Bonnie Sabraw

TO CITY OF OAKLAND, OAKLAND CITY COUNCIL, RESPONDENTS:

Judgment having been entered in this action, ordering that a peremptory writ of mandate be issued from this Court,

YOU ARE COMMANDED on receipt of this writ to do the following:

1. Set aside the certification of the EIR until a subsequent EIR is prepared with regard to only that portion of the EIR dealing with hydrological issues. As to the Geology segment of the EIR, additional review is ordered only if changes arising out of matters related to hydrology result in changes to the geology analysis in accord with standards set forth in CEQA Guideline 15162. (See also *Temecula Bank of Luiseno Mission Indians v. Rancho Cal. Water Dist.* (1996) 43 Cal. App. 4th 425, 437 [discussion of new baseline].) The subsequent EIR shall be given the same notice and public review as required under CEQA Guideline 15087;

2. Set aside the approvals issued pursuant to Resolution 77544 until a subsequent EIR is prepared with regard to only that portion of the EIR dealing with hydrological issues. As to the Geology segment of the EIR, additional review is ordered only if changes arising out of matters related to hydrology result in changes to the geology analysis in accord with standards set forth in CEQA Guideline 15162. (See also *Temecula Bank of Luiseno Mission Indians v. Rancho Cal. Water Dist.* (1996) 43 Cal. App. 4th 425, 437 [discussion of new baseline].) The subsequent EIR shall be given the same notice and public review as required under CEQA Guideline 15087;

3. Stay the force and effect of Ordinance 12457 pending a showing that decisions arising from the subsequent EIR process require the Court to take further action;

4. Comply with the Amended Judgment granting the Petition for Writ of Mandate in connection with any further actions relating to the Project;

5. Complete, prior to any future Project approval, a subsequent Environmental Impact Report that fully complies with the Amended Judgment granting the Petition for Writ of Mandate;

6. File and serve a return to the writ of mandate by December 5, 2003 detailing what actions have been taken to comply with the Writ, Judgment and CEQA.

7. The Court retains jurisdiction pursuant to Public Resources Code section 21168.9 to enforce the peremptory writ of mandate and judgment issued in this action. This Court further retains jurisdiction over Respondents' proceedings by way of a return to the peremptory writ until the Court has determined that Respondents have fully complied with all of the terms of the peremptory writ of mandate issued pursuant to this judgment, and to take such further actions as may be appropriate consistent with the Court's ruling. Under Public Resources Code section 21168.9(c), the Court specifically <u>does not</u> direct Respondents to exercise their lawful discretion in any particular way.

Date: AUG 2 9 2003

SARA DALLESKE,
CLERK

By: SARA DALLESKE
DEPUTY CLERK

<u>Let the foregoing writ issue</u>.

Date: AUG 2 9 2003

Bonnie Sabraw
Bonnie L. Sabraw
Judge of the Superior Court

APPROVED AS TO FORM: ______________________
Leila H. Moncharsh
Attorneys for Petitioners

APPENDIX B

NOTICE OF PREPARATION & RESPONDENTS

CITY OF OAKLAND

250 FRANK H. OGAWA PLAZA, SUITE 3330 • OAKLAND, CALIFORNIA 94612-2032

Community and Economic Development Agency (510) 238-3941
Planning & Zoning Services Division FAX (510) 238-6538
TDD (510) 839-6451

NOTICE OF PREPARATION OF
SUBSEQUENT ENVIRONMENTAL IMPACT REPORT
FOR THE LEONA QUARRY PROJECT

The Oakland Community and Economic Development Agency, Planning Division, is preparing a Subsequent Environmental Impact Report (SEIR) for certain aspects of the Leona Quarry Project, and we are requesting your comments on the scope and content of the SEIR.

The City previously certified an EIR for the Leona Quarry Project (SCH #1999042052) and approved a Zoning Boundary Adjustment (ZBA), Planned Unit Development (PUD) permit, Variances, Vesting Tentative Map (VTM) and Design Review approving the Modified Plan alternative for Leona Quarry. The Alameda County Superior Court ordered the EIR Certification, PUD Permit, Variances, VTM and Design Review "set aside until a subsequent EIR is prepared with regard to only that portion of the EIR dealing with hydrological issues." The court also ordered "as to the Geology segment of the EIR, additional review is ordered only if changes arising out of matters related to hydrology result in changes to the geology analysis in accord with standards set forth in CEQA Guideline 15162." The order also "stays the force and effect of [the ZBA] pending a showing that decisions arising from the subsequent EIR process require the Court to take further action." The City is preparing a Subsequent EIR to comply with this court order.

The City of Oakland is the Lead Agency for this project, which means that we are the public agency with the greatest responsibility for either approving it or carrying it out. We are sending this notice to Responsible Agencies and other interested parties. Responsible Agencies are those public agencies, besides the City of Oakland, that also have a role in approving or carrying out the project. Responsible Agencies may need to use the SEIR that we prepare when considering approvals related to the project. When the Draft SEIR is published, it will be sent to all Responsible Agencies and to others who respond to this Notice of Preparation or who otherwise indicate that they would like to receive a copy.

Please send us any response you may have within 30 days from the date of this notice, by Monday, September 19, 2003. Your response, and any questions or comments, should be directed to Claudia Cappio, City of Oakland, Community and Economic Development Agency, Planning Division, 250 Frank H. Ogawa Plaza, Suite 3330, Oakland, CA 94612, (510) 238-2229. Please reference case number **ER 01 – 33 - SUBSEQ** in your response.

The Oakland Planning Commission will hold a public scoping session on Wednesday, September 3, 2003, at 6:30 pm in Hearing Room 1 of Oakland City Hall, One Frank Ogawa Plaza. The purpose of the meeting will be to solicit public and Planning Commission comments about what information and analysis should be included in the SEIR.

PROJECT TITLE: **Leona Quarry Project**

PROJECT LOCATION: The 128 acre site is located at 7100 Mountain Boulevard in the City of Oakland, and is bounded by Edwards Avenue and I-580 to the south and west, Campus Drive to the north, and single family homes and open space to the east.

PROJECT SPONSOR: The DeSilva Group, 11555 Dublin Boulevard, Dublin, CA 94568

PROJECT DESCRIPTION:
To the extent required by the court order, the SEIR will evaluate the Modified Plan the City previously approved for Leona Quarry. The Modified Plan proposes to redevelop the 128 acre site into a residential community of 477 units. Nineteen single family lots are proposed to be subdivided at the upper portion of the site fronting on Campus Drive. 404 attached townhomes and condominiums and 54 senior affordable housing units are proposed for approximately 45 acres of the lower portion of the site, with access from Edwards Avenue. The Modified Plan includes a community center of approximately 2,300 square feet, a 2-acre park, 3 additional recreational areas, an improved Village Green area, and pedestrian trails. It proposes to dedicate more than 70 acres to permanent open space. A slope restoration and revegetation program and a storm water detention and treatment facility for the site are included. New interior roadways will be a part of the development. The primary emergency vehicle access route (EVA) is proposed near the senior housing, exiting on to Mountain Boulevard. A development schedule of six to ten years has been proposed by the applicant for completion of the project. A Geologic Hazard Abatement District (GHAD) has been formed to serve the project. A Reclamation Plan Amendment will likely be required to accommodate the project.

PROBABLE ENVIRONMENTAL EFFECTS: The prior EIR (SCH #1999042052) identified potentially significant environmental impacts dealing with hydrological issues related to increased stormwater runoff and water quality. The SEIR will provide further analysis of hydrology issues and whether changes arising out of matters related to hydrology result in changes to the geology analysis, as required by the court order.

DATE: August 18, 2003
ER File # 01 – 33 –SUBSEQ

____
Claudia Cappio, Development Director

The following is a list of Notice of Preparation (NOP) respondents who submitted letters by the end of the comment period, Monday, September 19, 2003. Copies of the NOP letters are contained within the Leona Quarry project files located at the City of Oakland, Community and Economic Development Agency Planning Department offices (250 Frank H. Ogawa Plaza, 3rd Floor, Oakland, CA 94612).

State, Regional, and Local Agencies:

Philip Crimmins, Project Analyst
State of California, Governor's Office of Planning and Research, State Clearinghouse

James S. Pompy, Manager
State of California, Department of Conservation

Diane Stark, Senior Transportation Planner
Alameda County Congestion Management Agency

William R. Kirkpatrick, Manager of Water Distribution Planning
East Bay Municipal Utility District

Community Organizations:

Philip Dow, President
Oak Knoll Neighborhood Improvement Association

Individuals:

Nancy Nadel, Oakland City Councilmember

Amanda Alston

Sparky Carranza

Marshall Hasbrouck

Mary Karne

Marilyn King

Irwin Luckman

Melissa Mandel

Rosemary Sanders

Tony Sweet

APPENDIX C

PHILIP WILLIAMS & ASSOCIATES LTD INITIAL REPORT, NOVEMBER 2002

PWA
PHILIP WILLIAMS & ASSOCIATES
CONSULTANTS IN HYDROLOGY
720 CALIFORNIA ST., 6TH FLOOR, SAN FRANCISCO, CA 94108
TEL 415.262.2300 FAX 415.262.2303
SFO@PWA-LTD.COM

LEONA QUARRY HYDROLOGIC REVIEW

Prepared for

City of Oakland
Community and Economic Development Agency

Prepared by

Philip Williams & Associates, Ltd.

November 20, 2002

PWA REF. # 1618

Services provided pursuant to this Agreement are intended solely for the use and benefit of the City of Oakland – Community and Economic Development Agency.

No other person or entity shall be entitled to rely on the services, opinions, recommendations, plans or specifications provided pursuant to this agreement without the express written consent of Philip Williams & Associates, Ltd., 720 California Street, 6th Floor, San Francisco, CA 94108.

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1. INTRODUCTION

The City of Oakland (City) retained Philip Williams & Associates (PWA) to provide support services related to hydrology and drainage issues for the proposed Leona Quarry development project. PWA's scope of work includes reviewing the hydrologic analysis performed by Balance Hydrologics on behalf of the DeSilva Group (project proponent), advising City staff regarding hydrologic issues, and other reviews and assessment as directed by City staff.

This report provides a summary of our review of the hydrologic analysis performed by Balance Hydrologics, and provides recommendations based on that review. PWA's initial review of hydrologic issues was based on the Balance Hydrologics report entitled *Analysis of Hydrologic Opportunities and Constraints at Leona Quarry, City of Oakland, California (2001)*. Subsequent to this initial review, Alameda County Flood Control and Water Conservation District (ACFCWCD) staff raised issues and questions regarding the way in which the existing conditions were described and modeled in the 2001 analysis. Balance Hydrologics has since revised their hydrologic analysis, and this memorandum describes PWA's review of the revised analysis.

In summary, PWA found the hydrologic methodology used by Balance Hydrologics to be generally consistent with published standards and requirements. However, there were some differences between modeling inputs used by Balance Hydrologics and those suggested by County staff. PWA performed sensitivity analyses on these differences and identified three areas where the input parameter selection made a material difference in the model results (detention pond initial storage, Mountain Boulevard watershed delineation, and curve number selection). These areas are discussed in detail in Chapter 2 of this report.

In this report, PWA makes recommendations as to which parameters are most appropriate to use in the hydrologic analysis. If these recommendations are followed, the project as currently proposed does not meet the requirements of the ACFCWCD. However, it is our opinion that the project could meet those requirements with revisions to the proposed detention pond design. As with any project, additional information and analysis will be required during the final design process to confirm that the final project design and performance meets the project goals and requirements. PWA recommends that the City impose Conditions of Approval on the project that require drainage design refinements during subsequent project review and approval in order to assure that the project meets the requirements of CEQA and the ACFCWCD.

1.1 BACKGROUND

PWA conducted on-site reconnaissance (August 29, 2002) and reviewed the 2001 Balance Hydrologics report as well as the calculations and hydrologic model on which the report was based. Balance

Hydrologics provided the calculations and hydrologic model to PWA at the request of City staff. The purpose of our review was to assess the appropriateness of the Balance Hydrologics approach, analysis and conclusions as compared to the published standards and ACFCWCD requirements as well as professional standards for civil engineering and hydrology. PWA used the document entitled *Hydrology and Hydraulics Criteria Summary for Western Alameda County* (Alameda County Public Works Agency, 1989) as the primary source for determining ACFCWCD standards and requirements. Other sources noted at the end of this memorandum were used for other aspects of our review.

The preliminary results of the above review were conveyed to the City staff in early October. In addition to the above in-house review, PWA recommended to the City that the active participation of the ACFCWCD in the hydrologic review process was essential to assure compliance with the ACFCWCD criteria. This was reinforced by local newspaper articles that indicated that the ACFCWCD staff had concerns regarding the adequacy of the developer's hydrologic assessment as included in the project EIR.

To address these concerns, additional review with the ACFCWCD was requested and initiated. This included a meeting with ACFCWCD representatives and the City staff (October 10, 2002) to clarify County design criteria, and CEQA concerns. ACFCWCD staff agreed to assist the City by providing technical input on the description of existing and future site hydrologic conditions, and in particular the hydrologic parameters to be included in the computer simulation model. The goal of this effort was to develop consensus between the developer (as represented by Balance Hydrologics) and ACFCWCD staff on the reasonableness of input parameters for the computer model being used to assess conformance with ACFCWCD standards, and conformance with CEQA criteria (that the project not worsen existing drainage problems). This included a site visit (attended by the City, ACFCWCD staff, developer's representatives and PWA staff on October 11, 2002) and a follow-up meeting (October 14 at the ACFCWCD offices, attended by Developer, Balance Hydrologics, ACFCWCD, and PWA staff) to develop consensus on the appropriate modeling parameters. The parameters discussed at these meetings included:

- Subwatershed boundaries
- Appropriate SCS Curve Numbers (describe soil types/infiltrations)
- "Time lag" methodology (describes how quickly rainfall appears as runoff)
- Modeling of existing on-site detention storage

As a result of this process, Balance Hydrologics revised their prior computer model to include more detail in the subdivision of the watershed into subwatersheds, the hydrologic parameters used to describe each subwatershed, and the modeling of existing site detention facilities.

This latter point (amount and functioning of existing site detention storage) was one of the primary concerns expressed by ACFCWCD staff. ACFCWCD staff indicated concern that the prior Balance Hydrologics study did not accurately reflect existing site conditions with respect to existing on-site detention storage. In general, they noted the difference in total detention storage between existing conditions (21.9 acre-feet) and post-project (about 17.1 acre-feet), although it was recognized that the proposed ponds could be designed to function much more efficiently and safely than the existing pond system. Other concerns related to the way existing detention was characterized in the hydrologic model. The potential implication of the characterization of this issue is that existing detention storage may reduce the peak flows from the site under existing conditions, resulting in a lower level of existing flow that would need to be met under post-project conditions. Therefore, if the hydrologic model of existing conditions reflected more effective existing detention storage, it would potentially establish a lower "baseline" condition that would need to be met in post-project conditions.

Based on the site visit and discussions, Balance Hydrologics agreed to modify their model of existing conditions to reflect 21.9 acre feet of existing on-site detention storage in four non-engineered ponds, with the outflow for each pond modeled as appropriate based on the outlet structure or weir dimensions. It is our understanding that the addition of the on-site detention storage to the hydrologic model as described above would address the concerns expressed by ACFCWCD staff; however, ACFCWCD staff have indicated that they will not provide formal written review of the current hydrologic refinement phase. ACFCWCD did provide a copy of their preliminary hydrologic model of the site to PWA for purposes of comparison with the Balance Hydrologic modeling approach.

2. PWA REVIEW

Based on the discussions described above, Balance Hydrologics revised the computer model to be more consistent with the ACFCWCD staff assessment of existing site conditions. PWA began a review of the revised model on November 4, 2002, and the results of this review are summarized below. In summary, PWA believes the type and level of hydrologic assessment being performed by Balance Hydrologics are appropriate for the current CEQA-level project assessment. Based on our review of the revised analysis, PWA found the hydrologic methodology used by Balance Hydrologics to be consistent with published standards and requirements, as described below. However, some differences remain between modeling inputs used by Balance Hydrologics and those suggested by ACFCWCD staff.

The following sections summarize PWA's review of the revised Balance Hydrologics modeling methodology as of November 4, 2002. The basic tool used by Balance Hydrologics to assess the hydrology of the Leona Quarry site was the HEC-1 computer model, developed by the US Army Corps of Engineers. This model is the standard tool used for estimating storm runoff and evaluating flow management facilities such as detention basins. HEC-1 is specifically approved by ACFCWCD for this type of analysis. In addition, it is the standard rainfall-runoff model approved for use by the federal government in conducting FEMA (Federal Emergency Management Agency) flood studies. HEC-1 estimates storm runoff from a design rainstorm using a variety of input parameters (described in detail below) that characterize the site hydrology. Based on the estimated runoff, the model can also be used to estimate storage volume requirements for detention facilities

2.1 HEC-1 INPUT PARAMETERS

The input parameters to the HEC-1 model are listed below, followed by a description of the review performed by PWA, and our conclusions.

2.1.1 Design Storm

The ACFCWD hydrology manual recommends using the 24-hour, 25-year design storm for drainage areas between 50 acres and 10 square miles in this area of the ACFCWCD. The watershed area for the Leona Quarry site falls in this range at approximately 250 acres. The 24-hour, 25-year storm is a storm that produces an amount of rainfall over 24 hours that occurs, on average, once in every 25 years. PWA's understanding of the ACFCWCD requirement is that the proposed development must be designed in such a way so as not to increase the current peak discharge levels for the design storm. There is a separate design storm requirement for detention ponds, which is that any detention pond must be designed to manage a 100-year, 24-hour storm such that the pond functions without failing.

2.1.2 Precipitation

ACFCWCD (1989) provides a method for estimating the depth of rainfall for a range of design storms based on the mean annual precipitation for a given location. The method is in the form of a factor that is applied to the annual precipitation depth to calculate the design storm depth. The factors for the 25- and 100-year storms are 0.1944 and 0.2411, respectively.

ACFCWCD (1989) provides an isohyetal map that shows mean annual precipitation for all of western Alameda County. For comparison with the ACFCWD isohyetal map, PWA also checked data from the Upper San Leandro Filter Plant (USLFP) rain gage, which has been operated continuously by the East Bay Municipal Utility District since 1948 and is located approximately ½ mile from the Leona Quarry site. The mean annual rainfall at the USLFP gage as reported by the Western Regional Climate Center (wrcc.dri.edu) is 25.4 inches. It is reasonable to assume that precipitation may be slightly higher in the portions of the Leona Quarry watershed area that are higher in elevation than the location of the USLFP rain gage. Therefore the 26-inch annual rainfall estimated from the ACFCWCD isohyetal map would provide a reasonable estimate of annual precipitation. Balance Hydrologics used 26 inches for their current HEC-1 analysis.

Applying the 0.1944 and 0.2411 factors to the 26-in annual average rainfall yield a 24-hour, 25-year design storm rainfall depth of 5.05 inches and a 24-hour, 100-year depth of 6.27 inches. These were the values used by Balance Hydrologics in their current HEC-1 analysis.

2.1.3 Drainage Area

HEC-1 applies the design storm rainfall to the area of the watershed in order to estimate rainfall over the area of interest. The boundaries of the watershed area are determined by topography and drainage infrastructure contributing runoff to the area of interest. Watershed areas are often sub-divided into sub-watersheds in order to provide a more detailed reflection of site drainage patterns and/or to generate peak flow estimates at particular locations (such as drainage infrastructure or stream confluences).

Using proposed development plans supplied by City Staff, topographic data provided by Balance Hydrologics (10/10/02), aerial photos from ACFCWCD, USGS topographic data, and information from site visits, PWA assessed the appropriateness of the watershed boundaries identified by Balance Hydrologics for use in the HEC-1 model. Complete topographic data for the Ridgemont Road and Mountain Boulevard areas were not included on the AutoCAD map provided by Balance Hydrologics. ACFCWCD staff "patched" the missing areas of the Balance map with USGS digital topographic data (ACFCWCD, 10/10/02). PWA used the ACFCWCD "patched" map in order to assess watershed boundaries in areas not covered by the AutoCAD map.

Based on topography, the Leona watershed can be separated into four major sub-watersheds: Ridgemont Road (north of the proposed development area), Leona Quarry (the proposed development area), I-580 (southeast of the proposed development area), and Mountain Boulevard (south of the proposed development area). All four of these areas ultimately drain to a 39" culvert under I-580. Runoff from the Ridgemont Road sub-basin first passes through the Leona Quarry sub-basin before reaching the I-580 culvert. Of the four major sub-watersheds, Balance further separated the Ridgemont Road area into two sub-watersheds in order to reflect a difference in land use. Balance separated the Quarry area into six sub-watersheds for the model of existing conditions in order to reflect existing drainage patterns and detention facilities on the site. For proposed conditions, the development area was modeled as a single sub-watershed draining to the proposed detention pond. To reflect the current development proposal, Balance also added approximately 4.5 acres of residential area to the Ridgemont Road sub-watershed. Under the proposal, runoff from this area would be re-directed to the Ridgemont Road sub-watershed from its current flow path. In general, the selection of sub-watersheds was appropriate to reflect site topography, drainage patterns and facilities.

In general, as shown in Table 1, Balance sub-watershed delineations (10/10/02) are similar to ACFCWCD delineations (10/10/02) except in the case of the Mountain Boulevard sub-watershed. PWA conducted sensitivity analyses on delineation differences between Balance and ACFCWCD by altering the sub-watershed parameters of the Balance HEC-1 model to reflect ACFCWCD sub-watershed acreages and then re-running the Balance model. The ACFCWCD delineation of the Mountain Boulevard sub-watershed includes approximately 10 acres along the eastern edge of the study area which Balance did not include. The inclusion of a larger area in the subwatershed results in a larger peak discharge estimated by the model for the Mountain Boulevard area in the ACFCWCD model. PWA's initial indication is that the Balance Hydrologics delineation is appropriate; however, PWA recommends further refinement of the Mountain Blvd delineation during final design and analysis. The results of the final delineation are not expected to significantly impact the conclusions of this analysis, as the same delineation will be used for modeling both pre-project and post-project conditions.

2.1.4 SCS Curve Number

The Curve Number is a parameter developed by the USDA Soil Conservation Service (SCS, now Natural Resource Conservation Service) to characterize infiltration characteristics of land areas. The SCS method is approved by ACFCWCD for hydrologic analysis. Based on aerial photographs, the proposed development plans, and site reconnaissance, PWA selected curve numbers to describe each of the existing and proposed land use types, and then weighted the curve numbers based on land use acreages in order to calculate an overall curve number for each sub-watershed. Tables 2 and 3 show curve number estimates for existing and developed conditions.

PWA conducted sensitivity analyses on curve number differences between Balance and ACFCWCD by altering the curve number parameters of the Balance HEC-1 model to reflect ACFCWCD sub-watershed curve numbers and then re-running the Balance model. A material increase to total watershed peak discharge occurred when the Mountain Boulevard sub-watershed curve number was changed from the curve number estimated by Balance to that estimated by ACFCWCD. Because the selection of different curve numbers had a material impact on model results, PWA used the USDA National Engineering Handbook (1985) (per ACFCWCD guidelines) to independently estimate a curve number for the Mountain Boulevard residential area, as documented in Tables 2 and 3. PWA calculated a composite curve number for the Mountain Boulevard sub-watershed of 80, which slightly increases the design storm total watershed peak discharge for both existing and proposed conditions over the Balance estimate.

2.1.5 Initial Loss

The initial loss parameter quantifies the amount of rainfall that is stored in small surface depressions, intercepted by vegetation etc. and therefore does not contribute to runoff for a given storm. Balance Hydrologics uses the HEC-1 default method to calculate initial loss.

2.1.6 Time Lag

The time lag calculation estimates the time required for runoff to reach the point where peak flows are being estimated. Inputs to the calculation include overland flow resistance, length of the runoff flow paths, and change in elevation. ACFCWCD recommends estimating a weighted overland flow resistance coefficient (or composite N-value) based on resistance values assigned by ACFCWCD to various land categories (Saleh, 11/12/02). The composite N-value is then fed into the ACFCWCD time lag equation, which also requires the total length of the sub-watershed flow path, the length from the bottom of the sub-watershed to the centroid, and the slope of the sub-watershed. Balance and ACFCWCD time lag values are shown in Tables 4 and 5.

While significant differences appear to exist between Balance and ACFCWCD time lag estimates, PWA found that those differences do *not* significantly impact the model results. PWA conducted sensitivity analyses on the time lag component of Balance's 24-hour, 25- and 100-year HEC-1 models for both existing and proposed conditions and found that time lag differences—in combination or singularly—did not materially change model results.

2.1.7 Detention Ponds

For detention pond analyses, HEC-1 calculates the volume of water stored in a detention pond of known dimensions based on the calculated storm runoff (inflow) in combination with a stage-discharge curve or rating curve (outflow) provided by the user. The rating curve indicates the amount of flow ("discharge") that will be leaving the pond when the water is at any given depth ("stage") in the pond. Stage-discharge relationships are calculated based on standard hydraulic equations for pipes, weirs and/or orifices, depending on the configuration of the pond outlet. PWA assessed the accuracy of Balance Hydrologic's estimations of storage and discharge for the five detention ponds: one proposed pond and four existing ponds.

A stage-storage curve or table for a pond shows the volume of water stored in that pond that corresponds to any given pond depth. In order to assess the stage – storage relationship of the existing ponds, PWA compared surveyed data of each pond to the volume estimations assumed by Balance. Both our assessment and Balance's estimations are based on the topographic data received from Balance on October 10, 2002. PWA did not independently survey the existing ponds; however, Balance's pond volume and stage-storage relationship estimations for each pond appear reasonable based on the surveyed footprint.

2.1.7.1 Ponds 1 and 2: Lower Detention Ponds

Ponds 1 and 2 are located in the lower, southwestern portion of the proposed development site. Balance and ACFCWCD stage–storage relationships for Ponds 1 and 2 are almost identical (Figure 1 and 2). Per Balance survey data, Pond 1 has a maximum volume of 3.35 acre-feet, and Pond 2 has a maximum volume of 4.38 acre-feet. Neither ACFCWCD nor Balance Hydrologics found existing outlet structures at either pond. Per Balance survey data, Pond 1 outflows via a non-engineered spillway, below which the pond retains 0.95 acre-feet of storage. Similarly, Pond 2 outflows via spillway, below which the pond retains 2.35 acre-feet of storage. Balance and ACFCWCD used slightly different methods to estimate a stage-discharge curve based on assumptions regarding flow over the spillway, resulting in slightly different curves (Figure 3 and 4). Both methods appear reasonable, and therefore PWA does not recommend any changes to Balance's rating curves.

There is one significant difference between the Balance and ACFCWCD approaches for modeling the detention ponds. For the existing conditions HEC-1 model, Balance assumes that Ponds 1 and 2 are initially full of water up to the spillway crest elevations (0.95 ac-ft and 2.35 ac-ft, respectively). However, ACFCWCD assumes that the ponds are initially empty, so that the pond storage volume below the spillway is available to store water from the design storm. This assumption results in a "baseline" peak runoff from the site that is 13 cfs lower than that estimated by Balance Hydrologics, which is a more conservative characterization of existing site conditions.

2.1.7.2 Pond 3: Large Upper Detention Pond

Pond 3 is the existing detention pond located in the east-central portion of the proposed development site. Figure 5 shows the stage–storage relationship of the proposed pond. The exact details of the outlet structure are not known because much of the structure is covered by rock. Balance Hydrologics and ACFCWCD assume that the pond outlet structure can be modeled as an 18-inch riser with a 12-inch circular orifice, whereby flow is limited to 22 cubic-feet per second by the 18-inch corrugated metal outlet pipe. The limiting flow parameter (22 cfs) appears reasonable based on the assumed outlet dimensions. Based on the above assumptions for Pond 3, PWA calculated a rating curve, which roughly agrees with Balance's curve (Figure 6). While the assumptions for Pond 3 and the related calculations appear reasonable, without a detailed understanding of the existing outlet structure, PWA does not have sufficient information to verify these assumptions.

2.1.7.3 Pond 4: Small Upper Detention Pond

Balance's estimates of the storage volume and associated stage-storage relationship of Pond 4 (Figure 7) appear reasonable based on the footprint of the pond. PWA generated a stage-discharge relationship using standard equations for pipe hydraulics based on the existing 30-inch corrugated metal pipe outlet and assuming a 15-foot weir spillway if the pond is overtopped. The rating curve generated by PWA approximately agrees with that used by Balance Hydrologics (Figure 8).

Under the current development proposal, the Pond 4 outlet would be replaced. Balance models the outflow under proposed conditions assuming a single drop box (the perimeter would be comparable to that of a 36-inch riser) with one rectangular orifice (2.75' x 2.00'). Balance's model assumes that all flow up to and including the 100-year flow would pass through the new drop box. Given the outlet dimensions specified by Balance for future conditions, PWA verified the Pond 4 rating curve (without spillway) for the developed scenario (Figure 9). It should be recognized that the existing 30-inch outlet pipe would not have the capacity to handle the flow from the proposed riser/orifice structure. PWA assumes that the proposed riser/orifice structure would dictate the limit of outflow and, as such, existing Pond 4 outlet structures would also be replaced as necessary.

Stage-storage dimensions of the pond should be verified by field survey prior to final project approval. The stage-discharge relationship and pond hydraulics should be reviewed again — in the context of the hydrologic analysis — when final design plans for the pond are being prepared. However, slight variations in the stage-discharge curve and storage volume assumptions used in the analysis are not expected to have a significant effect on the estimated peak flows from the pond.

The Quarry operators constructed this facility at some time in the past. We are not aware of any engineering design or construction plans or specifications to document the construction practices. A geotechnical engineer should therefore inspect the pond levees to verify structural integrity for future, ongoing use.

2.1.7.4 Proposed Detention Pond

In assessing the proposed detention pond, it is PWA's understanding that Balance Hydrologics assumed a detention pond design that would contain the design storm (24-hour, 25-year event) such that all runoff from the storm would drain through the existing 39-inch culvert that passes under the I-580 freeway. This is a reasonable approach to assessing the storage volume requirements for the proposed pond. It should be recognized that the 39-inch culvert conveying all drainage from this area under the freeway is a relatively small diameter pipe for a watershed of this size. As such, it represents a significant constriction in available flow capacity, requiring a larger detention volume than might otherwise be required.

Figure 10 shows the stage–storage relationship of the proposed pond. The precise stage–storage relationship and rating curve for the proposed detention pond will not be known until the final design of the pond outlet is complete. However, it is assumed that the outlet structure will be designed to limit the peak discharge from the pond to 180 cubic-feet per second (cfs), based on the capacity of the 39-inch pipe described above. The stage-discharge relationship assumed by Balance Hydrologics in their analysis is reasonable based on this assumption. Specifically, in order to model pond outflow, Balance assumed a single outlet box (the perimeter would be comparable to that of a 48-inch riser) with two rectangular orifices. Given these design criteria, PWA verified the Balance rating curve (Figure 11). PWA was not able to verify whether the pond would drain within 24 hours of the design storm as required by ACFCWCD. The rating curve and pond hydraulics should be reviewed again—in the context of the hydrologic model—when final design plans for the pond are being prepared.

2.2 MODEL RESULTS/CONCLUSIONS

Many of the parameters used in hydrologic modeling are somewhat subjective. Parameters must be selected that best characterize the watershed and are most appropriate to the purpose of the modeling. As a part of our review, PWA has recommended two changes to the parameters selected by Balance Hydrologics. While the assumptions made by Balance Hydrologics are not unreasonable, PWA has recommended the changes in order to provide a somewhat more conservative assessment of the existing watershed conditions. Due to the sensitive nature of the proposed project, PWA recommends using this conservative approach to evaluating the potential impacts of the proposed project.

The two changes to the model input parameters that PWA is recommending as a result of our review are described below:

1. <u>Mountain Boulevard curve number</u> — Because of the large discrepancy between the curve numbers estimated by Balance Hydrologics (76.9) and ACFCWCD (87) for this area, PWA independently estimated a composite curve number for the Mountain Boulevard sub-watershed. Based on our independent estimate, we recommend using a curve number of 80 for this sub-watershed in both existing and proposed conditions modeling. This is a somewhat more conservative estimate of sub-basin infiltration than that made by Balance Hydrologics.

2. <u>Initial storage assumption for Ponds 1 & 2</u> — The ACFCWCD assumption that the existing ponds are empty at the start of the design storm provides a more conservative estimation of peak flows from the site under existing conditions. PWA therefore recommends using this assumption in existing conditions modeling, as opposed to assuming the ponds are full of water.

If the above recommendations are followed, the hydrologic model of the Leona watershed generates the peak flow estimates summarized below:

HEC-1 Peak Flow Estimates – PWA recommended parameters

	25-year, 24-hour storm	100-year, 24-hour storm
Existing Conditions	158	212
Proposed Conditions	167	210

The results summarized above do not represent compliance with the published ACFCWCD standard that the post-project design storm peak flow be less than or equal to the existing peak flow. However, they do represent compliance with the requirement that the peak flow be less than the estimated capacity of the 39-inch culvert (approximately 180 cfs), and with the general CEQA standard of no increase in flood hazard for the 100-year event. Model results indicate that peak flows from a 100-year, 24-hour storm would exceed the capacity of the 39-inch pipe under I-580 under both existing and proposed conditions, although the proposed design would reduce the peak 100-year surface flow from by a negligible amount.

Based on the results of our review, PWA recommends that the City impose Conditions of Approval on the project that require compliance with ACFCWCD and CEQA requirements, such that the post-project, 25-year, 24-hour peak flow from the site is equal to or less than the existing peak flow as estimated using PWA's recommended parameters. This may require increasing the size of the proposed detention pond to provide additional storage, and/or changes to the proposed outlet structure design.

2.3 ADDITIONAL SITE OPPORTUNITIES

The above review has focused on flood hazard and drainage issues, as these represent the topics of primary concern to the City and local stakeholders. In addition to these issues, the project site presents a considerable opportunity for stream restoration, habitat benefit, and water quality management.

Topographically, the site represents the headwaters area of Chimes Creek. It is likely that it included the first and second order channels of the creek, which were fed by local springs in addition to winter rainfall-runoff. The quarry excavation eliminated these channels. The conceptual plans for the site indicate some consideration of incorporating a "restored" creek channel in the proposed development. We recommend inclusion of a restored stream system on the site, which will provide habitat, aesthetic, and water quality benefits.

Additional water quality and habitat benefits can be provided during the design of the detention facility, as well as design attributes of the developed areas. These are typically developed in coordination with the Regional Water Quality Control Board (RWQCB) as part of their 401 certification program, and are designed to minimize/remove typical urban runoff pollutants.

3. SOURCES

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LEONA QUARRY HYDROLOGIC REVIEW – Tables and Figures

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Table 1. Sub-watershed Delineation

	Sub-watershed	Area, acres Balance, 10/14/02	County, 10/13/02	Difference	Difference %
Existing Conditions	Ridgemont1	49.92	55.94	6.02	11%
	Ridgemont2	26.24	27.52	1.28	5%
	Upper Quarry	49.92	49.92	0.00	0%
	Pond1 Basin	3.84	3.84	0.00	0%
	Pond2 Basin	12.16	12.16	0.00	0%
	Lower Quarry - West	19.84	19.20	-0.64	-3%
	Lower Quarry	6.40	6.40	0.00	0%
	Lower Quarry - East	5.63	5.63	0.00	0%
	I-580	7.04	8.96	1.92	21%
	Mountain Blvd	48.00	59.52	11.52	19%
	Total	**228.99**	**249.09**	**20.10**	**8%**
Developed Conditions	Ridgemont1	54.40	55.94	1.54	3%
	Ridgemont2	26.24	27.52	1.28	5%
	Development	97.28	101.76	4.48	4%
	I-580	7.04	6.40	-0.64	-10%
	Mountain Blvd	49.92	59.52	9.60	16%
	Total	**234.88**	**251.14**	**16.26**	**6%**

Table 2. Curve Number Estimations, Existing Conditions

	Curve Number	Ridge-mont1, %	Ridge-mont2, %	Upper Quarry, %	Pond1 Basin, %	Pond2 Basin, %	Lower Quarry West, %	Lower Quarry, %	Lower Quarry East, %	Mtn Blvd, %	I-580, %
Balance, 10/14/02											
Wooded, fair	79.0	20.6	98.9				31.5		89.3	49.4	60.3
Residential, 1/4 acre lots	87.0	79.4					2.0				
Residential, 1/3 acre lots[1]	72.0									47.9	
Detention basin	98.0		1.1	0.4	7.3	3.3					
Dirt cover	89.0			99.6	92.7	96.7	41.1	39.1			
Gravel road	91.0						18.3	45.3			
Paved surfaces	98.0						7.1	15.6	10.7	2.7	39.7
Total %		100	100	100	100	100	100	100	100	100	100
Weighted Curve Number		85.4	79.2	89.0	89.7	89.3	86.8	91.3	81.0	76.2	86.5
PWA, Nov 2002											
Wooded, fair	79.0	35.0	99.0				20.0		85.0	30.0	45.0
Residential (D soil type)	89.0	60.0					2.0			20.0	
Residential (B soil type)	77.0									50.0	
Detention basin	98.0		1.0	1.0	6.0	3.0					
Dirt cover	89.0			99.0	94.0	97.0	60.0	75.0	10.0		10.0
Hard surface	92.0	5.0					18.0	25.0	5.0		45.0
Total %		100	100	100	100	100	100	100	100	100	100
Weighted Curve Number		85.7	79.2	89.1	89.5	89.3	87.5	89.8	80.7	80.0	85.9
County, 10/13/02											
Wooded, fair	79.0	40.0	100.0				15.0		90.0	20.0	55.0
Residential	89.0	45.0								80.0	
Dirt cover	89.0			100.0	100.0	100.0	78.0	98.0	10.0		
Hard surface	92.0	15.0					7.0	2.0			45.0
Total %		100	100	100	100	100	100	100	100	100	100
Weighted Curve Number		85.5	79.0	89.0	89.0	89.0	87.7	89.1	80.0	87.0	84.9

[1]Balance selected a curve number for Mountain Blvd. 1/3-acre lots based on group B soils.

Table 3. Curve Number Estimations, Proposed Developed Conditions

	Curve Number	Ridge-mont1, %	Ridge-mont2, %	Quarry, %	Mtn Blvd, %	I-580, %
Balance, 10/14/02						
Wooded, fair	79.0	18.9	98.9	5.5	47.5	62.5
Residential, rowhouses	92.0			40.9		
Residential, 1/4 acre lots	87.0	81.1		2.6		
Residential, 1/3 acre lots[1]	72.0				46.3	
Detention basin	98.0		1.1	1.1		
Dirt cover	89.0			11.6		
Gravel road	91.0					
Paved surfaces	98.0				2.6	37.5
Restored slope areas	89.0			38.2		
Commercial	95.0				3.8	
Total %		100	100	100	100	100
Weighted Curve Number		85.5	79.2	89.7	76.9	86.1
PWA, Nov 2002						
Wooded, fair	79.0	35.0	99.0		30.0	45.0
Residential (D soil type)	89.0	60.0		55.0	20.0	
Residential (B soil type)	77.0				50.0	
Graded/Restored slopes	92.0			35.0		
Detention basin	98.0		1.0	1.0		
Dirt cover	89.0			9.0		10.0
Hard surface	92.0	5.0				45.0
Total %		100	100	100	100	100
Weighted Curve Number		85.7	79.2	90.1	80.0	85.9
County, 10/13/02						
Wooded, fair	79.0	40.0	100.0		20.0	55.0
Residential	89.0	45.0			80.0	
Dirt cover	89.0					
Newly graded open space	89.0			80.0		
Hard surface	92.0	15.0				45.0
Impervious area	98.0			20.0		
Total %		100	100	100	100	100
Weighted Curve Number		85.5	79.0	90.8	87.0	84.9

[1]Balance selected a curve number for Mountain Blvd. 1/3-acre lots based on group B soils.

Table 4. Time Lag Estimations, Existing Conditions

SubBasin	Basin "N"	Length, L (ft)	Length, L (mi)	Length to Centroid, Lc (ft)	Length to Centroid, Lc (mi)	Slope, S (ft/mi)	K-factor[1]	Time Lag[2] (hr)	Time Lag[2] (min)
Balance, 10/14/02									
Ridgemont1	0.023	3872	0.733	2216	0.420	817	28.7	0.118	7.1
Ridgemont2	0.060	1649	0.312	716	0.136	1825	43.7	0.190	11.4
Upper Quarry	0.045	1985	0.376	858	0.163	1402	39.2	0.154	9.2
Pond1 Basin	0.045	503	0.095	327	0.062	1214	45.0	0.075	4.5
Pond2 Basin	0.045	1485	0.281	460	0.087	1126	45.0	0.130	7.8
Lower Quarry - West	0.045	1890	0.358	1047	0.198	869	40.3	0.183	11.0
Lower Quarry	0.041	746	0.141	449	0.085	228	45.0	0.123	7.4
Lower Quarry - East	0.057	1474	0.279	508	0.096	1419	45.0	0.163	9.8
I-580	0.037	1466	0.278	938	0.178	540	47.1	0.168	10.1
Mountain Blvd	0.038	4160	0.788	2925	0.554	529	28.0	0.235	14.1
County, 10/13/02									
Ridgemont1	0.024	3953	0.749	1451	0.275	245	28.4	0.132	7.9
Ridgemont2	0.060	1739	0.329	877	0.166	1686	42.3	0.205	12.3
Upper Quarry	0.045	2138	0.405	900	0.170	1315	37.6	0.156	9.4
Pond1 Basin	0.045	528	0.100	363	0.069	1307	45.0	0.078	4.7
Pond2 Basin	0.045	1701	0.322	659	0.125	955	42.9	0.155	9.3
Lower Quarry - West	0.052	1885	0.357	1086	0.206	857	40.4	0.216	12.9
Lower Quarry	0.045	740	0.140	423	0.080	264	45.0	0.128	7.7
Lower Quarry - East	0.058	1531	0.290	804	0.152	1357	45.0	0.203	12.2
I-580	0.040	1935	0.366	1183	0.224	409	39.7	0.196	11.8
Mountain Blvd	0.046	3272	0.620	1990	0.377	682	30.6	0.234	14.1

[1] K-factor = 15.22 + 2.1464 * L + (8.6981 / L)

[2] Time Lag = K-factor * N * [(L * Lc) / (S ^0.5)] ^ 0.38

PWA

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Table 5. Time Lag Estimations, Proposed Developed Conditions

SubBasin	Basin "N"	Length, L (ft)	Length, L (mi)	Length to Centroid, Lc (ft)	Length to Centroid, Lc (mi)	Slope, S (ft/mi)	K-factor[1]	Time Lag[2] (hr)	Time Lag[2] (min)
Balance, 10/14/02									
Ridgemont1	0.023	3872	0.733	2216	0.420	817	28.7	0.118	7.1
Ridgemont2	0.060	1649	0.312	716	0.136	1825	43.7	0.190	11.4
Development	0.023	4581	0.868	2975	0.563	680	27.1	0.138	8.3
I-580	0.037	1466	0.278	938	0.178	540	45.0	0.161	9.6
Mountain Blvd	0.038	4160	0.788	2925	0.554	529	28.0	0.235	14.1
County, 10/13/02									
Ridgemont1	0.024	3953	0.749	1451	0.275	245	28.4	0.132	7.9
Ridgemont2	0.060	1739	0.329	877	0.166	1686	42.3	0.205	12.3
Development	0.028	4556	0.863	1522	0.288	727	27.2	0.128	7.7
I-580	0.046	1935	0.366	1183	0.224	409	39.7	0.226	13.5
Mountain Blvd	0.040	3272	0.620	1990	0.377	682	30.6	0.204	12.2

[1] K-factor = 15.22 + 2.1464 * L + (8.6981 / L)

[2] Time Lag = K-factor * N * [(L * Lc) / (S ^0.5)] ^ 0.38

Table 6. HEC-1 Results

		Storm	Balance July, 2001	ACFC 10/13/02	Balance 10/14/02	PWA recommended changes to Balance (10/14/02) model: Mtn. Blvd CN = 80; & Ponds 1&2, no initial vol.
Existing Conditions	Discharge, cfs	24-hr, 25-yr	276	181	167	158
		24-hr, 100-yr	368	233	214	212
Developed Conditions	Discharge, cfs (additional Ridgemont, 4.5ac)	24-hr, 25-yr	173	191	163	167
		24-hr, 100-yr	335	246	207	210
	Discharge, cfs (NO additional Ridgemont)	24-hr, 25-yr			162	
		24-hr, 100-yr			201	

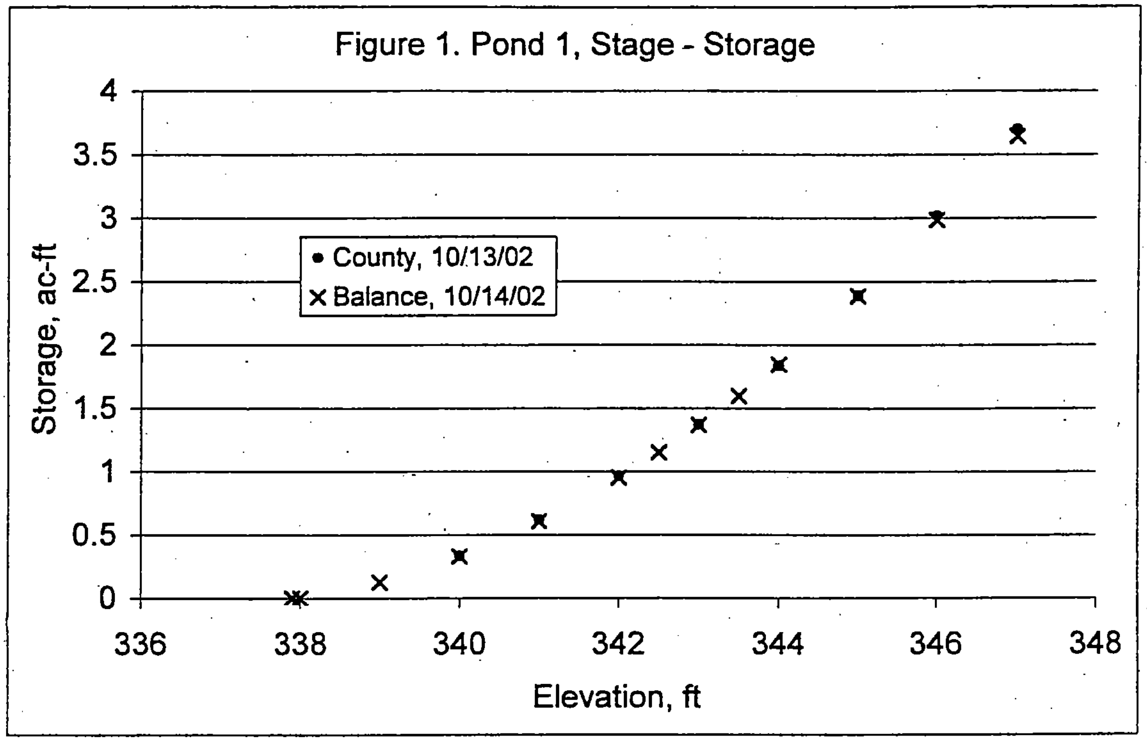


Figure 1. Pond 1, Stage - Storage
Storage, ac-ft
Elevation, ft
County, 10/13/02
Balance, 10/14/02
0
0.5
1
1.5
2
2.5
3
3.5
4
336
338
340
342
344
346
348

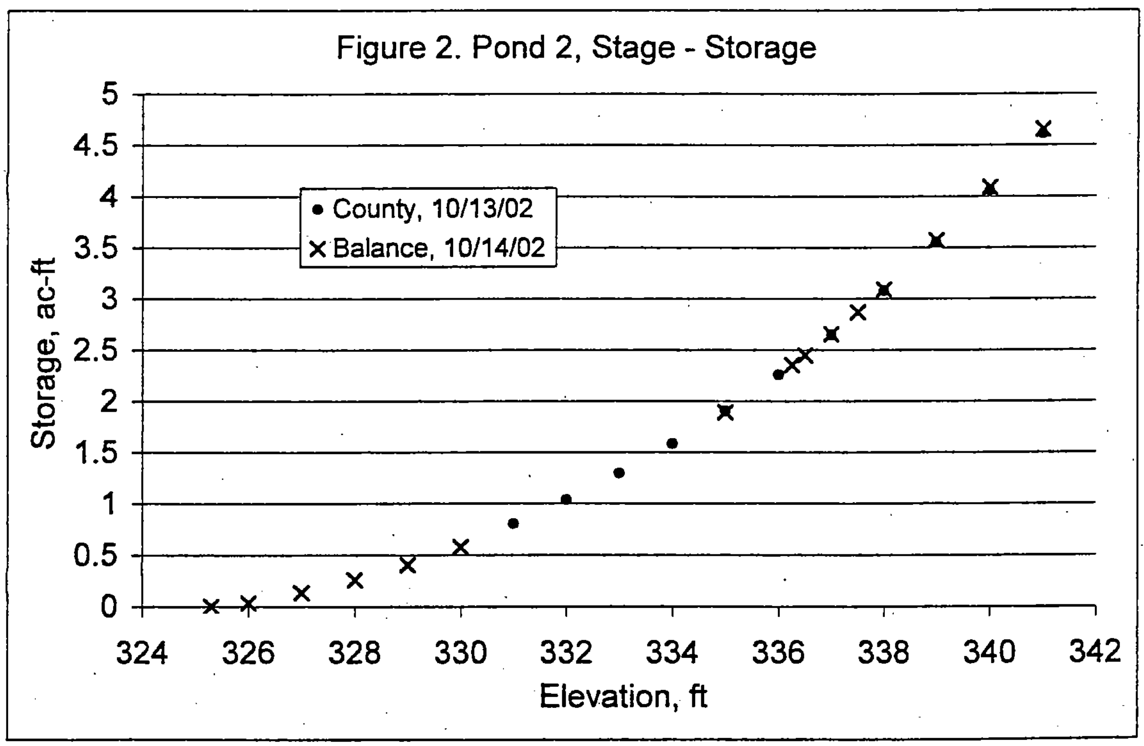
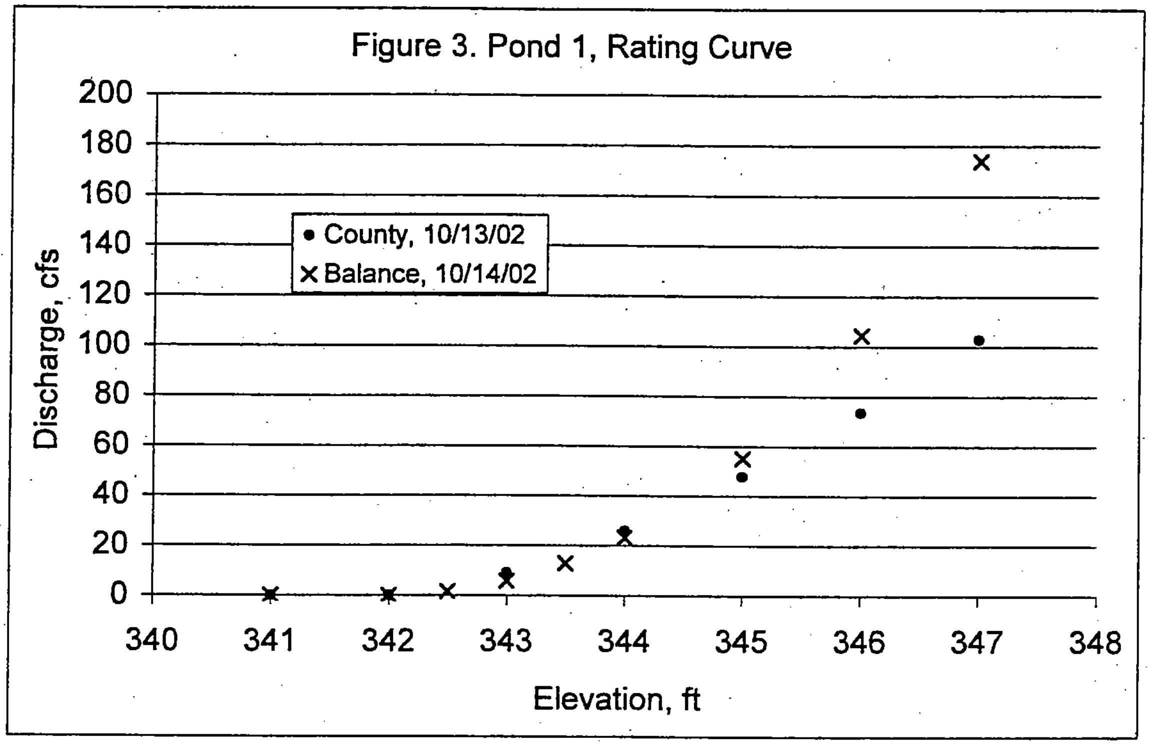
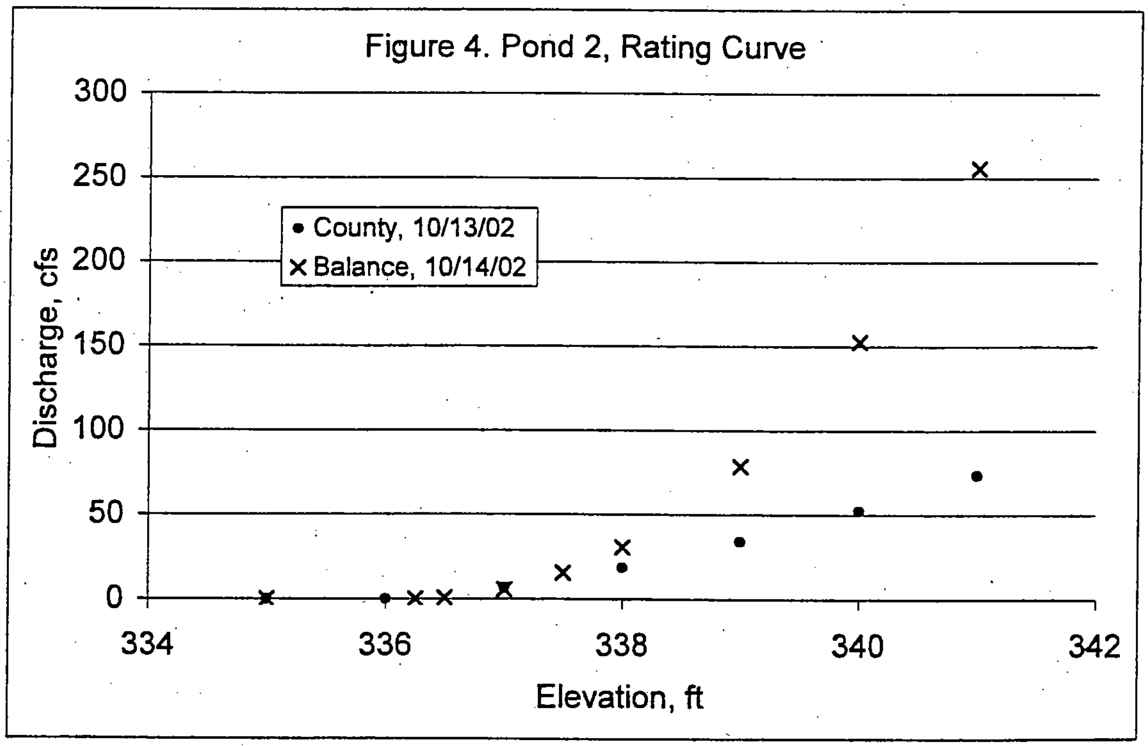


Figure 2. Pond 2, Stage - Storage
Storage, ac-ft
Elevation, ft
County, 10/13/02
Balance, 10/14/02
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
324
326
328
330
332
334
336
338
340
342





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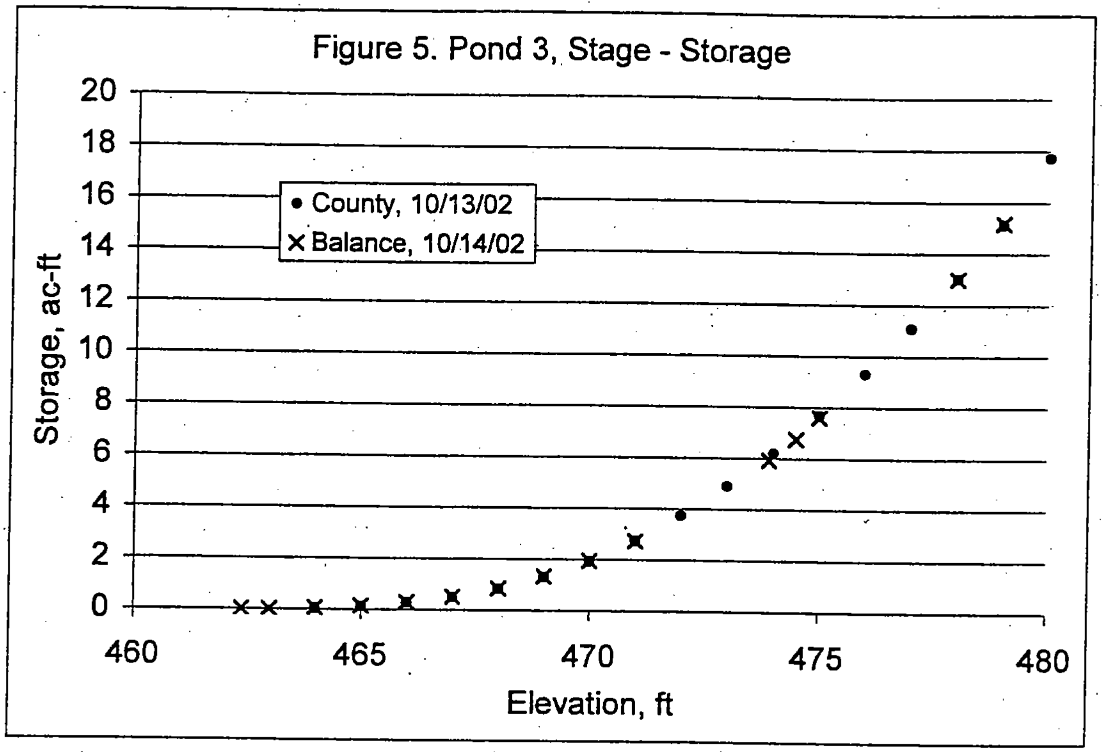

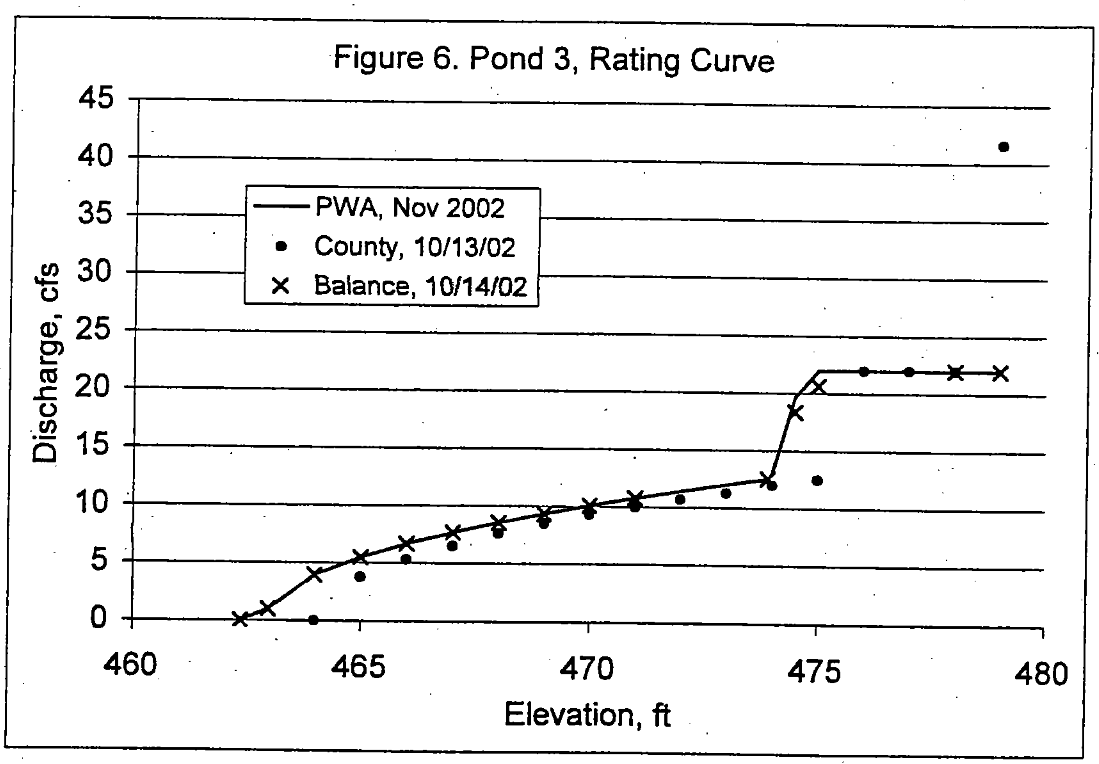

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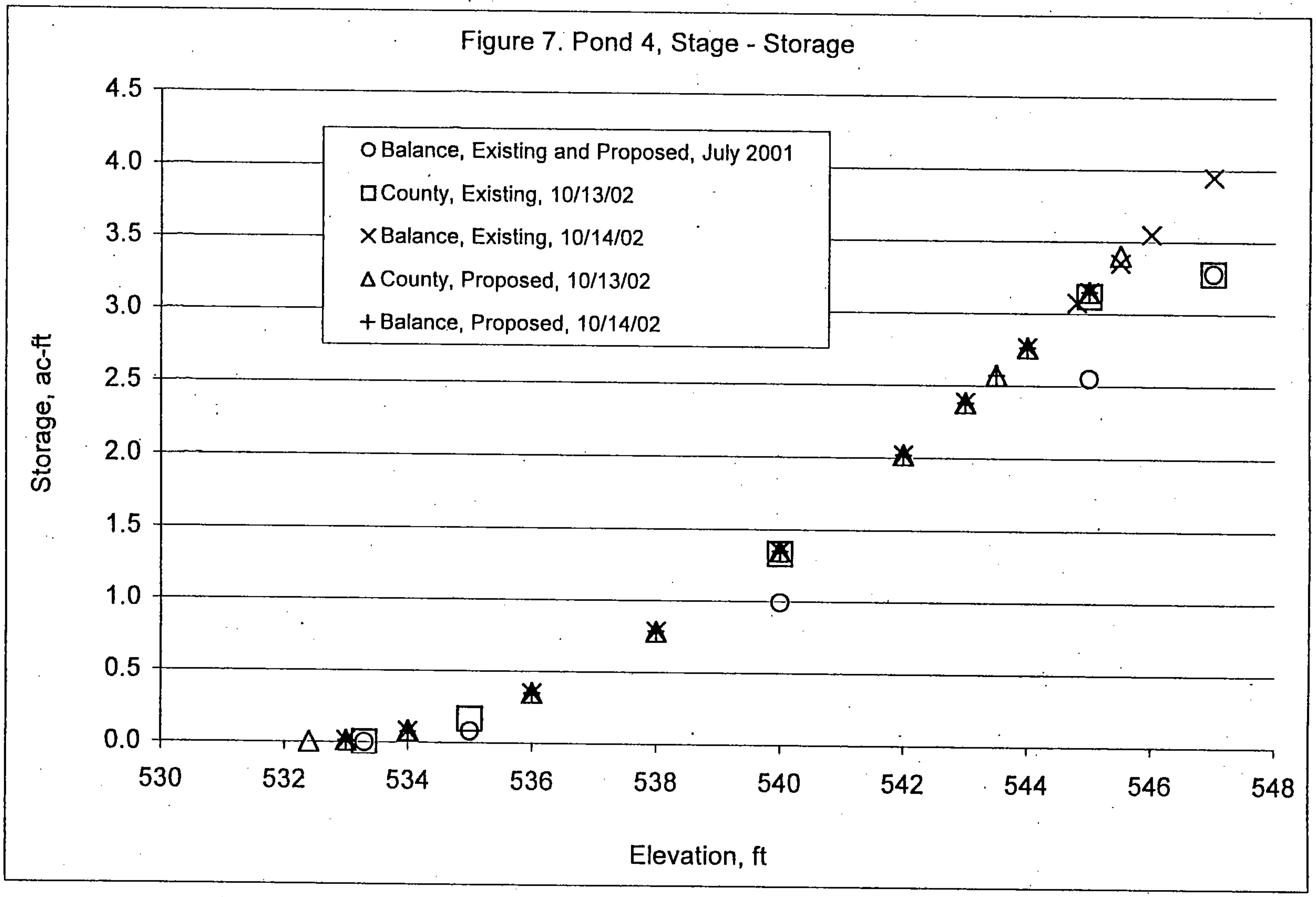

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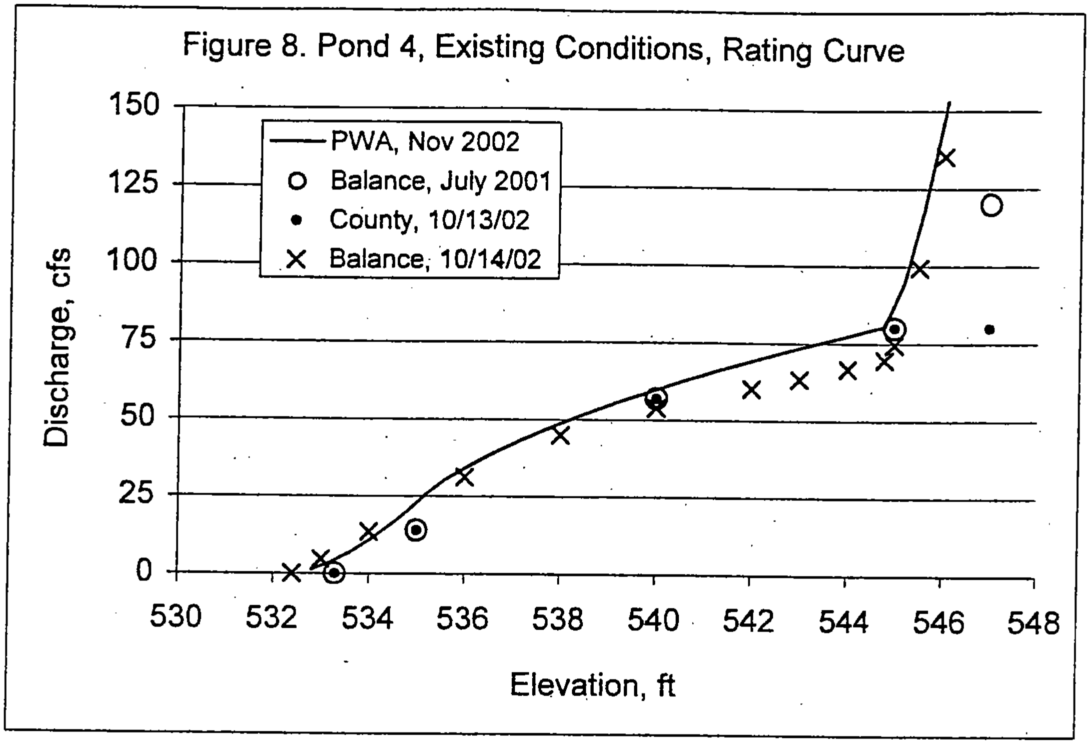

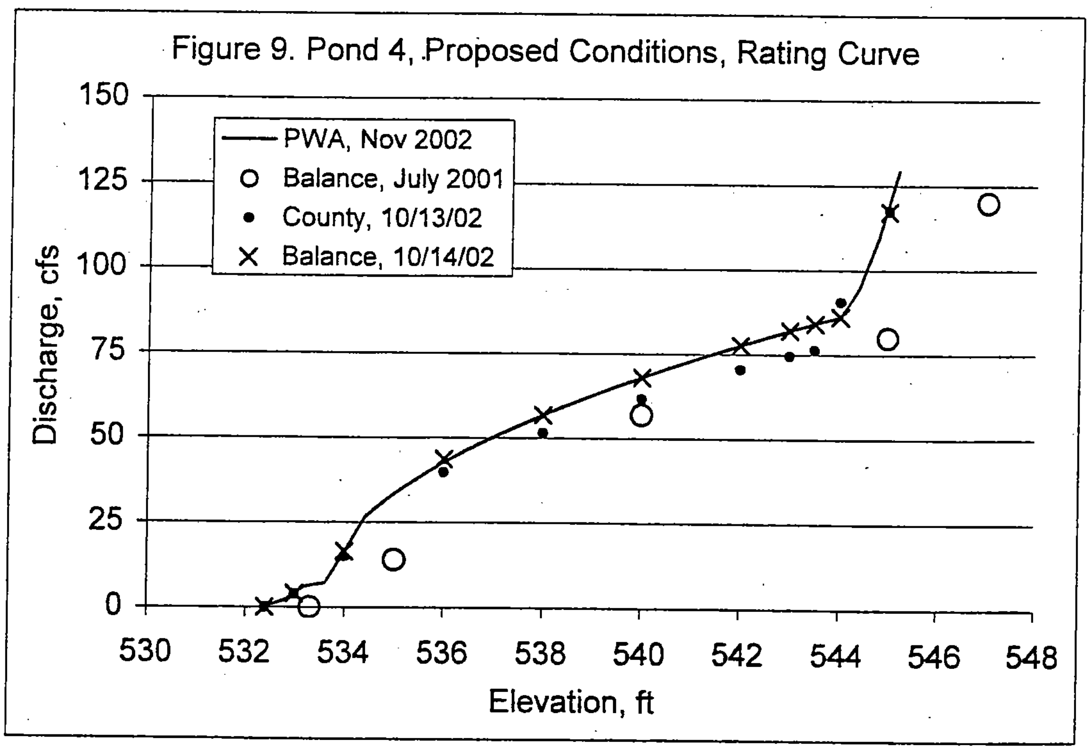

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Figure 10. Proposed Detention Basin, Stage - Storage

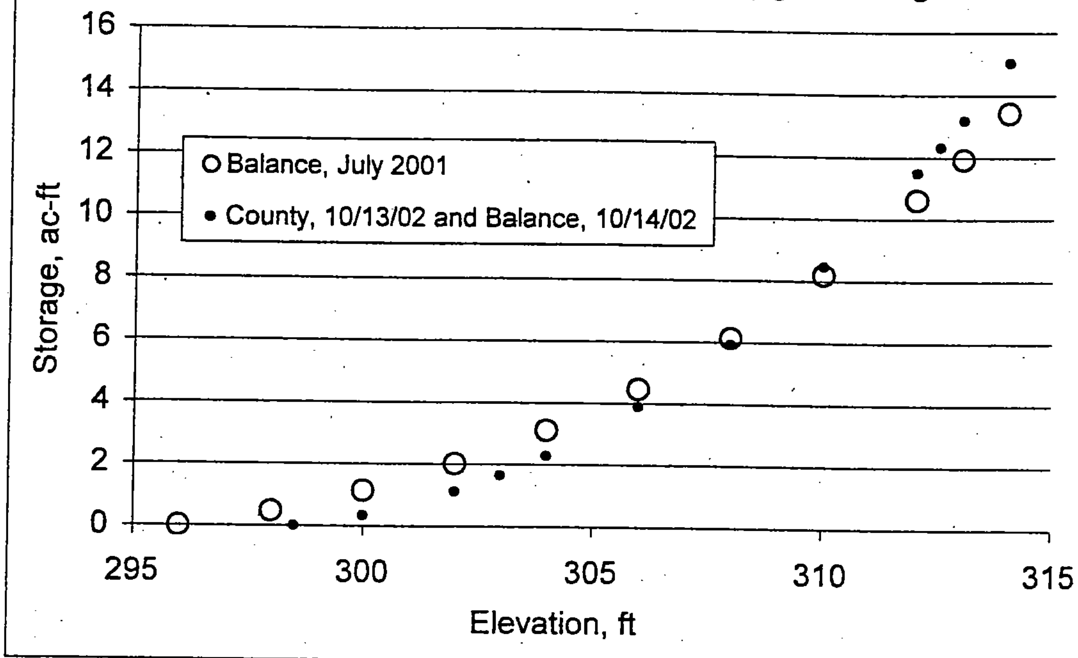
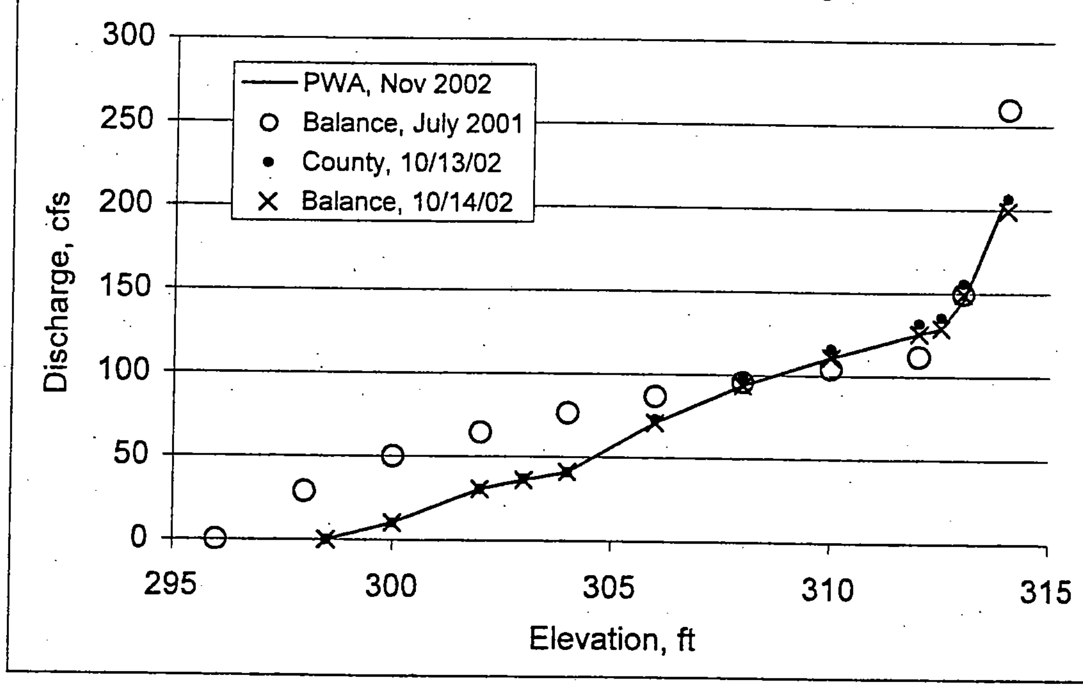


Figure 11. Proposed Detention Basin, Rating Curve



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APPENDIX D

PHILIP WILLIAMS & ASSOCIATES LTD. FINAL REPORT, OCTOBER 2003

LEONA QUARRY HYDROLOGIC REVIEW
PHASE TWO

Prepared for

City of Oakland
Public Works Agency

Prepared by

Philip Williams & Associates, Ltd.

October 21, 2003

PWA REF. # 1674

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10/21/03

LEONA QUARRY HYDROLOGIC REVIEW
PHASE TWO

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October 21, 2003

PWA REF. # 1674

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10/21/03

Services provided pursuant to this Agreement are intended solely for the use and benefit of the City of Oakland – Community and Economic Development Agency.

No other person or entity shall be entitled to rely on the services, opinions, recommendations, plans or specifications provided pursuant to this agreement without the express written consent of Philip Williams & Associates, Ltd., 720 California Street, 6th Floor, San Francisco, CA 94108.

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1. INTRODUCTION

The City of Oakland (City) retained Philip Williams & Associates (PWA) in Fall 2002 to provide support services related to hydrology and drainage issues for the proposed Leona Quarry development project (Project). PWA's scope of work included reviewing the hydrologic analysis performed on behalf of the DeSilva Group (Project developer) by Balance Hydrologics (BH), coordinating with Alameda County Flood Control and Water Conservation District (ACFCWCD or County), and providing input to the City as requested. The review performed by BH and by PWA evaluated the ability of the Leona Quarry drainage system to accommodate not only the storm flows caused by development of the Leona Quarry Project, but also a portion of the storm flows from the existing Ridgemont subdivision.

In November 2002, PWA published a report on an initial review (*Leona Quarry Hydrologic Review*; Phase 1) of the BH hydrologic analysis. Since the time of that report, changes have been made to the Project's proposed stormwater management system and BH has revised their calculations and hydrologic analysis to address CEQA requirements and to comply with the Project's conditions of approval. This report (Phase 2) provides an updated summary of our review of the revised BH calculations and hydrologic analysis, including a description of how the analysis has changed since the time of our first report in November 2002. In PWA's opinion, the BH proposed stormwater management system complies with the requirement that the project not worsen existing conditions; that is, post-Project peak flows from the site are equal to or less than existing peak flows for the chosen simulated storm events (24-hour, 2-, 5-, 10-, 25-, and 100-year events).

PWA has reviewed several versions of the stormwater system for Leona Quarry. Typical engineering practice is to develop a preliminary design for a stormwater management system, then refine the fundamental design and add details as the project progresses. Final design details of a stormwater management system typically are not developed before the final stages of project implementation, because it would be impractical to refine the details of a design before the preliminary, fundamental aspects of the design have been evaluated and certified as complying with applicable stormwater management criteria. PWA has reviewed the designs presented by BH as of Spring 2003. These designs are more detailed than are typically seen at this stage of project development, and include some details that are typically not seen until the time of final design. PWA has determined the adequacy of these designs to meet the criteria specified in this report. As is typical, the designs will be further refined and details will be added as the project progresses. In accordance with standard engineering practices, standard practices of the City of Oakland, and as typically required by conditions of approval, such as the previously adopted Condition of Approval 23, once the final details of the stormwater management system design are determined, they should be reviewed to confirm that the Project will not worsen existing conditions (as related to CEQA requirements) and will meet conditions of approval. PWA recommends that the City of Oakland coordinate with ACFCWCD to determine if the City should require specific criteria beyond the CEQA requirement that the Project not worsen existing conditions.

2. BACKGROUND

2.1 INITIAL REVIEW

PWA's initial work included review of hydrologic issues based on the BH report entitled *Analysis of Hydrologic Opportunities and Constraints at Leona Quarry, City of Oakland, California* (July 2001) and coordination with ACFCWCD. PWA conducted on-site reconnaissance (August 29, 2002) and reviewed the 2001 BH report as well as the calculations and hydrologic model on which the report was based. BH provided the calculations and hydrologic model to PWA at the request of City staff. The purpose of our review was to assess the appropriateness of the BH approach, analysis and conclusions to evaluate if the BH approach differed from the approach recommended by ACFCWCD and to determine whether the BH approach met professional standards for civil engineering and hydrology. PWA used the document entitled *Hydrology and Hydraulics Criteria Summary for Western Alameda County* (ACFCWCD, 1989) as the primary source for determining ACFCWCD hydrologic modeling standards. Other sources noted at the end of this report were used for other aspects of our review.

The preliminary results of the above review were conveyed to the City staff in early October 2002. In addition to the above in-house review, PWA recommended that the City work with ACFCWCD to clarify the hydrologic performance criteria that the Project should meet. ACFCWCD staff agreed to assist the City by providing technical input on the description of existing and future site hydrologic conditions and, in particular, the hydrologic parameters to be included in the computer simulation model. Hydrologic simulation results were assessed based on conformance with the CEQA criteria that the Project not worsen existing drainage problems, and the additional standard that redirected runoff from the existing Ridgemont subdivision not worsen existing drainage problems ("Not Worsen Criteria").

In October 2002, ACFCWCD, BH, PWA, and the City of Oakland sought agreement on the following modeling parameters:

- Subwatershed boundaries
- SCS Curve Numbers
- Time lag estimates
- Existing on-site detention storage

This latter point (amount and functioning of existing site detention storage) was one of the primary concerns initially expressed by ACFCWCD staff. ACFCWCD staff indicated concern whether the prior BH study accurately reflected existing site conditions with respect to existing on-site detention storage. In general, they noted the difference in total potential detention storage between existing conditions (approximately 21.8 acre-feet) and the Fall 2002 proposed post-Project preliminary detention estimate (approximately 18.2 acre-feet), although it was recognized that the proposed ponds would be designed to function much more efficiently and safely than the existing ponds (which had been constructed to facilitate sediment trapping desired for quarry operations and not as a flood detention system). Other concerns related to the method in which existing detention was characterized in the hydrologic model.

The intent of this analysis was to accurately and conservatively characterize the effectiveness of the existing site detention storage in reducing peak flood flows from the site.

BH agreed to run their model using the more conservative parameters recommended by ACFCWCD staff. BH ran their model using approximately 21.8 acre feet of existing on-site detention storage in four non-engineered ponds, with the outflow for each pond modeled as appropriate based on the outlet structure or weir dimensions.

In response to the process described above, BH indicated how use of the more conservative parameters would affect their prior hydrologic analysis and design proposal, and PWA reviewed the revised analysis in a November 2002 technical memo (PWA: *Leona Quarry Hydrologic Review*). In that memo, PWA reported that the hydrologic modeling methodology used by BH was generally consistent with published standards. PWA clarified which elements of the analysis represented consensus on methodology between the developer's proposal and the ACFCWCD published guidelines, and which elements were not in agreement. PWA noted some differences between modeling inputs used by BH and those suggested by ACFCWCD staff. PWA performed sensitivity analyses on these differences and identified three areas where the input parameter selection made a noticeable difference in the model results (detention pond initial storage volume, the watershed boundary determination near Mountain Boulevard, and the runoff curve number selection). These areas are discussed in detail in Chapter 3 of this report.

During fall 2002, ACFCWCD indicated that they would not formally comment further regarding the Project, since the City was the lead agency. ACFCWCD did, however provide a copy of their preliminary hydrologic model of the site to PWA for purposes of comparison with the BH modeling approach.

2.2 RECOMMENDATIONS

In the November 2002 review, PWA made recommendations to refine the analysis. PWA recommended that specific, more conservative parameters be used in the hydrologic analysis of both existing and post Project conditions. PWA noted however, that if the recommended parameters were used, the stormwater management system as it was then designed would not meet the Not Worsen Criteria requirement. PWA added that, in order to meet the Not Worsen Criteria, revisions to the proposed detention pond design and/or changes to the proposed detention pond outlet design may be required. PWA recommended that the City impose conditions of approval on the Project that require drainage design refinements during subsequent project review and approval in order to assure that the Project meets the Not Worsen Criteria and ACFCWCD guidelines.

During the Spring 2003, BH proposed additional refinements to the design (adding approximately 2.6 acre-feet of storage to the proposed detention basin) and analysis. PWA coordinated with BH on additional analysis issues and reviewed the spring 2003 BH proposal. Chapter 3 of this document summarizes our review of the Spring 2003 BH Leona Quarry hydrologic analysis and proposed stormwater system.

3. PWA REVIEW

The following sections summarize PWA's review of the revised BH modeling methodology as of September 2003. BH used ACFCWCD published hydrology guidelines (*Hydrology and Hydraulics Criteria Summary*, 1989) to model existing and post-Project peak flows. The basic tool used by BH to assess the hydrology of the Leona Quarry site was the HEC-1 computer model, developed by the US Army Corps of Engineers. This model is the standard computer model used for estimating storm runoff and evaluating flow management facilities such as detention ponds. HEC-1 is specifically approved by ACFCWCD for this type of analysis. In addition, it is the standard rainfall-runoff model approved for use by the federal government in conducting FEMA (Federal Emergency Management Agency) flood studies. HEC-1 estimates storm runoff from a design rainstorm using a variety of input parameters that characterize the site hydrology. Based on the estimated runoff, the model can also be used to estimate storage volume requirements for detention facilities. PWA applied HEC-1 to review the BH parameters used as input to the model for conformance with the ACFCWCD procedures and reviewed the model results.

The input parameters to the HEC-1 model are listed below, followed by a description of the review performed by PWA and our conclusions.

3.1 DESIGN STORM

The Project site watershed area is approximately 250 acres, and as such, the ACFCWCD Hydrology manual classifies the site as a "Primary Facility," having a "drainage area between fifty acres and ten square miles" (1989). The Project site is located in Western Alameda County Flood Control Zone 12. The ACFCWCD Hydrology manual recommends a 25-year design storm for Primary Facilities in Zone 12 (1989). The ACFCWCD Hydrology manual (1989) provides methodology for developing the recommended 25-year storm with duration of 24-hours in order to use the storm as input to the HEC-1 model. A 24-hour, 25-year storm is a storm that produces an amount of rainfall over 24 hours that occurs, on average, once every 25 years.

The 24-hour, 25- and 100-year design storms were selected for the analysis of existing and proposed site conditions, based on concurrence between ACFCWCD, BH, and PWA as described in the November 2002, PWA report. The 2-, 5-, and 10-year events were also included to assess the impacts of the proposed development given a wider range of storm events and to demonstrate compliance with the Not Worsen Criteria of no peak flow increase.

3.2 PRECIPITATION

ACFCWCD (1989) provides a method for estimating the depth of rainfall for a range of design storms based on the mean annual precipitation for a given location. The method provides a factor that is applied to the annual precipitation depth to calculate the design storm depth. The estimated factors for various events are as follows:

Event:	2-year	5-year	10-year	25-year	100-year
Factor:	0.0950	0.1340	0.1608	0.1944	0.2411

(ACFCWCD (1989) provides values for the 10-, 25-, and 100-year events, as shown above. The 2- and 5-year event values can be estimated using ACFCWCD's "Unit Mass Precipitation Curves" figure found in the ACFCWCD hydrology manual (1989); the 2- and 5-year event values shown above are reasonable based on that figure.)

ACFCWCD (1989) provides an isohyetal map that shows mean annual precipitation for all of western Alameda County. For comparison with the ACFCWD isohyetal map, PWA also checked data from the Upper San Leandro Filter Plant (USLFP) rain gage, which has been operated continuously by the East Bay Municipal Utility District since 1948 and is located approximately 0.5 miles from the Leona Quarry site. The mean annual rainfall at the USLFP gage as reported by the Western Regional Climate Center (wrcc.dri.edu) is 25.4 inches. It is reasonable to assume that precipitation may be slightly higher in the portions of the Leona Quarry watershed area that are higher in elevation than the location of the USLFP rain gage. Therefore the 26-inch annual rainfall estimated from the ACFCWCD isohyetal map would provide a reasonable estimate of annual precipitation. BH used 26 inches for their current HEC-1 analysis.

Applying the ACFCWD factors (see above) to the 26-inch annual average rainfall yields 24-hour, design storm rainfall depths as follows:

Event:	2-year	5-year	10-year	25-year	100-year
Depth (inches):	2.47	3.48	4.18	5.05	6.27

These were the values used by BH in their Spring 2003 HEC-1 analysis.

3.3 DRAINAGE AREA

HEC-1 applies the design storm rainfall to the area of the watershed in order to estimate rainfall over the area of interest. The boundaries of the watershed area are determined by topography and drainage infrastructure contributing runoff to the area of interest. Watershed areas are often sub-divided into sub-watersheds in order to provide a more detailed reflection of site drainage patterns and/or to generate peak flow estimates at particular locations (such as drainage infrastructure or stream confluences).

Using proposed development plans supplied by City Staff, topographic data provided by BH (10/10/02), aerial photos from ACFCWCD, USGS topographic data, and information from site visits, PWA assessed the appropriateness of the watershed boundaries identified by BH for use in the HEC-1 model. Complete topographic data for the Ridgemont Road and Mountain Boulevard areas were not included on the AutoCAD map provided by BH. ACFCWCD staff used USGS digital topographic data for these areas (ACFCWCD, 10/10/02). PWA used the ACFCWCD map to assess watershed boundaries in areas not covered by the AutoCAD map.

Based on topography, the Leona watershed can be separated into four major sub-watersheds: Ridgemont Road (north of the proposed development area), Leona Quarry (the proposed development area), I-580 (southeast of the proposed development area), and Mountain Boulevard (south of the proposed development area). All four of these areas ultimately drain to a 39-inch culvert under I-580. Runoff from the Ridgemont Road sub-basin first passes through the Leona Quarry sub-basin before reaching the I-580 culvert. The four major sub-watersheds were divided into smaller subbasins with similar characteristics to allow more accurate modeling. BH separated the Ridgemont Road area into two sub-watersheds to reflect a difference in land use. BH separated the Quarry area into six sub-watersheds for the model of existing conditions to reflect existing drainage patterns and detention facilities on the site. For proposed conditions, the development area was modeled as a single sub-watershed draining to the proposed detention pond. To reflect the City's desire that the Project accommodate some stormflows from existing Ridgemont subdivision, BH also added approximately 4.5 acres of residential area to the Ridgemont Road sub-watershed. Under the proposal, runoff from this area would be re-directed to the Ridgemont Road sub-watershed from its current flow path. PWA believes that the selection of sub-watersheds is appropriate to reflect site topography, drainage patterns and facilities.

In general, as shown in Table 1, the BH Fall 2002 sub-watershed delineations are similar to ACFCWCD delineations except in the case of the Mountain Boulevard sub-watershed. In Fall 2002, PWA conducted sensitivity analyses on delineation differences between BH and ACFCWCD by altering the sub-watershed parameters of the BH HEC-1 model to reflect ACFCWCD sub-watershed acreages and then re-running the BH model. The ACFCWCD delineation of the Mountain Boulevard sub-watershed includes approximately 10 acres along the eastern edge of the study area that BH did not include as of Fall 2002. The inclusion of a larger area in the subwatershed results in a larger peak discharge estimated by the model for the Mountain Boulevard area in the ACFCWCD model.

In the November 2002 memo, PWA indicated agreement with the BH delineation in three of the four subwatersheds; however, the PWA report recommended that the more conservative Mountain Boulevard delineation be used. Following the November memo, PWA staff conducted site reconnaissance of the Mountain Boulevard sub-watershed. Based on that reconnaissance, PWA and BH reached consensus on the area estimate to use for this more conservative analysis (see Table 1). The Mountain Boulevard sub-watershed area change was incorporated into the hydrology model after ACFCWCD indicated that they would no longer formally comment on the Project (see above).

3.4 SCS CURVE NUMBER

The Curve Number is a parameter developed by the USDA Soil Conservation Service (SCS, now Natural Resource Conservation Service) to characterize infiltration characteristics of land areas. The SCS method is approved by ACFCWCD for hydrologic analysis. Based on aerial photographs, the proposed development plans, and site reconnaissance, PWA selected curve numbers to describe each of the existing and proposed land use types, and then weighted the curve numbers based on land use acreages in order to calculate an overall curve number for each sub-watershed. Tables 2, 3, and 4 show curve number estimates for existing and developed conditions.

In Fall 2002, PWA conducted sensitivity analyses on curve number differences between BH and ACFCWCD by altering the curve number parameters of the BH HEC-1 model to reflect ACFCWCD sub-watershed curve numbers and then re-running the BH model. There were no material differences in peak discharge for most of the sub-watersheds. However, a material increase to total watershed peak discharge occurred when the Mountain Boulevard sub-watershed curve number was changed from the curve number estimated by BH to that estimated by ACFCWCD. Because the selection of different curve numbers had a significant impact on model results, PWA used the USDA National Engineering Handbook (1985) (per ACFCWCD guidelines) to independently estimate a curve number for the Mountain Boulevard residential area, as documented in Tables 2 and 3. PWA calculated a composite curve number for the Mountain Boulevard sub-watershed of 80, which slightly increases the design storm total watershed peak discharge for both existing and proposed conditions over the BH estimate.

Subsequent to the PWA Fall 2002 memo, BH and PWA agreed to run the HEC-1 model using the more conservative ACFCWCD estimates of curve numbers. Due to the sensitivity analysis described above regarding the Mountain Boulevard sub-watershed curve number estimate, BH conducted a more detailed land use and soil type analysis thereby setting the curve number to 85.3 and 85.7 for existing and proposed conditions, respectively, as compared to the ACFCWCD estimate of 87 (see Table 4). This represents a minor difference, and PWA concurs that this adjustment represents a more refined assessment of actual site conditions for the Leona Quarry Project, based on the Alameda County Soil Survey (USDA, 1975) and PWA site reconnaissance following the Fall 2002 hydrologic review. However, model results do not change significantly when the refined curve number estimates (85.3 and 85.7) are used versus the ACFCWCD estimate of 87; therefore, all ACFCWCD curve number estimates, including the Mountain Blvd. sub-watershed estimate of 87, are used in the current HEC-1 model.

3.5 INITIAL LOSS

The initial loss parameter quantifies the amount of rainfall that is stored in small surface depressions, intercepted by vegetation etc. and therefore does not contribute to runoff for a given storm. BH uses the HEC-1 default method to calculate initial loss. This represents conformance with ACFCWCD methodology.

3.6 TIME LAG

The time lag calculation estimates the time required for runoff to reach the point where peak flows are being estimated. Inputs to the calculation include overland flow resistance, length of the runoff flow paths, and change in elevation. ACFCWCD recommends estimating a weighted overland flow resistance coefficient (or composite Manning's "n" value) based on resistance values assigned by ACFCWCD to various land categories (Saleh, 11/12/02). The composite n-value is then input to the ACFCWCD time lag equation, which also requires the total length of the sub-watershed flow path, the length from the bottom of the sub-watershed to the centroid, and the slope of the sub-watershed. BH and ACFCWCD time lag values are shown in Tables 5 and 6.

While significant differences appear to exist between BH and ACFCWCD time lag estimates, PWA found that those differences do not significantly impact the model results. In Fall 2002, PWA conducted sensitivity analyses on the time lag component of BH 24-hour, 25- and 100-year HEC-1 models for both existing and proposed conditions and found that time lag differences—in combination or singularly—did not materially change model results.

In April 2003, ACFCWCD staff confirmed that the time lag estimates BH had used in its 2002 analysis reflected current ACFCWCD guidelines. BH used ACFCWCD (10/12/02) input parameters for calculating the time lag estimates, with the exception of the Mountain Boulevard area, which was changed as discussed above. PWA concurs that the general methodology and the refinement of the time lag values are appropriate. Tables 5 and 6 show the time lag values used in the revised BH HEC-1 model (Spring 2003).

3.7 DETENTION PONDS

Our review of the site hydrologic functioning included review of the existing conditions and proposed detention facilities, site visits, and coordination with the ACFCWCD and BH to develop consensus on the methods for modeling the existing and future conditions.

Detention ponds can have the effect of reducing the rate of discharge from one point in the watershed to the next point further downstream. Detention pond size and outlet structure configuration, among other factors, control the discharge rate. Detention ponds can be used to offset the impact of flooding by reducing discharge rates to levels below that which may be damaging to downstream structures and/or facilities.

For detention pond analyses, HEC-1 calculates the volume of water stored in a detention pond of given dimensions based on the calculated storm runoff (inflow) in combination with a stage-discharge curve or rating curve (outflow) provided by the user. The rating curve indicates the amount of flow ("discharge") that will be leaving the pond when the water is at any given depth ("stage") in the pond. Stage-discharge relationships are calculated based on standard hydraulic equations for pipes, weirs and/or orifices, depending on the configuration of the pond outlet. PWA reviewed BH's analysis of storage and discharge for the five ponds: four existing ponds (ponds 1 – 4), and one proposed detention pond.

A stage-storage curve or table for a pond shows the volume of water stored in that pond that corresponds to any given pond depth. To assess the stage–storage relationship of the existing ponds, PWA compared surveyed data of each pond to the volume estimations assumed by BH. BH's pond volume and stage-storage relationship estimations for the existing ponds appear reasonable based on topographic data received from BH.

3.7.1 Ponds 1 and 2: Lower Ponds

Ponds 1 and 2 are existing ponds located in the lower, southwestern portion of the proposed development site. Ponds 1 and 2 would be removed under the proposed Project design. BH and ACFCWCD stage–storage relationships for Ponds 1 and 2 are almost identical (Figures 1 and 2). Per BH survey data, Pond 1 has a maximum volume of 3.35 acre-feet, and Pond 2 has a maximum volume of 4.38 acre-feet. Neither ACFCWCD nor BH found existing outlet structures at either pond. According to BH survey data, Pond 1 outflows via a non-engineered spillway, below which the pond retains 0.95 acre-feet of storage. Similarly, Pond 2 outflows via spillway, below which the pond retains 2.35 acre-feet of storage. BH and ACFCWCD used slightly different methods to estimate a stage-discharge curve based on assumptions regarding flow over the spillway, resulting in slightly different curves (Figure 3 and 4). Both methods appear reasonable. As the results are essentially the same, PWA does not recommend any changes to BH's rating curves. Neither pond has a low elevation outlet to drain the pond quickly following a storm event. Water below the spillway elevation exits the ponds via seepage and evaporation.

At the time of the November 2002 PWA memo, there was one significant difference between the BH and ACFCWCD approaches for modeling Ponds 1 and 2. In the existing conditions HEC-1 model, BH assumed that Ponds 1 and 2 were initially full of water up to the spillway crest elevations, thereby retaining 0.95 acre-feet and 2.35 acre-feet, respectively. The reasoning was that the design rainstorm would likely not be the first storm of the wet season, and the ponds would already be filled by prior minor storms to the spillway elevation at the beginning of the design storm. ACFCWCD recommended that the ponds be considered initially empty, so that the full pond storage volume below the spillway is available to store water from the design storm. Assuming that the ponds are initially empty results in a more conservative characterization of existing site conditions. In the November 2002 memo, PWA concurred with this more conservative assumption, recommending that Ponds 1 and 2 should be considered initially empty. The spring 2003 BH model reflects that recommendation.

3.7.2 Pond 3: Large Upper Pond

Pond 3 is the existing pond located in the east-central portion of the proposed development site. Pond 3 would be removed under the proposed Project design. Figure 5 shows the stage–storage relationship of the proposed pond. BH estimates that Pond 3 has a detention volume of 14.27 acre-feet. The exact details of the existing outlet structure are not known because much of the structure is covered by rock. BH and ACFCWCD assume that the pond outlet structure can be modeled as an 18-inch riser with a 12-inch circular orifice, whereby flow is limited to 22 cubic-feet per second by the 18-inch corrugated metal outlet pipe. The limiting flow parameter (22 cfs) appears reasonable based on the assumed outlet dimensions. Based on the above assumptions for Pond 3, PWA calculated a rating curve, which roughly agrees with BH's curve (Figure 6). The assumptions for Pond 3 and the related calculations appear reasonable.

3.7.3 Pond 4: Small Upper Detention Pond

Pond 4 is the existing pond located at the west-central corner of the proposed development site. BH's estimates of the storage volume and associated stage-storage relationship of Pond 4 (Figure 7) appear reasonable based on the footprint of the pond. BH estimates that Pond 4, under existing conditions, has a detention volume of 3.07 acre-feet. PWA generated a stage-discharge relationship using standard equations for pipe hydraulics based on the existing 30-inch corrugated metal pipe outlet and assuming a 15-foot weir spillway if the pond is overtopped. The rating curve generated by PWA approximately agrees with that used by BH (Figure 8).

Under the current development proposal, Pond 4 would remain and the Pond 4 outlet works would be improved. BH estimates that Pond 4 improvements would result in a slight detention storage increase, from 3.07 acre-feet to 3.15 acre-feet. BH models the outflow under proposed conditions assuming a single drop box (the perimeter would be comparable to that of a 36-inch riser) with one rectangular orifice (2.75 ft x 2.00 ft). BH's model assumes that all flow up to and including the 100-year flow would pass through the new drop box. Given the outlet dimensions specified by BH for future conditions, PWA verified the Pond 4 rating curve (without spillway) for the developed scenario (Figure 9). It should be recognized that the existing 30-inch outlet pipe would not have the capacity to handle the flow from the proposed 36-inch riser/orifice structure. BH reports that the applicant plans to replace this pipe with a 42-inch pipe, which appears adequate. PWA assumes that the proposed riser/orifice structure would dictate the limit of outflow and, as such, existing Pond 4 outlet structures, including the existing 30-inch outlet pipe, would also be replaced as necessary. This was required by Condition of Approval 23, and is consistent with standard engineering practice, and would be expected to be imposed as a condition of project approval. PWA assumes that the 42-inch outlet pipe would discharge directly to the proposed detention pond (see below), which would further control stormwater flows from Pond 4.

The Quarry operators constructed Pond 4 at some time in the past. We are not aware of any engineering design plans, construction plans, or specifications to document the construction practices. A geotechnical engineer should therefore inspect the pond levees and proposed Project changes to verify structural integrity for future, ongoing use. This is required by Condition of Approval 23h and is consistent with standard engineering practice.

3.7.4 Proposed Detention Pond

In assessing the proposed detention pond, it is PWA's understanding that BH sought to develop a detention pond design that would contain the design storm (24-hour, 25-year event) such that all storm runoff from the Project site, including the 4.5 acres of the Ridgemont subdivision and the Mountain Boulevard sub-watershed described above, would drain through the existing 39-inch culvert that passes under the I-580 freeway, and would satisfy the Not Worsen Criteria for the chosen range of storms (24-hour, 2-, 5-, 10-, 25-, and 100-year storms).

In November 2002, BH proposed a pond detention storage capacity of 13.2 acre-feet, maintaining one foot of freeboard (15.0 acre-feet total detention capacity when full). The plan has been refined to provide a proposed detention storage capacity of 15.6 acre-feet of water volume, maintaining one foot of freeboard (resulting in total capacity greater than 17 acre-feet). The BH model assumes that the proposed detention basin will maintain 3:1 internal side slopes (same as November 2002) and a four-foot northern (uphill side, adjacent to proposed homes) retaining wall of approximately 700 linear feet (this was added to the design subsequent to the November 2002 review). As of November 2002, BH projected the bottom and top proposed pond elevations to be 298.5 and 314.0 feet, respectively, and assumed a single outlet box with a perimeter comparable to that of a 48-inch riser at an elevation of 312.5 feet and two rectangular orifices (lower orifice 2 ft by 2 ft with flowline elevation at 298.5 ft, and upper orifice 2.25 ft by 2 ft with flowline elevation at 304.0 ft). As of Spring 2003, BH models the proposed pond outlet assuming bottom and top elevations at 296.0 and 315.5 feet, respectively, and assuming a single outlet box with a perimeter comparable to that of a 42-inch riser at an elevation of 313.5 feet and two rectangular orifices (lower orifice 2 ft by 2 ft with flowline elevation at 299.0 ft, and upper orifice 1.75 ft by 2 ft with flowline elevation at 307.0 ft). Currently, BH assumes that the lowermost three feet of the proposed pond would be reserved for water quality improvement, and the 15.6 acre-foot detention capacity of the pond does not include these bottom three feet.

Figure 10 shows the stage–storage relationship of the proposed pond. As is commonly the case, the precise stage–storage relationship and rating curve for the proposed detention pond cannot be known until the final design of the pond outlet is complete. The outlet structure included in the plans BH submitted in Spring 2003 is designed to limit peak discharge for the 25-year design storm to within the estimated capacity of the 39-inch pipe (see below). Based on the design assumptions described above, PWA verified the BH rating curve (Figure 11). The HEC-1 model confirms that the proposed detention pond would return to its original water surface elevation within 24 hours after cessation of the 100-year, 24-hour rain storm, as required by ACFCWCD. The HEC-1 model also indicates that the 100-year, 24-hour hour rain storm would yield a peak stage of approximately 314.5 feet in the proposed detention basin (corresponding to the proposed volume of 15.6 acre-feet, while maintaining one foot of freeboard). PWA recommends that the proposed detention basin be designed so as not to structurally fail in the event of a 24-hour, 100-year storm event; therefore, PWA recommends that appropriate engineers (for example, geotechnical engineer and/or civil engineer) review the final design of the proposed detention basin as a Project condition of approval.

The capacity of the storm drain system downstream of the Project site, including the I-580 39-inch culvert, has been estimated "on the order of 180 cfs" by ACFCWCD staff (Balance Hydrologics, 2001). BH estimated that the I-580 culvert has a maximum non-pressurized flow capacity of 172 cfs based on a Manning's pipe flow analysis. It is standard engineering practice to determine precisely how the proposed Project stormwater system (including the detention pond, the proposed pond outlet structure, the junction box between the proposed pond and the I-580 culvert, and all connections to and from the junction box) will accommodate the constraints of downstream facilities during the final design stages. The final design details of the stormwater system should be reviewed to confirm the conclusions of this report; the review should include a detailed hydraulic evaluation of this junction point in the context of upstream and downstream facilities and conditions. This analysis would be used to determine the flow characteristics under which post-project flows will be released. The flow characteristics are controlled by the final design of the outlet structure, its configuration and its connection to the junction box. This analysis would therefore be used to confirm that the Project (as discussed herein) would not worsen the peak flow rates and that applicable ACFCWCD and City of Oakland stormwater management requirements would be met.

4. MODEL RESULTS/CONCLUSIONS

As of June 2003, PWA had reviewed the refined plans proposed by BH (Spring 2003), including the input parameters and assumptions to be used in the Project analysis. In PWA's opinion, all parameters and assumptions used to design the stormwater management system (as indicated by BH), including the 15.6 acre-foot proposed detention pond capacity, comply with standard engineering practice. Table 7 summarizes peak stormwater flows before and after Project development as shown in current PWA Leona watershed HEC-1 peak flow model results. These are based on input parameters recommended by PWA, including the parameter that characterizes existing conditions of Ponds 1 and 2 being initially empty.

The existing Project site detention capacity, including ponds 1 – 4, is approximately 21.8 acre-feet. However, existing Project site detention facilities were not engineered to handle stormwater flow from a housing development. As of November 2002, the proposed Project site detention, including Pond 4 (after proposed improvements) and the proposed detention basin, was approximately 18.2 acre-feet. As of Spring 2003, the proposed Project site detention was approximately 20.8 acre-feet.

The model results indicate that the refined stormwater management system, with the 15.6 acre-foot proposed detention pond capacity (total capacity greater than 17 acre-feet due to freeboard requirements), complies with the Not Worsen Criteria. However, PWA recommends that a detailed hydraulic analysis, which would take into account hydraulic conditions (head and tailwater conditions) both upstream and downstream of the I-580 culvert as described above, be conducted as the proposed stormwater management system is refined and finalized during the design phase. Based on the current analysis, it should be noted that the 39-inch pipe is not adequate to handle the estimated 100-year discharge under either existing conditions or post-development conditions. The model results also indicate that the refined stormwater management system, with the 15.6 acre-foot proposed detention pond capacity, will maintain post-Project, 100-year, 24-hour peak flow from the site at a rate equal to or less than the existing peak flow from the 100-year, 24-hour design storm.

5. ADDITIONAL SITE OPPORTUNITIES

Given the current status of the Project review and design process, there is benefit in maintaining some flexibility regarding the exact volume and design specifications of the proposed detention pond. It is recognized that the area available for this pond is constrained. The proposed detention pond footprint can be maintained while altering various pond design specifications to vary detention capacity, such as varying the internal side slopes or making the pond deeper. While a detailed analysis of the exact stage-storage-discharge relationship would be necessary in order to provide precise design specifications, and the feasibility of increasing the proposed detention pond size, both hydraulically and geotechnically, would require detailed analysis before further consideration, our preliminary estimate is that the design of the proposed detention pond could be increased without disrupting the Project site plan.

6. SOURCES

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Table 1. Sub-watershed Delineation

	Sub-watershed	Area, square miles: BH, 10/14/02	County, 10/13/02	BH, July, 2003
Existing Conditions	Ridgemont1	0.078	0.087	0.078
	Ridgemont2	0.041	0.043	0.041
	Upper Quarry	0.078	0.078	0.078
	Pond1 Basin	0.006	0.006	0.006
	Pond2 Basin	0.019	0.019	0.019
	Lower Quarry - West	0.031	0.030	0.031
	Lower Quarry	0.010	0.010	0.010
	Lower Quarry - East	0.009	0.009	0.009
	I-580	0.011	0.014	0.011
	Mountain Blvd	0.075	0.093	0.080
	Total	**0.358**	**0.389**	**0.363**
Developed Conditions	Ridgemont1	0.085	0.087	0.085
	Ridgemont2	0.041	0.043	0.041
	Development	0.152	0.159	0.152
	I-580	0.011	0.010	0.011
	Mountain Blvd	0.078	0.093	0.083
	Total	**0.367**	**0.392**	**0.372**

Table 2. Curve Number Estimations, Existing Conditions

	Curve Number	Ridge-mont1, %	Ridge-mont2, %	Upper Quarry, %	Pond1 Basin, %	Pond2 Basin, %	Lower Quarry West, %	Lower Quarry, %	Lower Quarry East, %	Mtn Blvd, %	I-580, %
County, 10/13/02											
Wooded, fair	79.0	40.0	100.0				15.0		90.0	20.0	55.0
Residential	89.0	45.0								80.0	
Dirt cover	89.0			100.0	100.0	100.0	78.0	98.0	10.0		
Hard surface	92.0	15.0					7.0	2.0			45.0
Total %		100	100	100	100	100	100	100	100	100	100
Weighted Curve Number		**85.5**	**79.0**	**89.0**	**89.0**	**89.0**	**87.7**	**89.1**	**80.0**	**87.0**	**84.9**
BH, 10/14/02[1]											
Wooded, fair	79.0	20.6	98.9				31.5		89.3	49.4	60.3
Residential, 1/4 acre lots	87.0	79.4					2.0				
Residential, 1/3 acre lots[2]	72.0									47.9	
Detention basin	98.0		1.1	0.4	7.3	3.3					
Dirt cover	89.0			99.6	92.7	96.7	41.1	39.1			
Gravel road	91.0						18.3	45.3			
Paved surfaces	98.0						7.1	15.6	10.7	2.7	39.7
Total %		100	100	100	100	100	100	100	100	100	100
Weighted Curve Number		**85.4**	**79.2**	**89.0**	**89.7**	**89.3**	**86.8**	**91.3**	**81.0**	**76.2**	**86.5**
PWA, November 2002											
Wooded, fair	79.0	35.0	99.0				20.0		85.0	30.0	45.0
Residential (D soil type)	89.0	60.0					2.0			20.0	
Residential (B soil type)	77.0									50.0	
Detention basin	98.0		1.0	1.0	6.0	3.0					
Dirt cover	89.0			99.0	94.0	97.0	60.0	75.0	10.0		10.0
Hard surface	92.0	5.0					18.0	25.0	5.0		45.0
Total %		100	100	100	100	100	100	100	100	100	100
Weighted Curve Number		**85.7**	**79.2**	**89.1**	**89.5**	**89.3**	**87.5**	**89.8**	**80.7**	**80.0**	**85.9**

[1]BH chose to use County (10/12/02) curve numbers for the current model (as of July, 2003).
[2]BH (10/14/02) selected a curve number for Mtn. Blvd. 1/3-acre lots based on group B soils.

PWA

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Table 3. Curve Number Estimations, Proposed Developed Conditions

	Curve Number	Ridge-mont1, %	Ridge-mont2, %	Quarry, %	Mtn Blvd, %	I-580, %
County, 10/13/02						
Wooded, fair	79.0	40.0	100.0		20.0	55.0
Residential	89.0	45.0			80.0	
Dirt cover	89.0					
Newly graded open space	89.0			80.0		
Hard surface	92.0	15.0				45.0
Impervious area	98.0			20.0		
Total %		100	100	100	100	100
Weighted Curve Number		**85.5**	**79.0**	**90.8**	**87.0**	**84.9**
BH, 10/14/02[1]						
Wooded, fair	79.0	18.9	98.9	5.5	47.5	62.5
Residential, rowhouses	92.0			40.9		
Residential, 1/4 acre lots	87.0	81.1		2.6		
Residential, 1/3 acre lots[2]	72.0				46.3	
Detention basin	98.0		1.1	1.1		
Dirt cover	89.0			11.6		
Gravel road	91.0					
Paved surfaces	98.0				2.6	37.5
Restored slope areas	89.0			38.2		
Commercial	95.0				3.8	
Total %		100	100	100	100	100
Weighted Curve Number		**85.5**	**79.2**	**89.7**	**76.9**	**86.1**
PWA, November 2002						
Wooded, fair	79.0	35.0	99.0		30.0	45.0
Residential (D soil type)	89.0	60.0		55.0	20.0	
Residential (B soil type)	77.0				50.0	
Graded/Restored slopes	92.0			35.0		
Detention basin	98.0		1.0	1.0		
Dirt cover	89.0			9.0		10.0
Hard surface	92.0	5.0				45.0
Total %		100	100	100	100	100
Weighted Curve Number		**85.7**	**79.2**	**90.1**	**80.0**	**85.9**

[1]BH chose to use County curve numbers (10/13/02) for the current model (as of July, 2003).
[2]BH (10/14/02) selected a curve number for Mtn. Blvd. 1/3-acre lots based on group B soils.

Table 4. Balance Hydrologics Mountain Blvd. Curve Number Estimations

Existing Conditions:	Area, mi^2	Soil Group	CN
Grassland, range, poor	0.0156	D	89
Residential at top	0.0039	D	89
Wooded, fair	0.0156	D	79
Residential Mayhem	0.0156	D	89
Residential Xerorthents	0.0191	B	81
Residential Millsholm/Mayhem	0.0068	D	89
Residential Los Gatos	0.0014	C	87
I-580 I	0.0014	n.a.	98
I-580 II	0.0006	n.a.	98
Total	0.0801		
Weighted Curve Number			85.3

Proposed Developed Conditions:	Area, mi^2	Soil Group	CN
Grassland, range, poor	0.0156	D	89
Residential at top	0.0039	D	89
Wooded, fair	0.0156	D	79
Residential Mayhem	0.0156	D	89
Residential Xerorthents	0.0191	B	81
Residential Millsholm/Mayhem	0.0068	D	89
Residential Los Gatos	0.0014	C	87
I-580 I	0.0014	n.a.	98
I-580 II	0.0006	n.a.	98
Leona Gateway, commercial	0.0029	D	95
Total	0.0829		
Weighted Curve Number			85.7

BH chose to use County curve numbers (10/13/02) for the current model (as of July, 2003).

Table 5. Time Lag Estimations, Existing Conditions

SubBasin	Basin "N"	Length, L (ft)	Length, L (mi)	Length to Centroid, Lc (ft)	Length to Centroid, Lc (mi)	Slope, S (ft/mi)	K-factor[1]	Time Lag[2] (hr)	Time Lag[2] (min)
County, 10/13/02									
Ridgemont1	0.024	3953	0.749	1451	0.275	245	28.4	0.132	7.9
Ridgemont2	0.060	1739	0.329	877	0.166	1686	42.3	0.205	12.3
Upper Quarry	0.045	2138	0.405	900	0.170	1315	37.6	0.156	9.4
Pond1 Basin	0.045	528	0.100	363	0.069	1307	45.0	0.078	4.7
Pond2 Basin	0.045	1701	0.322	659	0.125	955	42.9	0.155	9.3
Lower Quarry - West	0.052	1885	0.357	1086	0.206	857	40.4	0.216	12.9
Lower Quarry	0.045	740	0.140	423	0.080	264	45.0	0.128	7.7
Lower Quarry - East	0.058	1531	0.290	804	0.152	1357	45.0	0.203	12.2
I-580	0.040	1935	0.366	1183	0.224	409	39.7	0.196	11.8
Mountain Blvd	0.046	3272	0.620	1990	0.377	682	30.6	0.234	14.1
BH, 10/14/02									
Ridgemont1	0.023	3872	0.733	2216	0.420	817	28.7	0.118	7.1
Ridgemont2	0.060	1649	0.312	716	0.136	1825	43.7	0.190	11.4
Upper Quarry	0.045	1985	0.376	858	0.163	1402	39.2	0.154	9.2
Pond1 Basin	0.045	503	0.095	327	0.062	1214	45.0	0.075	4.5
Pond2 Basin	0.045	1485	0.281	460	0.087	1126	45.0	0.130	7.8
Lower Quarry - West	0.045	1890	0.358	1047	0.198	869	40.3	0.183	11.0
Lower Quarry	0.041	746	0.141	449	0.085	228	45.0	0.123	7.4
Lower Quarry - East	0.057	1474	0.279	508	0.096	1419	45.0	0.163	9.8
I-580	0.037	1466	0.278	938	0.178	540	47.1	0.168	10.1
Mountain Blvd	0.038	4160	0.788	2925	0.554	529	28.0	0.235	14.1
BH, Spring 2003									
Ridgemont1	0.024	3953	0.749	1451	0.275	245	28.5	0.132	7.9
Ridgemont2	0.060	1739	0.329	877	0.166	1686	30.0	0.145	8.7
Upper Quarry	0.045	2138	0.405	900	0.170	1315	30.0	0.125	7.5
Pond1 Basin	0.045	528	0.100	363	0.069	1307	30.0	0.052	3.1
Pond2 Basin	0.045	1701	0.322	659	0.125	955	30.0	0.108	6.5
Lower Quarry - West	0.052	1885	0.357	1086	0.206	857	30.0	0.160	9.6
Lower Quarry	0.045	740	0.140	423	0.080	264	30.0	0.085	5.1
Lower Quarry - East	0.058	1531	0.290	804	0.152	1357	30.0	0.135	8.1
I-580	0.040	1935	0.366	1183	0.224	409	30.0	0.148	8.9
Mountain Blvd	0.046	3272	0.620	1990	0.377	682	30.0	0.230	13.8

[1] Fall 2002 ACFCWCD K-factor = 15.22 + 2.1464 * L + (8.6981 / L); Spring ACFCWCD 2003 K-factor = 15.22 + 2.15 * (8.7 / L)
[2] ACFCWCD Time Lag = K-factor * N * [(L * Lc) / (S ^0.5)] ^0.38

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Table 6. Time Lag Estimations, Proposed Developed Conditions

SubBasin	Basin "N"	Length, L (ft)	Length, L (mi)	Length to Centroid, Lc (ft)	Length to Centroid, Lc (mi)	Slope, S (ft/mi)	K-factor[1]	Time Lag[2] (hr)	Time Lag[2] (min)
County, 10/13/02									
Ridgemont1	0.024	3953	0.749	1451	0.275	245	28.4	0.132	7.9
Ridgemont2	0.060	1739	0.329	877	0.166	1686	42.3	0.205	12.3
Development	0.028	4556	0.863	1522	0.288	727	27.2	0.128	7.7
I-580	0.040	1935	0.366	1183	0.224	409	39.7	0.196	11.8
Mountain Blvd	0.046	3272	0.620	1990	0.377	682	30.6	0.234	14.1
BH, 10/14/02									
Ridgemont1	0.023	3872	0.733	2216	0.420	817	28.7	0.118	7.1
Ridgemont2	0.060	1649	0.312	716	0.136	1825	43.7	0.190	11.4
Development	0.023	4581	0.868	2975	0.563	680	27.1	0.138	8.3
I-580	0.037	1466	0.278	938	0.178	540	45.0	0.161	9.6
Mountain Blvd	0.038	4160	0.788	2925	0.554	529	28.0	0.235	14.1
BH, Spring 2003									
Ridgemont1	0.024	3953	0.749	1451	0.275	245	28	0.132	7.9
Ridgemont2	0.060	1739	0.329	877	0.166	1686	30	0.145	8.7
Development	0.028	4556	0.863	1522	0.288	727	27	0.128	7.7
I-580	0.040	1935	0.366	1183	0.224	409	30	0.148	8.9
Mountain Blvd	0.046	3272	0.620	1990	0.377	682	30	0.230	13.8

[1] Fall 2002 K-factor = 15.22 + 2.1464 * L + (8.6981 / L); Spring 2003 K-factor = 15.22 + 2.15 * (8.7 / L)

[2] Time Lag = K-factor * N * [(L * Lc) / (S ^0.5)] ^ 0.38

Table 7. HEC-1 Results

		Storm	BH July, 2001	County 10/13/02	BH 10/14/02	PWA November 20, 2002, recommended changes to BH (10/14/02) model: Mtn. Blvd. CN = 80; & Ponds 1&2, no initial vol.	BH Spring 2003
Existing Conditions	Discharge, cfs	24-hr, 2-yr					71
		24-hr, 5-yr					112
		24-hr, 10-yr					139
		24-hr, 25-yr	276	181	167	158	168
		24-hr, 100-yr	368	233	214	212	224
Developed Conditions	Discharge, cfs (additional Ridgemont, 4.5ac)	24-hr, 2-yr					70
		24-hr, 5-yr					112
		24-hr, 10-yr					137
		24-hr, 25-yr	173	191	163	167	163
		24-hr, 100-yr	335	246	207	210	224
	Discharge, cfs (NO additional Ridgemont)	24-hr, 25-yr			162		
		24-hr, 100-yr			201		

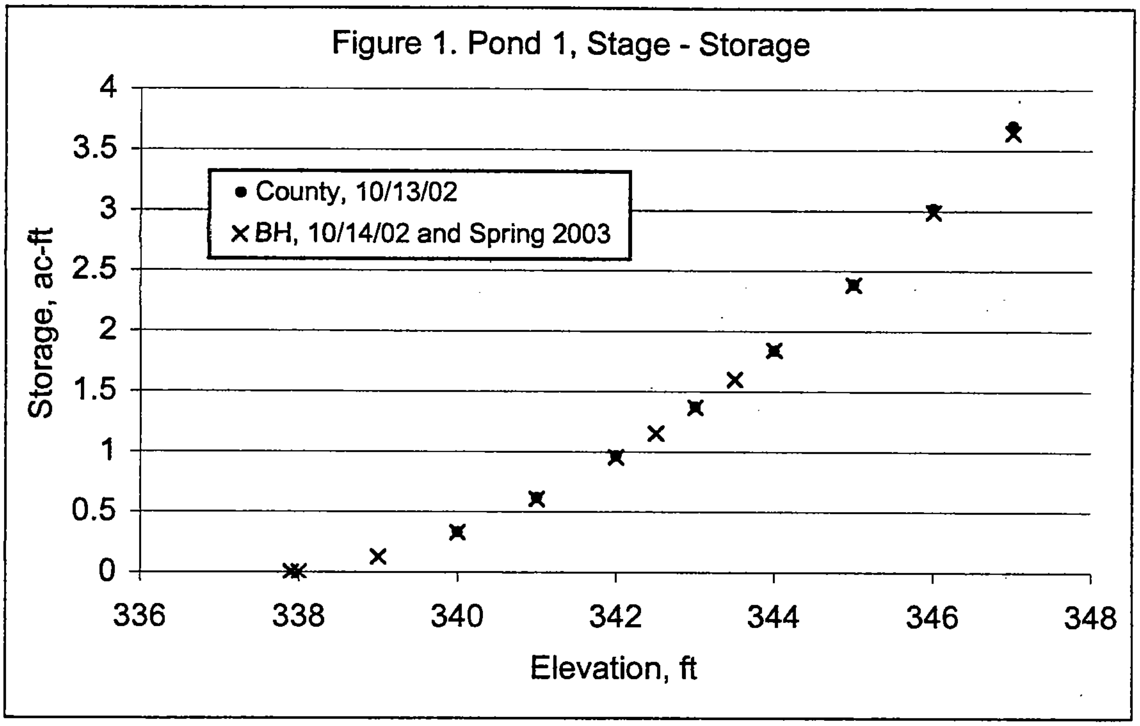


Figure 1. Pond 1, Stage - Storage
4
3.5
3
2.5
2
1.5
1
0.5
0
Storage, ac-ft
County, 10/13/02
BH, 10/14/02 and Spring 2003
336
338
340
342
344
346
348
Elevation, ft

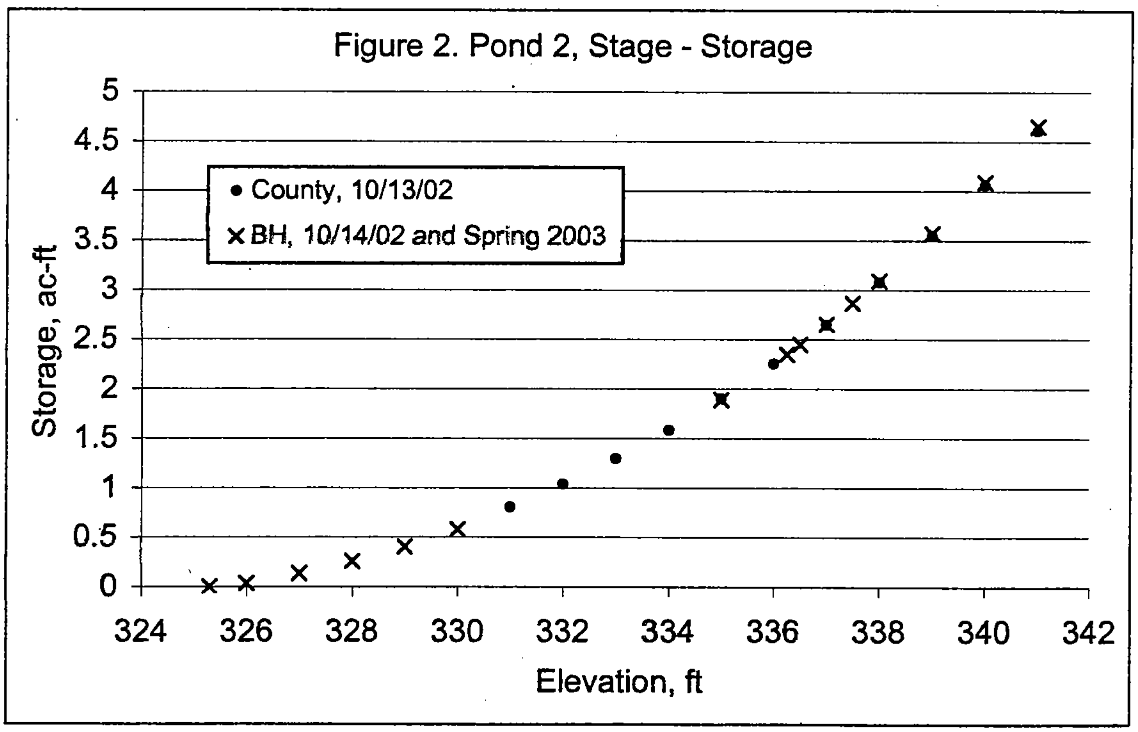


Figure 2. Pond 2, Stage - Storage
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Storage, ac-ft
County, 10/13/02
BH, 10/14/02 and Spring 2003
324
326
328
330
332
334
336
338
340
342
Elevation, ft

PWA

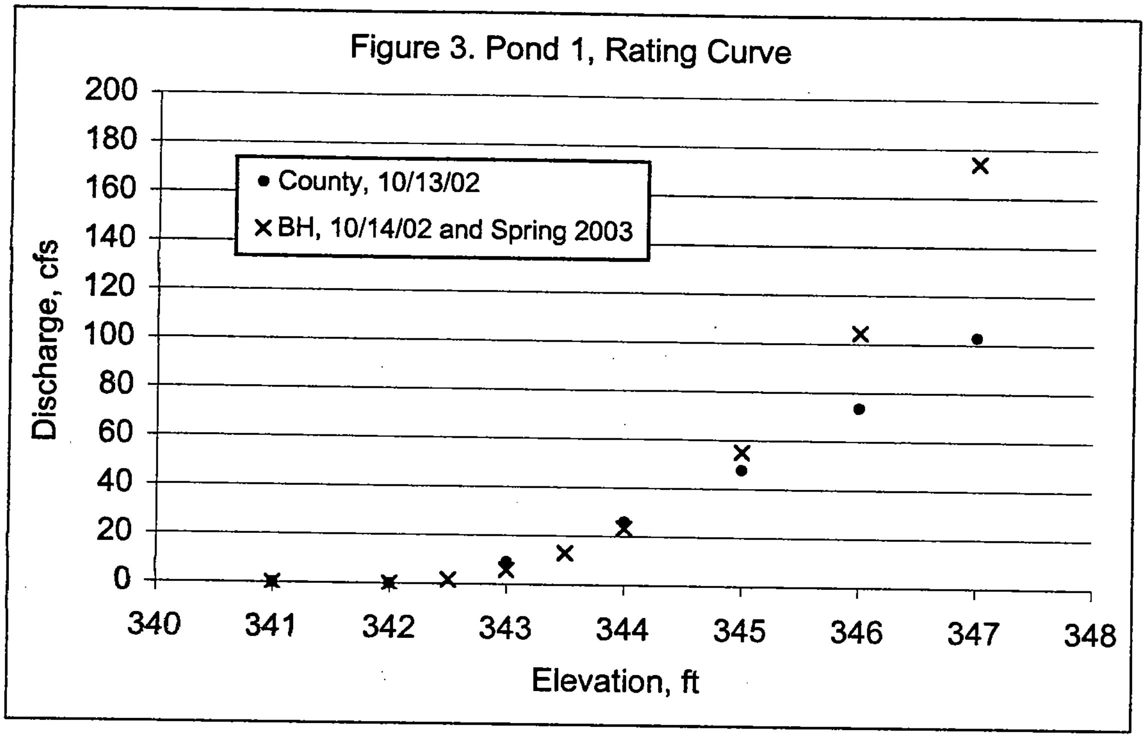


Figure 3. Pond 1, Rating Curve
200
180
160
140
120
100
80
60
40
20
0
Discharge, cfs
• County, 10/13/02
× BH, 10/14/02 and Spring 2003
340
341
342
343
344
345
346
347
348
Elevation, ft

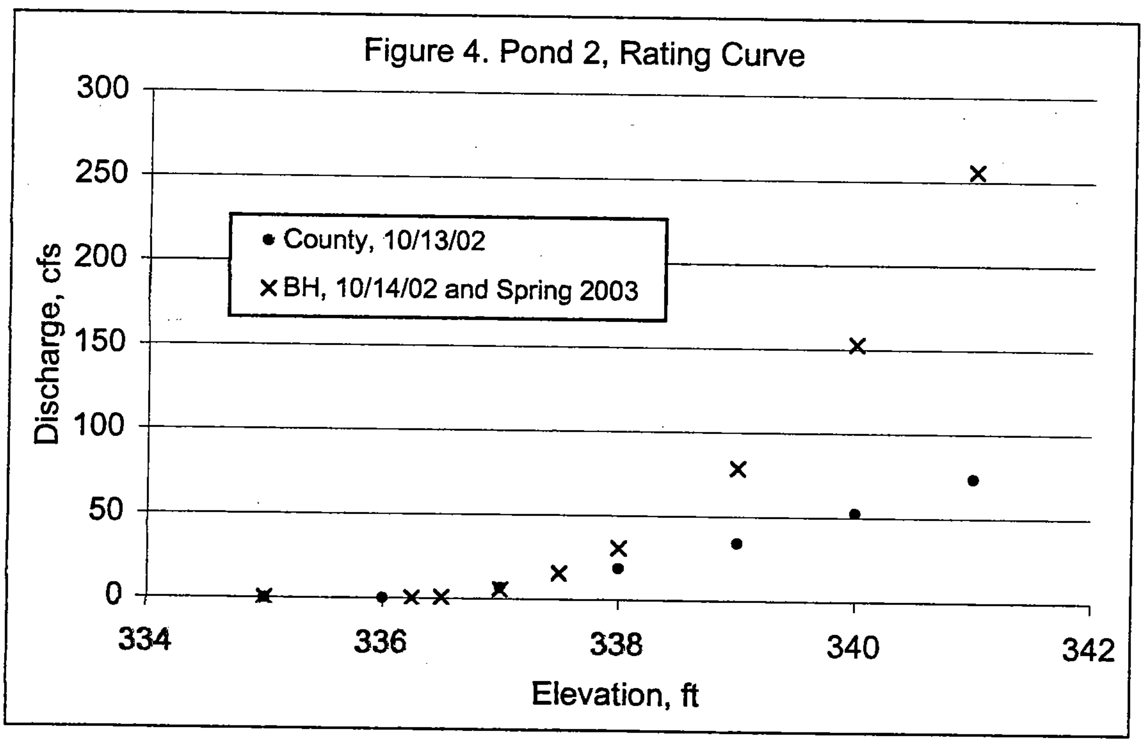


Figure 4. Pond 2, Rating Curve
300
250
200
150
100
50
0
Discharge, cfs
• County, 10/13/02
× BH, 10/14/02 and Spring 2003
334
336
338
340
342
Elevation, ft

PWA

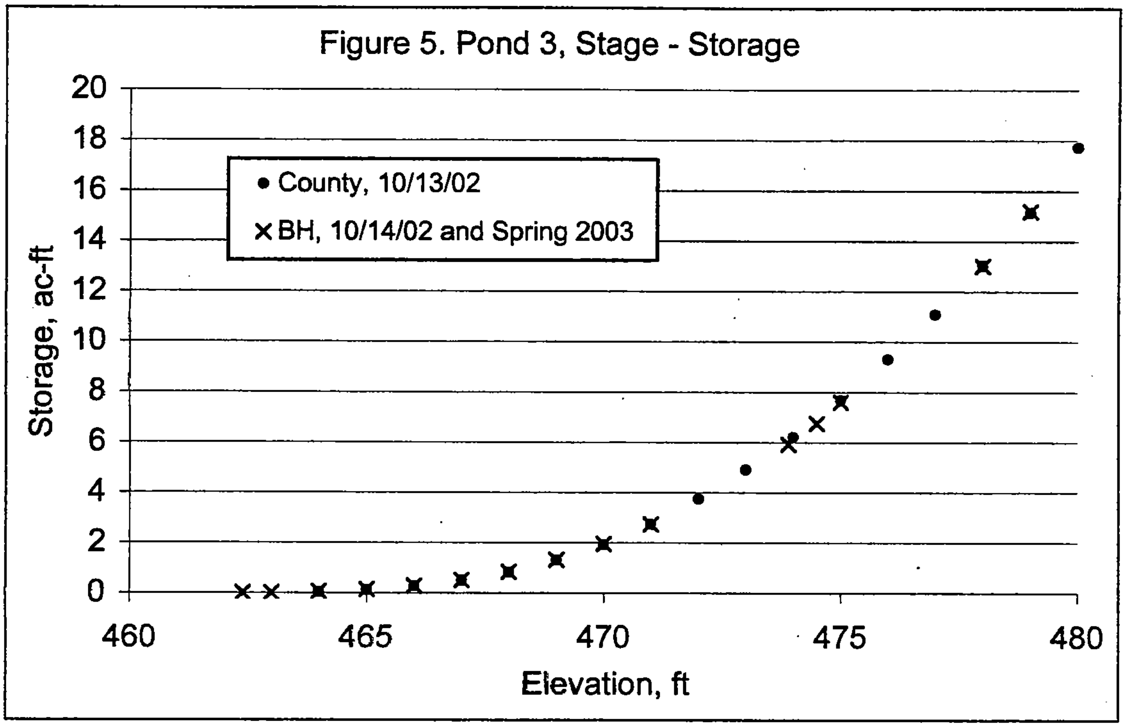


Figure 5. Pond 3, Stage - Storage
County, 10/13/02
BH, 10/14/02 and Spring 2003
Storage, ac-ft
Elevation, ft
0
2
4
6
8
10
12
14
16
18
20
460
465
470
475
480

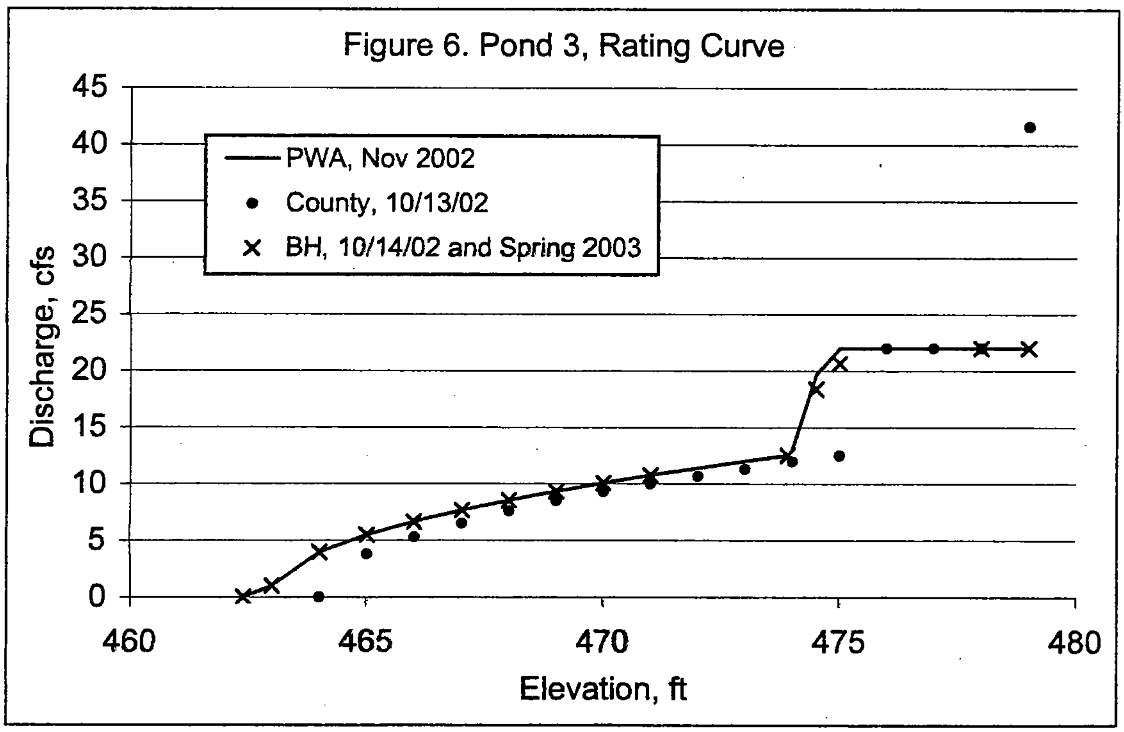
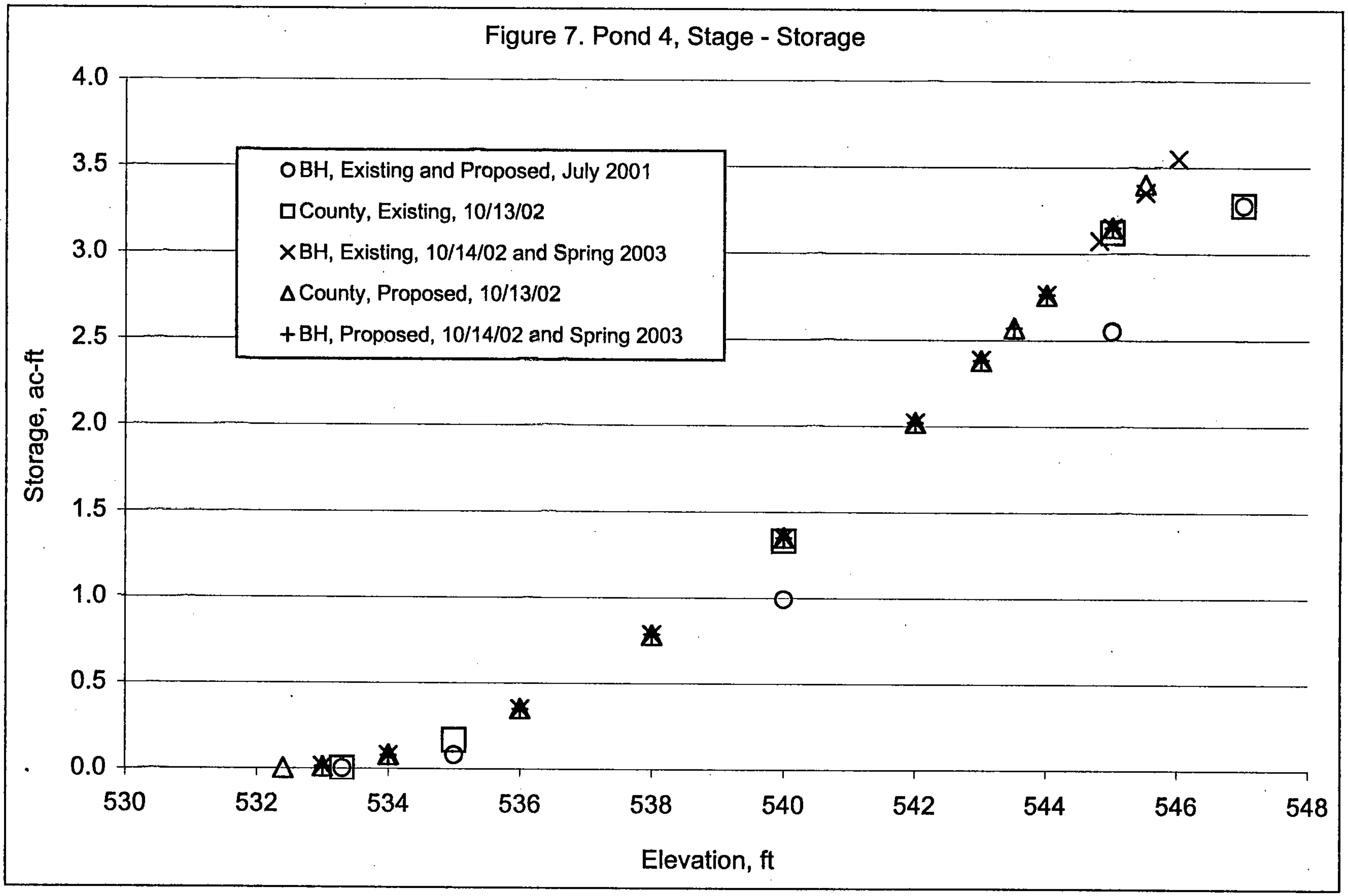


Figure 6. Pond 3, Rating Curve
PWA, Nov 2002
County, 10/13/02
BH, 10/14/02 and Spring 2003
Discharge, cfs
Elevation, ft
0
5
10
15
20
25
30
35
40
45
460
465
470
475
480



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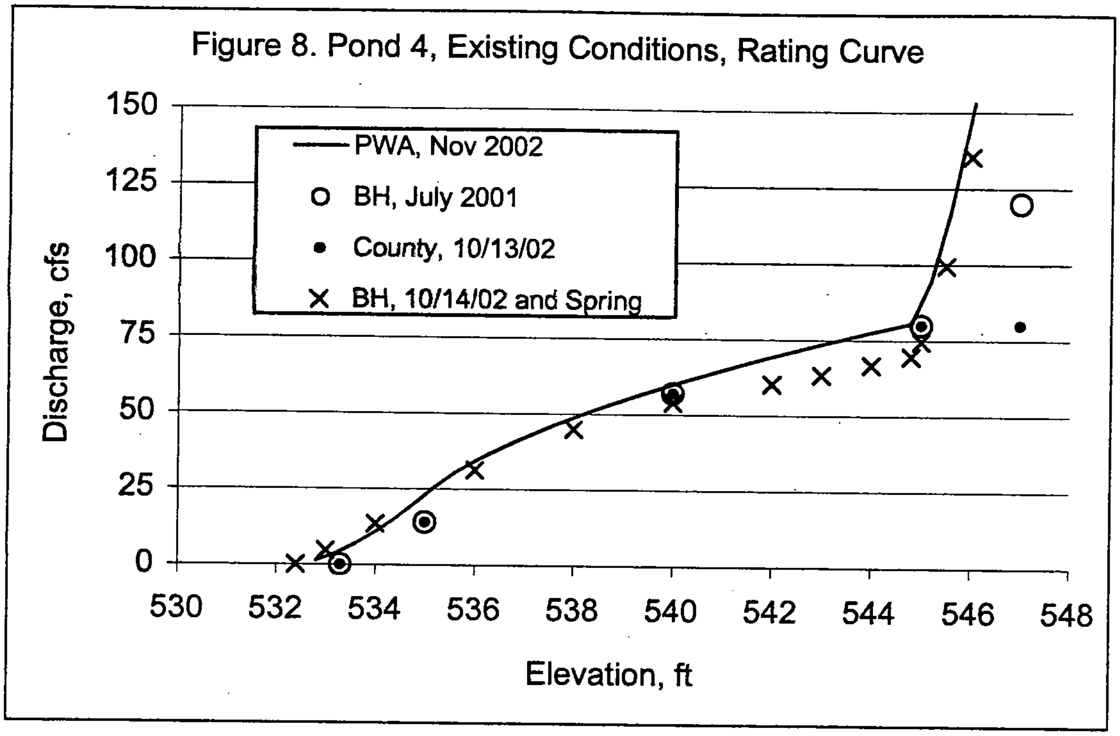


Figure 8. Pond 4, Existing Conditions, Rating Curve
PWA, Nov 2002
BH, July 2001
County, 10/13/02
BH, 10/14/02 and Spring
Discharge, cfs
150
125
100
75
50
25
0
530
532
534
536
538
540
542
544
546
548
Elevation, ft

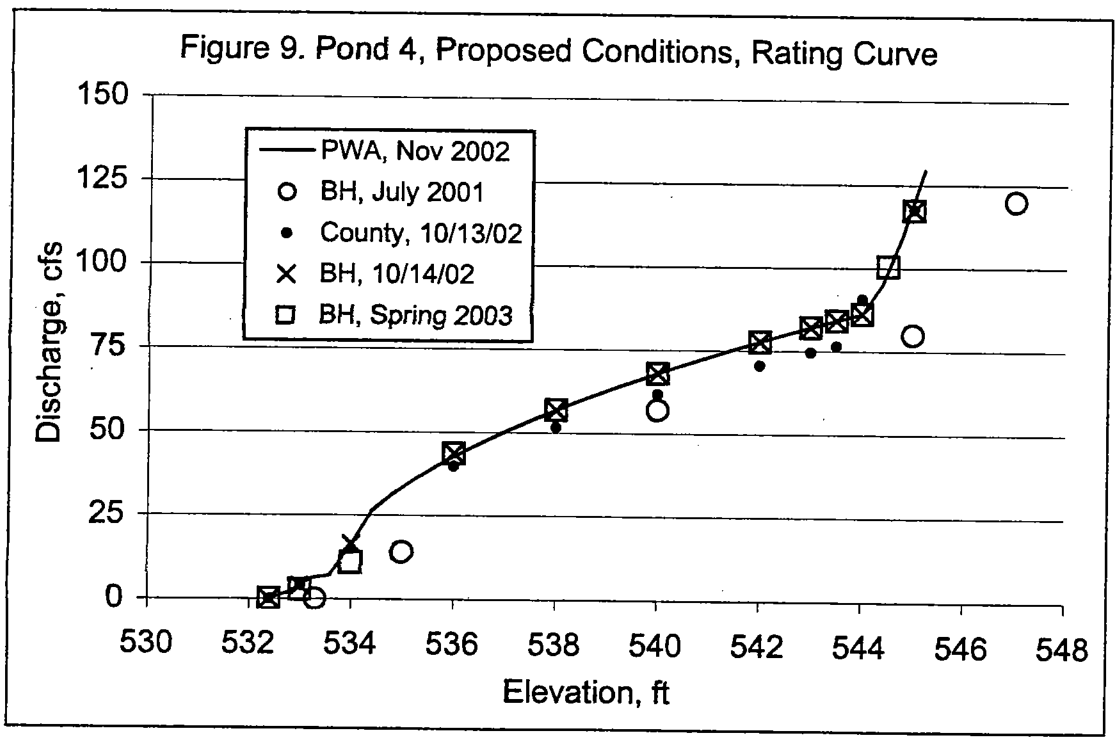


Figure 9. Pond 4, Proposed Conditions, Rating Curve
PWA, Nov 2002
BH, July 2001
County, 10/13/02
BH, 10/14/02
BH, Spring 2003
Discharge, cfs
150
125
100
75
50
25
0
530
532
534
536
538
540
542
544
546
548
Elevation, ft

PWA

Figure 10. Proposed Detention Basin, Stage - Storage

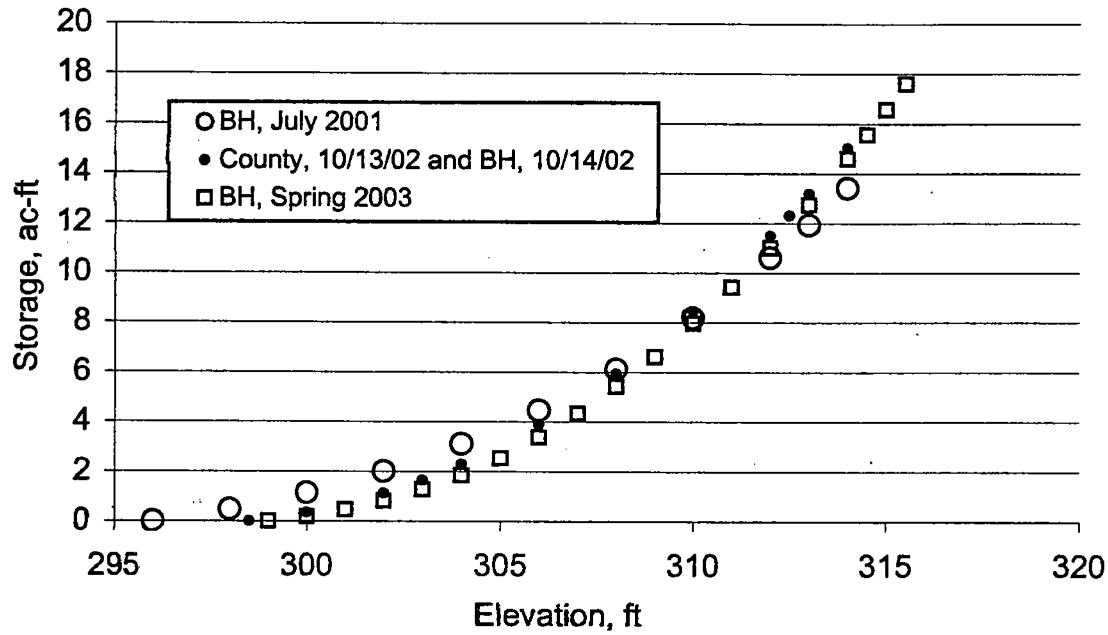
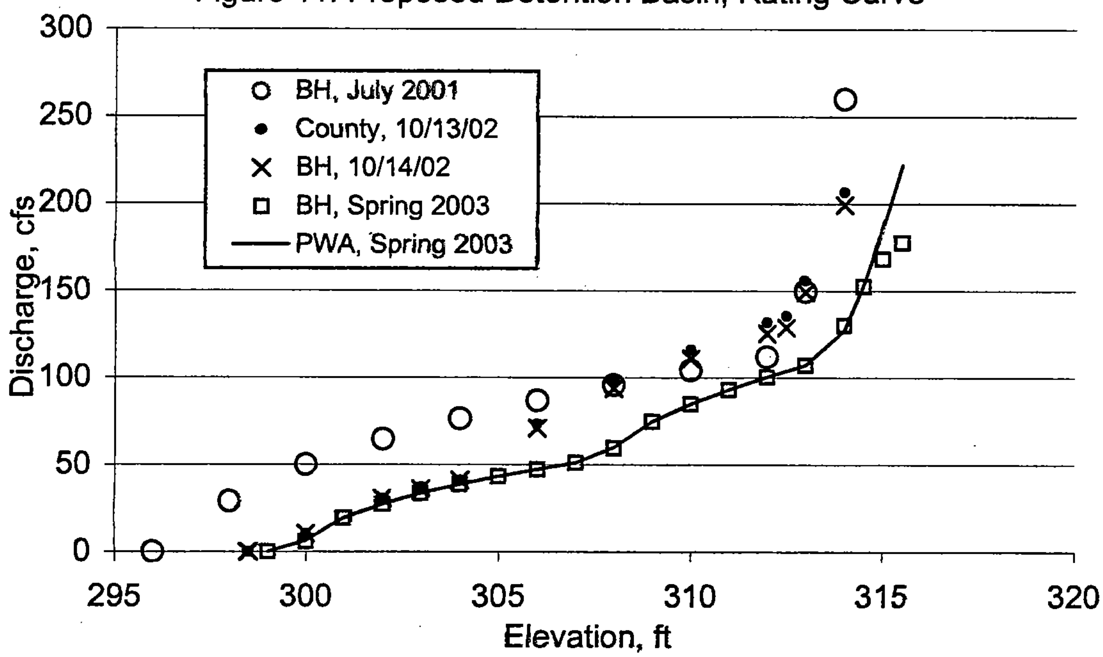


Figure 11. Proposed Detention Basin, Rating Curve



PWA

APPENDIX E

BALANCE HYDROLOGICS, INC., ANALYSIS OF HYDROLOGIC OPPORTUNITIES AND CONSTRAINTS AT LEONA QUARRY, JULY 2001A

Analysis of Hydrologic Opportunities and Constraints at Leona Quarry City of Oakland, California

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July 2001

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Analysis of Hydrologic Opportunities and Constraints at Leona Quarry, City of Oakland, California

Balance Project Assignment 200057

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July 17, 2001

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1.0 INTRODUCTION

1.1 Purpose

This report presents the findings of our analyses related to the hydrologic constraints and opportunities that characterize the Leona Quarry site located in the City of Oakland, Alameda County, California. Specific conditions were evaluated to assess the potential for partial development of the site as part of an overall reclamation program.

The Quarry is located in the upper headwaters of the Chimes Creek system in the eastern sections of the City of Oakland directly adjacent to the I-580 (MacArthur) freeway. This location implies that reasonable site development should consider both local and sub-regional hydrologic factors. Therefore, The DeSilva Group requested that Balance Hydrologics, Inc. carry out analyses as part of a site-specific hydrologic evaluation to support planning alternatives for reclamation of the site. The opportunities and constraints and conceptual approaches that are derived from this hydrologic study are intended to serve as the basis for developing comprehensive and effective storm water and wetlands management approaches for the project.

1.2 Goals and Objectives of the Hydrologic Study

Leona Quarry represents a highly altered hydrologic landscape that itself lies within an already moderately developed setting in the Oakland Hills. Overall, there is recognition that the hydrologic context of the site will have a direct impact on the specific plans for the site as well as the type and location of drainage infrastructure for any future development at this location. Additionally, the hydrologic context of the site calls for storm water conveyance and water quality enhancement that protect the extensive storm drain and creek systems found downstream. It is this recognition that framed the selection of specific objectives for this hydrologic study. The specific objectives of this study include:

- assembling historic meteorological, geological and soils information needed to describe the hydrologic context of the site as well as previous studies conducted within the Chimes Creek watershed;

- utilizing the information obtained to identify opportunities and constraints for dealing with surface water drainage on the site;

- developing conceptual designs for handling drainage of storm water runoff from the site to reduce the risk of localized flooding during and after large storm events;
- developing conceptual designs that provide for storm water quality that is compatible with the proposed receiving waters;
- establishing systems that are self-maintaining and self-perpetuating to the greatest extent possible.

1.3 Work Conducted

To meet the specific goals enumerated in Section 1.2, Balance Hydrologics reviewed previous studies and existing documents relating to the hydrology of the site and its immediate surroundings. The documents reviewed as part of this study include the following:

- Site topography and mass grading scenarios prepared by the project civil engineers (Carlson, Barbee and Gibson, Inc. May 2000)
- Underground utility maps (including storm drains) provided by the Public Works Agency of the City of Oakland (various dates and revisions).
- Ridgemont watershed areas map prepared by CSW Consultants (December 1989).
- HEC-1 modeling input for preliminary analysis of a sub-regional storm water detention basin at Leona Quarry provided by Frank Codd at the Alameda County Flood Control and Water Conservation District (run of November 1995).
- Draft preliminary geotechnical investigations, Leona Quarry, Oakland, California prepared for The DeSilva Group by Berlogar Geotechnical Consultants (March 2000).
- Final phase I environmental site assessment, Leona Quarry located at 7100 Mountain Boulevard, Oakland, California prepared for The DeSilva Group by Uribe & Associates (April 2000).
- Development Plan CBG 2001.

The previous technical studies pertaining to the respective watersheds were augmented by additional hydrologic and hydraulic analyses to more thoroughly address specific issues affecting Leona Quarry. These analyses included recreating the previous HEC-1 rainfall-runoff modeling using updated HEC-HMS software and extending the range of the modeling to include proposed additions of watershed area and the effects of reclamation and partial development of the Quarry.

As part of the backgrounding process, Balance staff met with representatives of the Public Works Agency at the City of Oakland. Additionally, field visits were carried out at the site in June and July 2000 and May to July 2001. These visits were intended to assess characteristics of the site such as existing flow paths for surface drainage, location and sizing of important storm drain elements, creek bed and bank conditions in Chimes Creek, and culvert inlet conditions.

This report presents the results of the literature review and additional analyses. The report begins by reviewing the regional and site-specific characteristics of the study area. This leads to the identification of the primary opportunities and constraints that exist at the site from the perspective of flooding and drainage. The final section of the report discusses the hydrologic modeling that was carried out and specific findings related to storm water management and drainage associated with reclamation of the Leona Quarry site.

1.4 Acknowledgments

Balance staff would like to express appreciation to a number of individuals for their assistance in assembling previous studies and interpreting issues of importance at the study site. Darian Avelino at the Public Works Agency of the City of Oakland provided important insight and context to drainage issues in the vicinity of the Quarry. Additional mention must be made of the assistance provided by Frank Codd, engineer with the ACFCWCD, who shared concerns of the District regarding storm water management in the upper Chimes Creek area and provided the input used in preliminary runoff modeling carried out by the District. Nancy Sidebotham, a local resident, was instrumental in arranging access to Chimes Creek within the Burckhalter neighborhood. Another resident, Marilyn King, provided an excellent account of the problems experienced from stormwater runoff originating in the Ridgemont subdivision.

2.0 HYDROLOGIC SETTING

2.1 Geographic Description of the Leona Quarry

2.1.1 Location and regional setting

The Leona Quarry site is located in the eastern hills of the City of Oakland, Alameda County, California (Figure 1). The project site is bounded on the south and southwest by the Mountain Boulevard and I-580 (MacArthur) freeway. Immediately to the northwest and southeast are low-density residential areas on the steep face of the Oakland Hills. To the north and northwest the site is surrounded by somewhat higher density housing along Ridgemont Road and Campus Drive on the local crest of the Hills. The Quarry property covers a total of approximately 128 acres, although not all of this has been mined in the past.

The site topography is characterized by a steep hillside area (slopes up to 75%) with a maximum elevation of roughly 1045 feet along Campus Drive at the northeastern boundary, to gentler slopes (5%) at the base. The minimum site elevation is approximately 300 feet at the southwestern border along Mountain Boulevard. The steep slopes of the site contribute to short times of storm water concentration and rapid runoff after rainfall events. The site is approximately 1000 feet from the Hayward fault, a major active fault zone, whose presence could affect slope and impoundment stability.

2.1.2 Current and historical land use

As mentioned, the Quarry property covers approximately 128 acres. The site currently consists of fill material emplaced over large excavations, from which rock was extracted during the period of time (approximately 1904 to present).

Prior to the establishment of quarry operations the site was most likely covered by the mixed oak and chaparral communities that are evident on the less disturbed portions of the site and adjacent watershed areas to the north and south. Due to the lack of grazing or intensive uses these hillslope areas are in generally good condition.

2.2 Climate Characteristics of the Site

The area encompassing the Leona Quarry is located in the Mediterranean climate zone typical of coastal, central California. This climate zone is characterized by cool, wet winters and hot, dry summers tempered, in this case, by proximity to San Francisco Bay and by the occurrence of coastal fog, especially in late spring and summer. Average rainfall conditions in this area are the statistical mean of rainfall totals that show a wide range of values strongly influenced by global weather patterns such as the El Niño Southern Oscillation and prolonged periods of drought. Additionally, the location of the site high on the western hillsides of the Oakland Hills strongly influences event and annual rainfall totals. The elevations and aspects typical of the Oakland Hills produce orographic (mountain-induced) precipitation that can be markedly higher than the rainfall that is measured along the edges of San Francisco Bay only several miles to the west. Maps prepared by the Alameda County Flood Control and Water Conservation District show a mean annual rainfall of approximately 25 inches at the site (ACFCWCD, 1989). Long-term meteorological data has been recorded at the Upper San Leandro Filter Plant (USLFP) operated by the East Bay Municipal Utility District roughly 0.5 miles to the southeast since the late 1940's (41 years of complete records). Maximum annual rainfall in this period on a water year basis[1] occurred in the El Niño water year of 1998 with a total of 49.3 inches. The minimum annual total was 11.5 inches in the short, severe drought of 1977. The long-term average at the filtration plant is 25.6 inches. It is reasonable to assume that the overall precipitation is somewhat greater in the higher elevations that comprise the upper watersheds in the study area. The modeling presented here is based on a mean annual precipitation of 28 inches.

Per the calculation framework presented in the Alameda County guidelines, the 100-year 24-hour rainfall at the site is on the order of 6.75 inches (ACFCWCD, 1989). This compares with the maximum historical daily rainfall total of 5.1 inches recorded at the USLFP gage site on October 14, 1962. The applicable design storm per ACFCWCD standards is the 25-year 24-hour event. This storm has a total rainfall of 5.44 inches.

[1] The water year is defined as the period from October 1 to September 30 of each year and is a typical basis for tracking annual precipitation since all the rainfall in a given wet season falls within the same water year.

2.3 Soil Characteristics

As mentioned previously, soils throughout the project site consist primarily of cuts and fill. Soil borings indicate that the fill material consists of dark to light brown silty clay with poorly sorted gravel (Uribe & Associates, 2000).

A small portion of the Quarry property was left undisturbed by the mining operations and is covered with soils in the Maymen loam series (Welch, 1981). This soil also covers the majority of the two Chimes Creek sub-basins that were included in the hydrologic modeling tasks of this report. The Maymen series consist of a moderately permeable loam of limited depth (typically less than 19 inches) found on slopes of 30 to 75 percent. Due to the limited soil depth, runoff is considered to be rapid to very rapid with a high erosion hazard. The soil is classified as hydrologic soil group D (where A represents the least runoff potential and D the highest).

Approximately 35 percent of the sub-basin to the south of Leona Quarry (Mountain Boulevard sub-basin) is covered by soils in the Xerorthents-Millsholm complex. Specifically, it appears the soils in this case are primarily of the Xerorthents portion described as heterogeneous loams that are generally used as fill material for residential areas and are typically on the order of 60 inches in depth. Permeability is moderate with rapid runoff and high erosion hazard. These soils are classified as hydrologic soil group B.

2.4 Surface Water Drainage

2.4.1 Regional drainage patterns

The location of the study site in the upper reaches of Chimes Creek, surrounded by developed properties, creates a relatively complex combination of drainage systems. Nonetheless, it is important to note that no potential development options have been planned for the site that would impact existing jurisdictional channel or wetland resources.

Rainfall runoff and groundwater discharges flow from the site and neighboring sub-basins into storm drains that cross I-580 (see Section 2.4.2 below) and eventually daylight in remnant channels of Chimes Creek roughly 500 feet downstream. Chimes Creek appears to have been a second-order tributary of the much larger Lion Creek system prior to residential development in the local area. The mainstem of Lion Creek was formerly on the order of 6600 feet in length. Currently there are only three open channel reaches remaining (Sowers, 1995), with a combined length of approximately 1300 feet. The longest of these reaches parallels Hillmont Drive and is roughly 900 feet in length.

Chimes Creek flows into third-order Lion Creek near the southwest corner of Mills College just east of MacArthur Boulevard (the confluence is culverted). Lion Creek flows southwesterly from this confluence approximately 2.6 miles along 66th Avenue almost exclusively in underground storm drains before emerging into an engineered channel that carries it just to the north of the Coliseum sports complex to its mouth at Damon Slough.

2.4.2 Local storm drain system

Figure 1 illustrates the sub-basins of upper Chimes Creek that directly impact stormwater management decisions at Leona Quarry. To the south and east of the Quarry runoff flows overland and in pipes into an underground storm drain along the Mountain Boulevard right-of-way. This catchment will be referred to as the Mountain Boulevard sub-basin, key hydrologic characteristics of which are summarized in Table 1. Total drainage area in this sub-basin is on the order of 76 acres. The storm drain along Mountain Boulevard is a 30-inch RCP per drawings provided by the City of Oakland.

Almost the entire Leona Quarry property is included in another sub-basin that will be referred to as the Quarry sub-basin, with a total drainage area of approximately 114 acres. This basin stretches from Mountain Boulevard at the lowest elevations up to the crest of the ridge just west of Campus Drive. Runoff from this sub-basin is routed via pipes and overland flow to a series of three sedimentation/catch basins just upslope from Mountain Boulevard (see Figure 2).

In addition to direct runoff from the Quarry itself, the Quarry sub-basin also receives stormwater from the developed portions of the ridge immediately to the north and west. This catchment will be referred to as the Ridgemont Road sub-basin. Currently, roughly 84 acres of mixed moderate density housing and open hillslope drain to a pipe system that carries runoff from the hilltop areas down to a detention basin located in the northern section of the Quarry property.

Flow from the entire upper watershed of Chimes Creek is ultimately collected in a single 39-inch RCP that crosses the I-580 freeway approximately 500 feet northwest of the Edwards Avenue undercrossing.

2.4.3 Existing on-site stormwater management features

A number of features currently exist at Leona Quarry for managing stormwater runoff. These features generally fall into two categories: detention basins and water quality infrastructure.

There are four existing stormwater detention basins at the site. The most northerly of these was mentioned in the previous section and receives runoff from the Ridgemont Road sub-basin on the hilltops to the north. This basin was apparently constructed by berming an unmined ravine. Topographic information provided by Carlson, Barbee and Gibson, Inc. (CBG) indicates that the storage volume of this detention basin is on the order of 2.7 acre-feet at maximum depth. The basin appears to drain via a single 30-inch CMP that is exposed on the hillslope just below.

The three remaining detention basins appear to have been relatively recent additions to the site based on descriptions of aerial photographs included in Dean and Erskine, 2000. The uppermost of these detentions basins is located in the so-called "bowl area" of the Quarry and is equipped with a perforated riser that may or may not drain into an 18-inch diameter CMP that descends steeply to the lower portions of the site. The lower basins were formed by grading overburden material to create detention volume. Neither of these detention basins was found to have outlet works. Thus, it appears that these basins offer only limited peak discharge attenuation in prolonged wet periods since they would fill rather quickly and not empty before subsequent storm events.

The detention basins are augmented by a wide array of water quality control features such as K-rails to slow overland flow as well as straw bale berms. Our field reconnaissance indicated that these features have been very effective at removing sediment from runoff in the last two rainy seasons (Water Years 2000 and 2001), as seen by the widespread deposits of fine material behind the water quality control elements.

2.4.4 Hydrologic conditions observed at the site

Flow rates, specific conductance (a measure of salinity) and water temperature were measured at a number of points at Leona Quarry as well as in Chimes and Lion Creeks as part of our field visits. The measurements are summarized in the Observer's Log included as Appendix A.

There are several important observations that should be noted, including:

- *Outflow from the "bowl area" of the Quarry.* Significant flow was found coming out of the 18-inch CMP that descends from the "bowl area" to the lower level of the Quarry (see Figure 2). The flow rate at this point has been in excess of 10 gpm at all observation times over the two summers of field visits. Specific conductance of this water was on the order of 1200 to 1500 micromhos, which is strongly indicative of the flow originating as ground water upslope, perhaps from springs exposed by former quarry operations. Another possibility is that this water represents percolated rainwater draining from the "bowl area", in which case regrading of the site could reduce or eliminate this flow. Further monitoring would be needed to verify the actual source of this water.

- *Flow in Chimes Creek.* We observed significant flow in Chimes Creek near Seminary Avenue on July 21, 2000 and at various locations in the Burckhalter neighborhood in June and July 2001. Measured specific conductance was on the order of 600 micromhos, indicative of ground water inputs to the creek upstream, possibly in the vicinity of the Quarry. The flow was estimated to be on the order of 20 to 90 gpm, another strong indicator that the upper reaches of the stream are perennial and fed by ground water inflows and/or other urban return flows.

- *Chimes Creek channel morphology.* Field visits along the open sections of Chimes Creek upstream from Seminary Avenue confirm that much of the channel is in a highly degraded and unstable state at present. The reach directly above Seminary has recently been stabilized using an underground bypass channel and surface low flow channel. However, channel sections immediately upstream exhibit numerous knickpoints and bank failures. Several neighborhood residents have indicated that they feel that incision processes were initiated with the construction of the Ridgemont subdivision, but it is not immediately evident at what point this process began. There are a number of large trees along the banks that would appear to indicate that the process began within the last forty to fifty years, but more investigations would be needed to draw conclusions.

3.0 HYDROLOGIC OPPORTUNITIES AND CONSTRAINTS

The characteristics of the site itself, its location with respect to the other sub-basins and constraints due to the request to mitigate additional existing off-site drainage define the considerations that need to be addressed in planning policies and infrastructure for stormwater runoff management at Leona Quarry.

3.1 Downstream Conveyance and Creek Bank Stability Constraints

Perhaps the most important hydrologic constraints identified at the present time are related to the limitations downstream of the site. Per ACFCWCD there are two primary considerations in this regard:

- *Storm drain capacity issues.* According to the ACFCWCD, the downstream storm drain system leading to Chimes Creek is not capable of handling the quantity of runoff generated by large rainfall events in the area under existing conditions. Street flooding has apparently occurred in the residential areas to the west of the I-580 freeway on a number of occasions. The ACFCWCD did not identify the specific maximum capacity for the existing storm drain system, but it is probably on the order of 180 cfs (Frank Codd, personal communication).
- *Creek stability issues.* The ACFCWCD is also concerned with the stability of the banks of Chimes Creek downstream from the Quarry as discussed above. They recognize that increased discharge in the creek has led to erosion problems that degrade the creek environment, affect adjacent property owners and contribute sediment that may interfere with downstream facilities.

The most traditional stormwater management technique to address these types of concerns would be the construction of a sub-regional detention basin as part of any reclamation/development plan for the Quarry. The ACFCWCD has prepared preliminary calculations in this regard in the form of rainfall-runoff modeling, which was updated to reflect additional site considerations as part of this study (see Section 4.0 below). The ACFCWCD apparently views construction of an appropriately sized detention basin as a probable condition of approval for any future plans at the site. The District would be open to cost-sharing for land acquisition and/or construction and would be willing to assume maintenance responsibilities as needed (Frank Codd, personal communication).

3.2 Off-Site Storm Drain Deficiencies Upstream of Leona Quarry

Another constraint with regard to the quantity of stormwater runoff that would need to be accommodated at the site is related to deficiencies in the storm drain system along Ridgemont Road to the north. Conversations with the Public Works Agency of the City of Oakland reveal that approximately nine acres of residential uses along the west side of Ridgemont Road were not tied into the storm drain system that is routed to the upper detention basin on the Quarry property (see Figure 3). Runoff from the homes and west half of the roadway is instead directed to outfalls (without detention) in the upper portions of ravines that define the steep hillside in this location. This arrangement is clear on the storm drain drawings prepared by CSW Consultants in 1989 where three separate outfalls are indicated. Properties downslope of these outfalls have experienced numerous episodes of flooding and the presumed cause is increased runoff associated with the development along Ridgemont Road (Darian Avelino, City of Oakland, and Marilyn King, resident, personal communication).

Clearly, the most straightforward manner of dealing with this situation would be to tie the three inlets in question to the 42-inch RCP that runs down Ridgemont Road and eventually to the Quarry. This would add nine additional acres to the total Ridgemont sub-basin, an increase of approximately 11 percent. The impact of such a change on peak runoff rates and the upper detention basin are presented in Section 4.2.

3.3 Required Design Storm Conditions

The relatively high rainfall experienced at the site imposes another design constraint. The mean annual rainfall total of 28 inches is among the highest in Alameda County. Since the total precipitation and maximum intensity of storms used in the design process is scaled by mean annual rainfall per County design guidelines, the magnitude of the storm events becomes quite large (Alameda Public Works, 1989). Additionally, the ACFCWCD requires the use of the 25-year storm event for design in the City of Oakland and all facilities must also be able to accommodate the 100-year event without failure. The 25-year, 24-hour design storm per these guidelines has a total rainfall of 5.44 inches and the 100-year, 24-hour event has total of 6.75 inches. Despite the relatively large size of these storms, stormwater infrastructure can be appropriately sized and constructed using standard design techniques.

3.4 Stormwater Quality Management

The large number of sediment control features currently in place at the site are indicative of the chief water quality concern at Leona Quarry, the control of erosion and transport of eroded material into the Chimes and Lion Creek systems. In this regard, reclamation and partial development of the site offers many opportunities to improve water quality leaving the site.

Perhaps the most significant potential stormwater quality improvement at the site stems from the potential reconstruction and revegetation of slopes within the Quarry. Source control is widely recognized as the single most effective BMP measure (BAASMA, 1999). Under existing conditions the site has large areas of unvegetated slopes highly susceptible to erosion. Appropriate efforts to reclaim these areas will markedly reduce the potential for erosion and sediment loading. Reduction of erosion at the source would clearly be a more effective strategy than relying on sediment removal strategies to protect the beneficial uses in the ultimate receiving waters.

A generalized assessment of the suitability of various stormwater quality best management practices (BMPs) can be made on the basis of the information generated for this report. Overall, most traditional BMPs can prove effective at the site, with a few notable exceptions. These exceptions include BMPs that rely on infiltration as the primary removal mechanism for pollutants. Reclamation of the slopes at the site and the potential steep gradients would indicate that promoting infiltration is not the best approach due to slope stability concerns. Additionally, the generally steep gradients do not favor the use of traditional vegetated bioswales that rely on low velocities to promote settling of particulates. This shortcoming can be addressed through use of BMPs such as stepped micro-pools that overcome the limitations imposed by steeper slopes. It is important to note that these exceptions still allow for a wide range of proven BMPs to be implemented in a manner that creates the type of effective treatment train that provides for multiple removal mechanisms and redundancies (Storm Water Quality Task Force, 1993).

3.5 Ground Water Resources at the Site

The exploratory borings carried out as part of the geotechnical investigations (Berlogar, 2000) and the field observations summarized in Section 2.4.4 indicate that there may be a significant source of ground water that surfaces in the "bowl area" of the Quarry. If further investigations reveal that this is a persistent ground water source of suitable quality there will be a number of opportunities for beneficial use on the site. There are at least two immediate possibilities for utilizing this water on-site:

- *Irrigation.* Discharge from the 18-inch CMP descending from the "bowl area" was consistently in excess of 10 gallons per minute as late as mid-July (see Appendix A). Flows of this magnitude could be stored and utilized for landscape irrigation purposes and markedly reduce the water demand associated with any development that occurs at the Quarry.

- *Creation of wetlands or other mitigation habitat.* If the source of the water proves to be a spring, it is reasonable to assume that this water once surfaced in the area prior to quarry operations. This water could continue to be captured and directed to appropriate locations to create mitigation habitat (seasonal or, perhaps, permanent wetlands or channel habitat). Alternatively, this water could be used to augment the function of certain BMPs (such as step pools or water quality ponds) by maintaining healthy vegetation into the early winter period. Additionally, such flows could provide year-round inflow to water quality features that would increase circulation and reduce potential problems related to stagnation.

Water quality analyses were conducted on samples of water from this source on the project site collected in July 2001. The results of these analyses are presented in Appendix B along with the results of similar analyses carried out on samples from Chimes and Lion Creeks collected on the same day. The water from the discharge point at the Quarry was generally higher in dissolved solids and sulfate, but lower in nitrate than the other samples. No heavy metals were detected in any of the samples. Overall, the water quality of the sample at the Quarry was better than the down stream sampling points.

4.0 ASSESSMENT OF STORMWATER DETENTION NEEDS

It is important to note that the constraints summarized in Sections 3.1 and 3.2 revolve around a number of issues that include policy decisions by the City of Oakland and ACFCWCD as to how to best manage drainage problems in the vicinity of, but not on, the Leona Quarry site. It is not clear at this point whether it is appropriate for these issues to be addressed by requiring solutions on-site that may prove costly or otherwise constrain successful reclamation of the Quarry.

Nonetheless, the perceived needs to manage downstream conveyance limitations and creek impacts as well as better manage runoff from the west side of Ridgemont Road could all be met by providing an appropriately designed sub-regional stormwater detention facility at the Quarry. To better frame the constraint that providing such a detention basin would entail, hydrologic and hydraulic modeling was undertaken to assess the approximate size of the basin that would be required.

4.1 Rainfall-Runoff Modeling Methodology and Assumptions

As with any hydrologic analyses there are a number of important assumptions that are made as the basis for creating a model of the runoff generated by various input design storms.

4.1.1 Design storms and unit hydrographs

The guidelines for storm water runoff modeling outlined in the Hydrology and Hydraulics Criteria Summary for Western Alameda County (Alameda County Public Works Agency, 1989) were followed throughout. These guidelines require the use of the Soil Conservation Service (SCS, now NRCS) Unit Hydrograph Method whenever detention basin volumes are calculated.

The design storm for the unit hydrograph analysis is the Alameda County Type I storm of 24-hour duration. As discussed above, design guidelines call for the use of both the 25-year and 100-year storms. Based on a mean annual precipitation of 28 inches, the guidelines establish a 25-year, 24-hour design storm with a total rainfall of 5.44 inches and maximum rainfall intensity of 1.35 inches/hour. The equivalent 100-year, 24-hour design storm has a total rainfall of 6.75 inches and maximum intensity of 1.67 inches/hour.

In addition to the above design storms, model runs were also conducted using a 2-year, 24-hour storm. The latter design storm was run to assess the potential effect that a sub-regional stormwater basin could have on the more frequent urban runoff events that likely account for much of the channel degradation that was observed in Chimes Creek below I-580. The 2-year storm is based on regional rainfall parameters prepared by the United States Geological Survey (Rantz, 1971) and indicated a total 24-hour rainfall of 3.00 inches. This rainfall total was then distributed using the Alameda County Type I storm to create the input hyetograph.

4.1.2 Sub-basin hydrologic parameters

The upper watershed of Chimes Creek was divided into three sub-basins to facilitate the modeling work (see Table 1). Sub-basin boundaries were delineated using a combination of the topographic mapping prepared by CBG, the USGS 7.5-minute Oakland East topographic quadrangle, and the storm drain maps provided by the City of Oakland. Soil type and distribution were compiled from the soil survey covering the area (Welch, 1981). Vegetative cover was assessed using the digital orthoquad base as presented in Figure 1.

Basin boundaries, soil types, and cover were combined to produce map coverages for the site under one potential development scenario with associated stabilization and revegetation of the remaining acreage. Additionally, hydrologic parameters were calculated for the existing conditions at within the three sub-watersheds. All area measurements were made within ArcView GIS and used to calculate a composite curve number by the weighted area method (SCS, 1972).

Hydrologic time lags for use with the unit hydrographs were taken as 60 percent of the time of time of concentration within each sub-basin. The time of concentration was calculated by combining roof-to-gutter time with overland and pipe flow time as outlined in the ACFCWCD guidelines.

4.1.3 Model type and organization

The hydrologic parameters were used to create a watershed model utilizing the U.S. Army Corps of Engineers' HEC-HMS computer package (successor to the standard HEC-1 software).

Routing of runoff within the model is as shown in Figure 4. Two detention basins were included in the analyses:

- *Upper detention basin.* This detention basin already exists near the northern limit of the property (see Figure 3) and receives runoff from the Ridgemont sub-basin. It is likely that this basin would be kept as part of any reclamation plan for the site. A depth-storage relationship was determined for this basin using topographic information provided by CBG with the maximum storage volume found to be 2.9 acre-feet (see Figure 5). A discharge rating curve for the basin was approximated for the existing 30-inch CMP outlet assuming a culvert under inlet control.

- *Hypothetical sub-regional detention basin.* A hypothetical detention basin was modeled under the assumption that it would receive runoff from the upper detention basin as well as the Quarry sub-watershed, including additional drainage area requested by the City. An approximate depth-storage relationship and rating curve were calculated assuming two 48-inch outlet risers (see Figure 6). It is important to bear in mind that this is a conceptual basin design only and that the actual depth-storage-discharge relationship can be adjusted as needed in final design.

4.2 Results of the Rainfall-Runoff Modeling

Table 2 summarizes the results of the rainfall-runoff modeling subject to the assumptions discussed above. The most important findings include the following:

- *Comparison of existing and post-project predicted discharge.* The hypothetical stormwater basin that was used in the modeling would produce marked reductions in peak stormwater runoff at I-580. Peak discharge for the 2-year, 24-hour storm is predicted to decrease from 128 to 91 cfs, a reduction of 29 percent. This reduction could be accomplished even with the proposed addition of the nine additional acres of drainage from the Ridgemont subdivision. Peak flow for the 25-year, 24-hour storm is calculated to decrease from 276 to 172 cfs, a drop of 38 percent. Note that the 25-year storm total with the added detention is below the 180 cfs threshold identified by ACFCWCD. Peaks for the much larger 100-year storm are calculated to be reduced from 368 to 335 cfs, a decrease of nine percent.

- *Capacity of the existing upper detention basin.* The modeling predicts that the upper detention basin provides moderate attenuation of peak flows coming from the Ridgemont sub-watershed. More importantly, the model indicates that the upper detention basin is not capable of containing the 100-year storm in its present configuration. Since this detention basin is not equipped with an emergency spillway, there is a significant risk that the basin would be damaged, or even fail, under conditions similar to the 100-year design storm.

- *Impact of adding area to the Ridgemont sub-basin.* As discussed in Section 3.2, the City of Oakland would like to see an additional nine acres of residential runoff directed to the upper detention basin. The modeling results indicate that this additional area would cause moderated increases in peak runoff to the upper detention basin, but at a critical threshold level. Peak flow for the 25-year event would increase 11 percent (82 to 91 cfs) and peak flow for the 100-year event would rise from 109 to 121 cfs. More importantly, the model predicts that the additional acreage would create enough additional runoff to overtop the upper detention basin even in the 25-year event. The latter would occur even if the outlet were free of debris and other obstructions. Therefore, adding the acreage from Ridgemont would markedly increase the risk of failure of the upper detention basin.

- *Estimated sub-regional detention needs.* The modeling indicates that roughly 12.0 acre-feet of active detention volume would be needed to meet the downstream conveyance limitations cited by the ACFCWCD. The physical dimensions of a detention basin with this volume clearly depend on design considerations such as maximum allowable depth, bank slopes, etc. Nonetheless, it is unlikely that this volume can be provided in an area much less than 300 feet by 300 feet (e.g. 2.1 acres). This represents a significant constraint to land use planning at the Quarry.

- *Comparison with previous ACFCWCD studies.* There are significant differences between the modeling parameters used in this study and that used by ACFCWCD in a preliminary analysis in 1995. The ACFCWCD modeling apparently did not include runoff from the Ridgemont Road area and assumed that additional existing detention storage was available within the Quarry. Less significant differences were also found in the size and distribution of the design storms used. Overall, these differences led to results indicating that a sub-regional detention basin could be much smaller, on the order of 5.8 acre-feet volume, to meet the downstream conveyance limitations.

5.0 CONCLUSIONS

Several important conclusions are derived from this opportunities and constraints analysis and include the following.

1. The Alameda County Flood Control and Water Conservation District will likely attempt to make mitigation of existing downstream conveyance limitations a condition of any project at Leona Quarry. This would limit the maximum 25-year stormwater discharge at I-580 to roughly 180 cfs, considerably below their estimates for runoff under existing conditions.

2. The City of Oakland has requested that any project at the Quarry make modifications to the existing storm drain system on Ridgemont Road to collect the runoff from an additional nine acres of residential development and route it through the Quarry to Chimes Creek. The goal would be to mitigate existing flooding from runoff that is currently routed directly downslope to the west of Ridgemont Road.

3. Considerable enhancement in the quality of stormwater leaving the site can likely be achieved through a reclamation plan for the Quarry that utilizes appropriate revegetation and slope stabilization techniques. Such actions would constitute effective source control for sediment that is now being managed after it is mobilized. A range of proven BMP measures can be employed to deal with constituents generated on any developed portion of the site.

4. There is direct, but not conclusive, evidence of significant ground water flows out of the "bowl area" of the Quarry. If properly collected, these flows could be utilized for a number of beneficial purposes at the site including landscape irrigation, creation of wetland or channel features or creating water-based amenities. The range of possibilities in this regard will depend on the source and sustained nature of the flow and further monitoring should be continued to collect this information.

5. Rainfall-runoff modeling indicates that the existing upper detention basin that receives runoff from the Ridgemont Road area cannot accommodate the 100-year design storm. Field inspections have consistently revealed that the outlet pipe from the basin is well over half obstructed with woody debris. This basin does not currently have an emergency spillway and could be damaged, or even fail, in a storm similar to the 100-year event. Modifications to increase the safety of this detention basin would need to include provision for an emergency spillway and/or reconstruction of the outlet works, assuming that the berm forming the basin is geotechnically sound.

6. The impact of the additional nine acres of drainage area from Ridgemont Road proposed by the City of Oakland would have moderate impacts on total runoff to the upper detention basin. Peak flow to the basin would increase by roughly nine cfs (11 percent) for the 25-year event and 12 cfs (11 percent) for the 100-year event. However, the modeling indicates that even the modest increases in runoff for the 25-year event would lead to water levels in excess of the elevation of the upper detention basin berm. Thus, including the additional

runoff from Ridgemont would significantly increase the risk of failure in the existing upper detention basin.

7. If a sub-regional detention basin were to be provided at the Leona Quarry site to accommodate the conveyance limitations cited by the ACFCWCD, modeling indicates that a minimum active storage area of at 12 acre-feet would be needed. It is unlikely that this volume can be provided in an area less than two acres, creating a significant constraint to land use planning for the site.

8. Preliminary calculations carried out by the ACFCWCD were based on different assessments of regional drainage patterns and watershed areas leading to a lower estimate of the size of a sub-regional detention basin (5.8 acre-feet). The estimate of 12 acre-feet by Balance Hydrologics is based on ACFCWCD guidelines, and we feel it more likely represents the size of basin that would be required to meet their goals. It is important to note that a smaller detention basin would still provide some benefit downstream for small to moderate storms.

6.0 LIMITATIONS

This report was prepared in general accordance with the accepted standard of practice in surface-water hydrology existing in Northern California for projects of similar scale at the time the investigations were performed. No other warranties, expressed or implied, are made.

As is customary, we note that readers should recognize that interpretation and evaluation of factors affecting the hydrologic context of any site is a difficult and inexact art. Judgments leading to conclusions and recommendations are generally made with an incomplete knowledge of the conditions present. More extensive or extended studies, including additional hydrologic baseline monitoring, can reduce the inherent uncertainties associated with such studies. We note, in particular, that many factors affect local and regional issues related to the magnitude and frequency of flooding. If the client wishes to further reduce the uncertainty beyond the level associated with this study, Balance should be notified for additional consultation.

We have used standard environmental information -- such as rainfall, topographic mapping, and soil mapping -- in our analyses and approaches without verification or modification, in conformance with local custom. New information or changes in regulatory guidance could influence the plans or recommendations, perhaps fundamentally. As updated information becomes available, the interpretations and recommendations contained in this report may warrant change. To aid in revisions, we ask that readers or reviewers advise us of new plans, conditions, or data of which they are aware.

Concepts, findings and interpretations contained in this report are intended for the exclusive use of The DeSilva Group, under the conditions presently prevailing except where noted otherwise. Their use beyond the boundaries of the site could lead to environmental or structural damage, and/or to noncompliance with water-quality policies, regulations or permits. Data developed or used in this report were collected and interpreted solely for developing an understanding of the hydrologic context at the site as an aid to conceptual planning. They should not be used for other purposes without great care, updating, review of sampling and analytical methods used, and consultation with Balance staff familiar with the site. In particular, Balance Hydrologics, Inc. should be consulted prior to applying the contents of this report to geotechnical or facility design, sale or exchange of land, or for other purposes not specifically cited in this report.

Finally, we ask once again that readers who have additional pertinent information, who observed changed conditions, or who may note material errors should contact us with their findings at the earliest possible date, so that timely changes may be made.

7.0 REFERENCES

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TABLES

Table 1. Sub-basin parameters used as input to the HEC-HMS rainfall-runoff model, Leona Quarry, City of Oakland.

			Ridgemont Road		Quarry		Mountain Blvd.
			Existing	*Proposed*	*Existing*	*Proposed*	*Ex & Prop*
Drainage area	*(acres)*	1	82	93	114	114	76
Initial losses	*(inches)*		0.0	0.0	0.0	0.0	0.0
SCS curve number		2	77.6	77.6	94.0	84.1	71.4
Time of concentration	*(min)*	3	11.4	11.4	5.2	12.0	10.2
Lag time	*(min)*		6.8	6.8	3.1	7.2	6.1

Notes:

1 Drainage areas are delineated as shown in Figure 1, based on USGS 7.5' topographic maps, digital photo orthoquads, and existing drainage plans. The proposed drainage area for Ridgemont Road includes nine acres that curretly drain away from the Quarry as shown in Figure 3.

2 SCS Curve Numbers are calculated based on existing and potential land use categories and hydrologic class B and D soils as indicated by the latest USDA survey for the area (Welch,1981).

3 Time of concentration consists of initial time, including overland flow time for undeveloped areas and roof-to-gutter and gutter flow time for developed watersheds, and conduit time, as outlined by Alameda County Public Works, 1989. Lag time is 60 percent of the time of concentration.

Table 2. Results of HEC-HMS rainfall-runoff modeling after potential development at Leona Quarry, City of Oakland.

			Design Storm		
			2-year, 24-hour	25-year, 24-hour	100-year, 24-hour
Rainfall total	*(inches)*	1	3.00	5.44	6.75
Peak intensity	*(in/hr)*		0.74	1.35	1.67
Ridgemont					
Existing	*(cfs)*	2	33 (31)	82 (71)	109 (103)
Proposed	*(cfs)*		36 (34)	91 (76)	121 (116)
Quarry					
Existing	*(cfs)*		78	150	188
Proposed	*(cfs)*		57	127	166
Quarry + Ridgemont					
Existing	*(cfs)*		106	212	280
Proposed	*(cfs)*	3	90 (74)	201 (113)	277 (254)
Mountain					
Existing	*(cfs)*		22	64	88
Proposed	*(cfs)*		22	64	88
Total at I-580					
Existing	*(cfs)*		128	276	368
Proposed	*(cfs)*		91	173	335

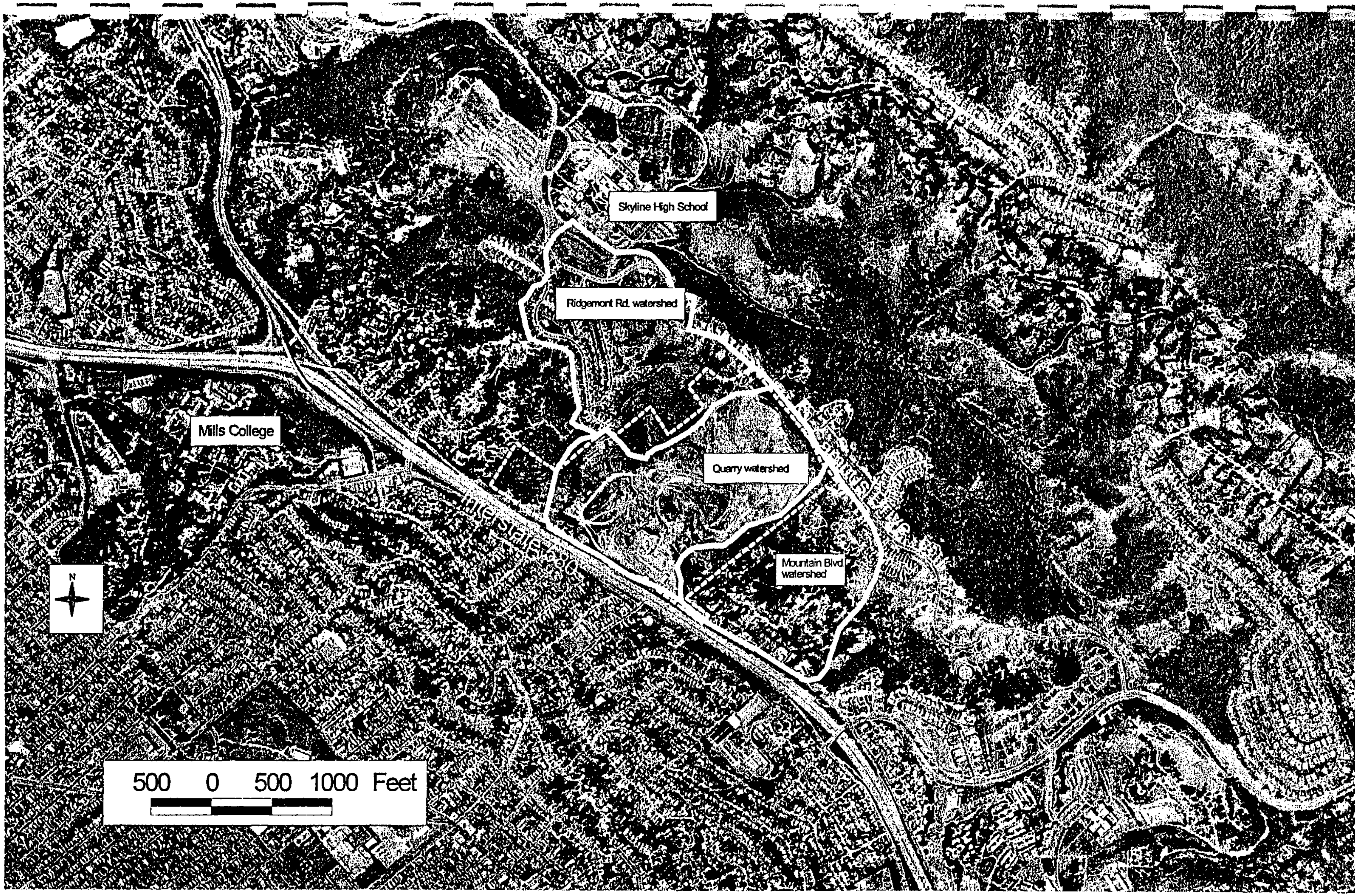
Notes:

1 Rainfall distribution based on the Alameda County Type I design storm and a mean annual precipitation of 28 inches.

2 Values in parentheses represent the effect of stormwater detention by the existing upper detention basin. Note that the model indicates this basin would be overtopped in the 100-year storm under existing conditions and in the 25-year storm under the proposed conditions, which add nine acres to the Ridgemont watershed.

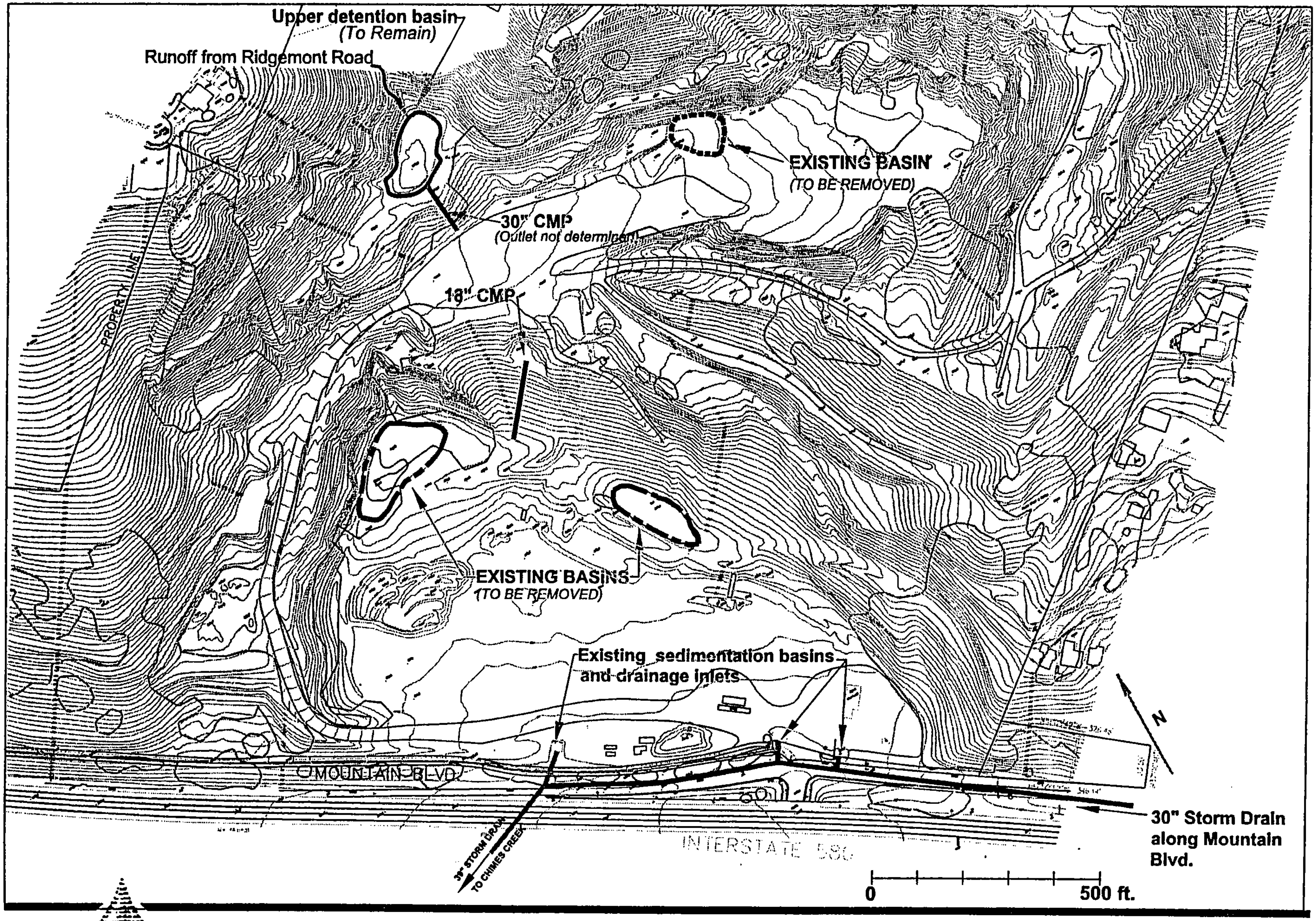
3 Values in parentheses represent the effect of stormwater detention by the hypothetical stormwater basin with 12 acre-feet capacity.

FIGURES



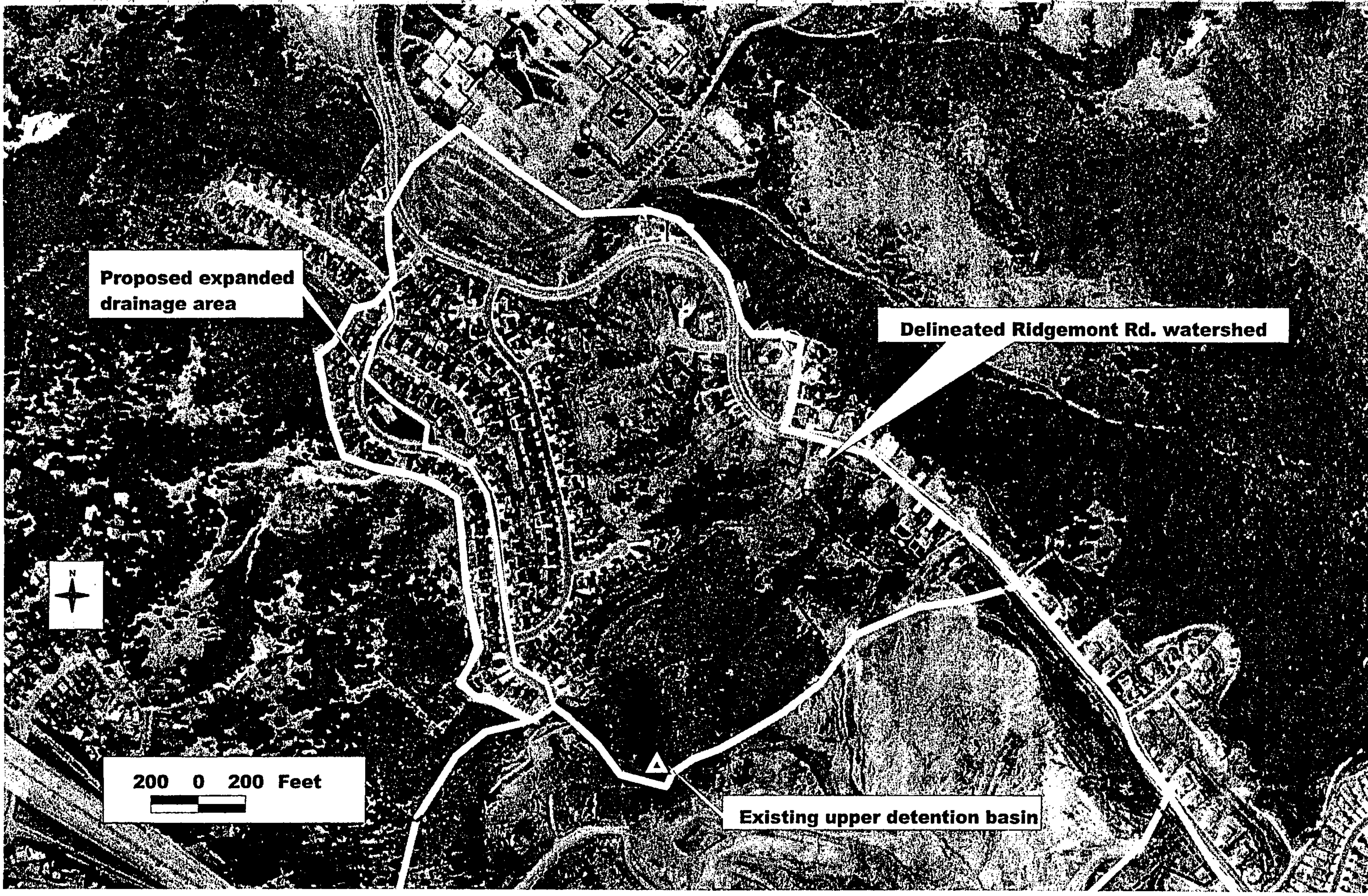
Balance Hydrologics, Inc.

Figure 1. Site location map and modeled watersheds, Leona Quarry, City of Oakland



Balance Hydrologics, Inc.

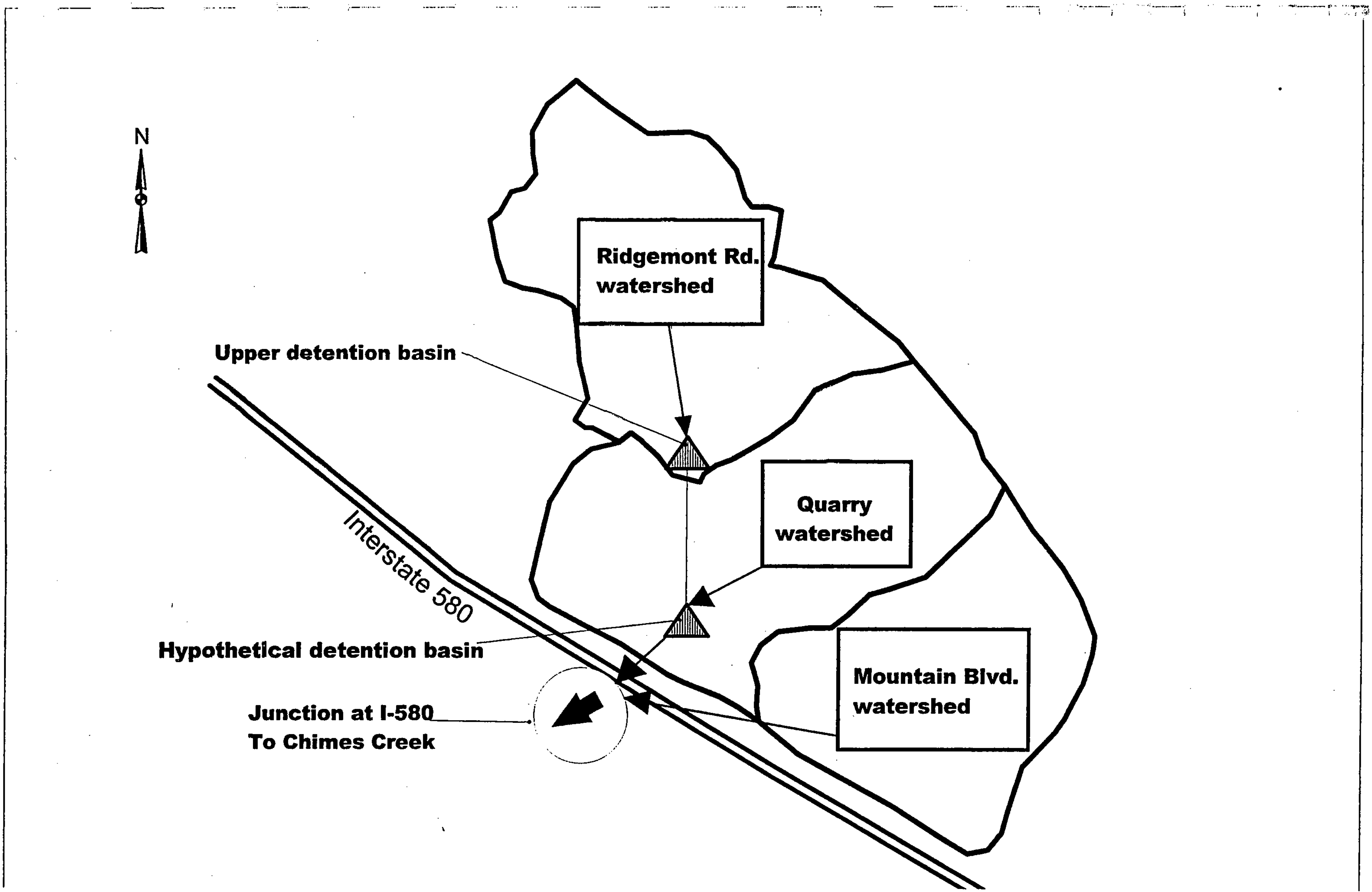
Figure 2. Existing drainage structures at Leona Quarry, City of Oakland.



Balance Hydrologics, Inc.

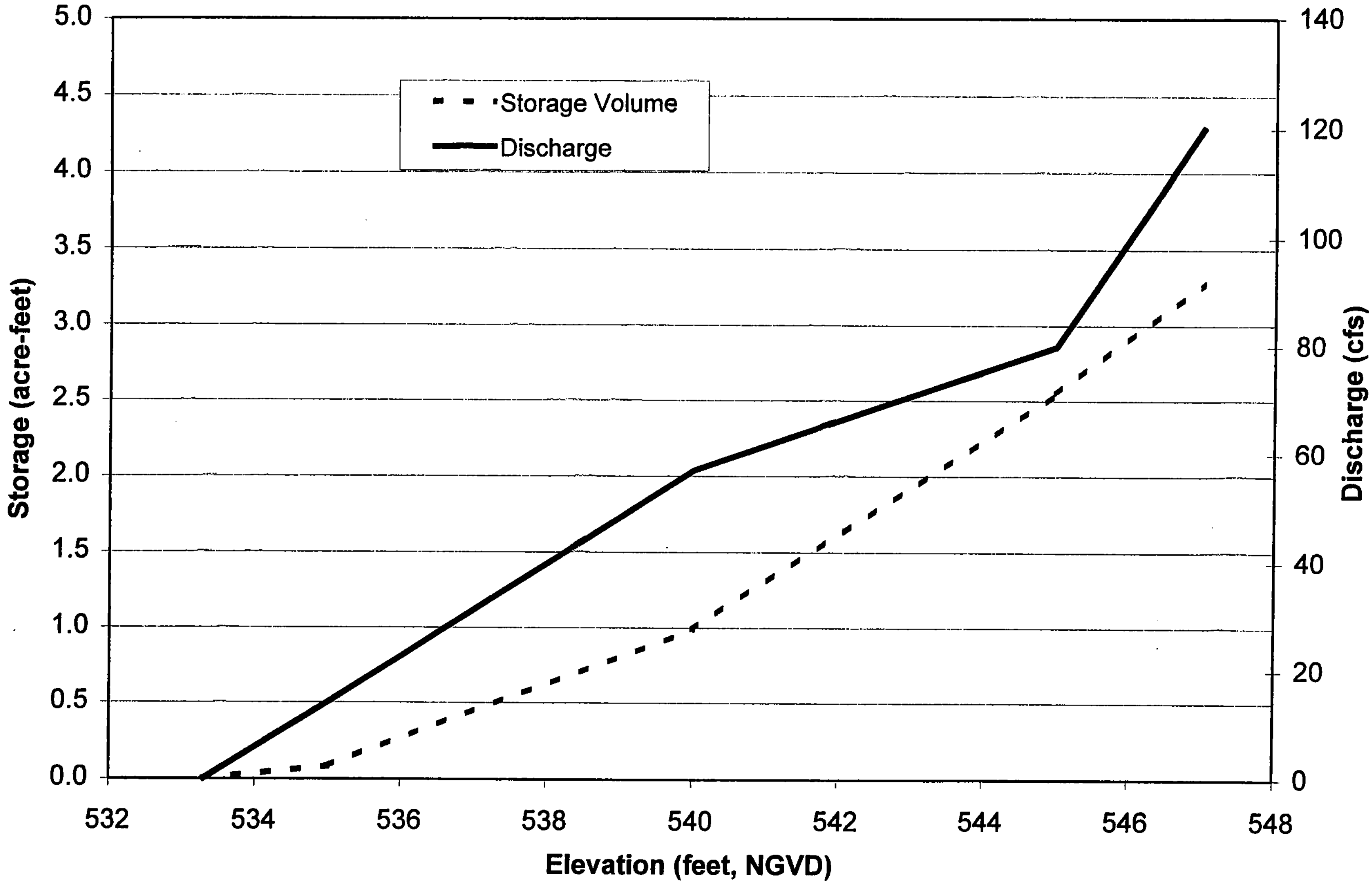
Figure 3. Watershed map of the Ridgemont Road storm drain system showing additional drainage area proposed by the City of Oakland.

Note that approximately 9 acres along the west side of Ridgemont Road currently drains by overland flow down steep hillsides toward Mountain Blvd.



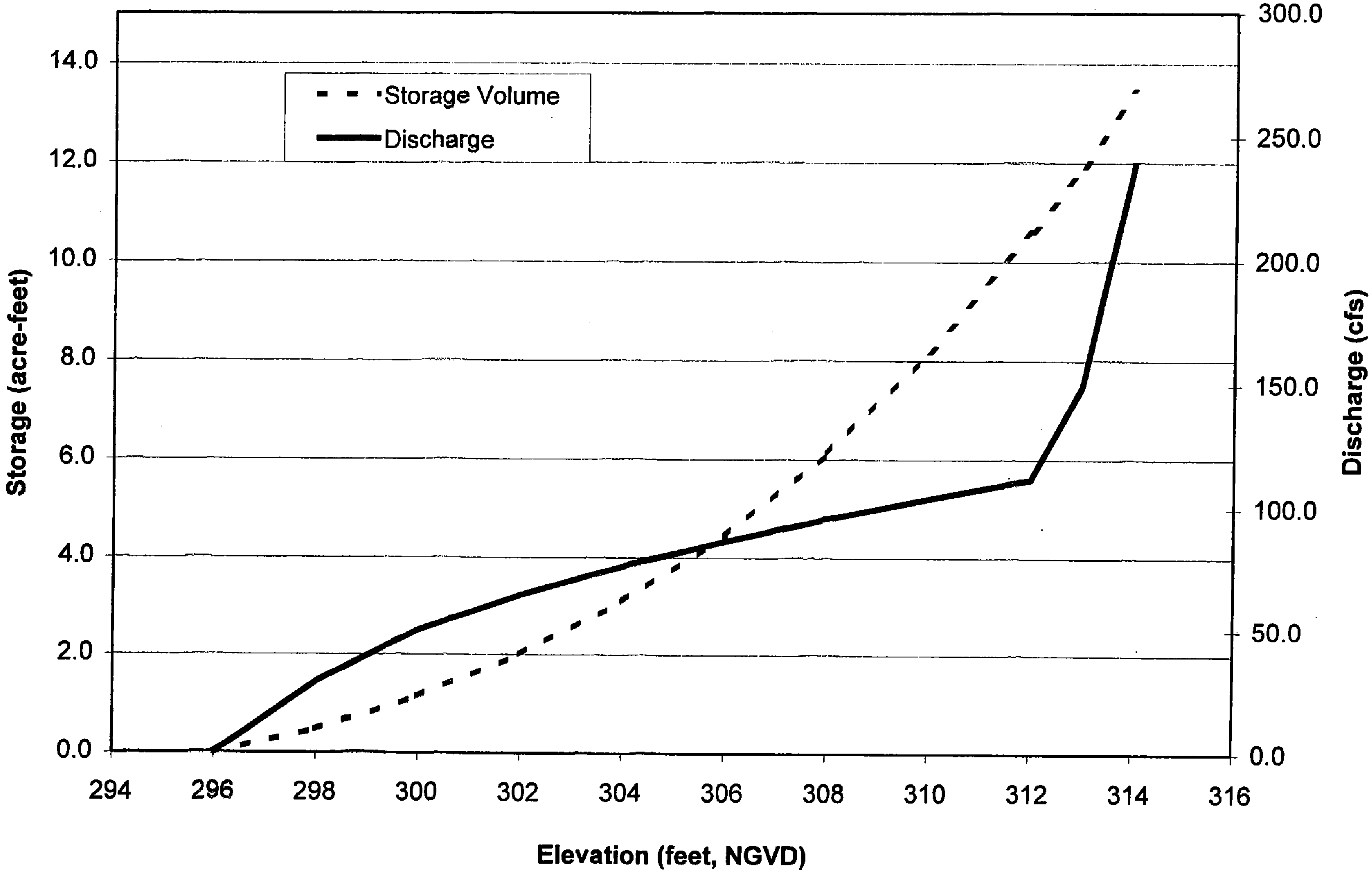
Balance Hydrologics, Inc.

Figure 4. Watershed Schematic at Leona Quarry, City of Oakland.



Balance Hydrologics, Inc.

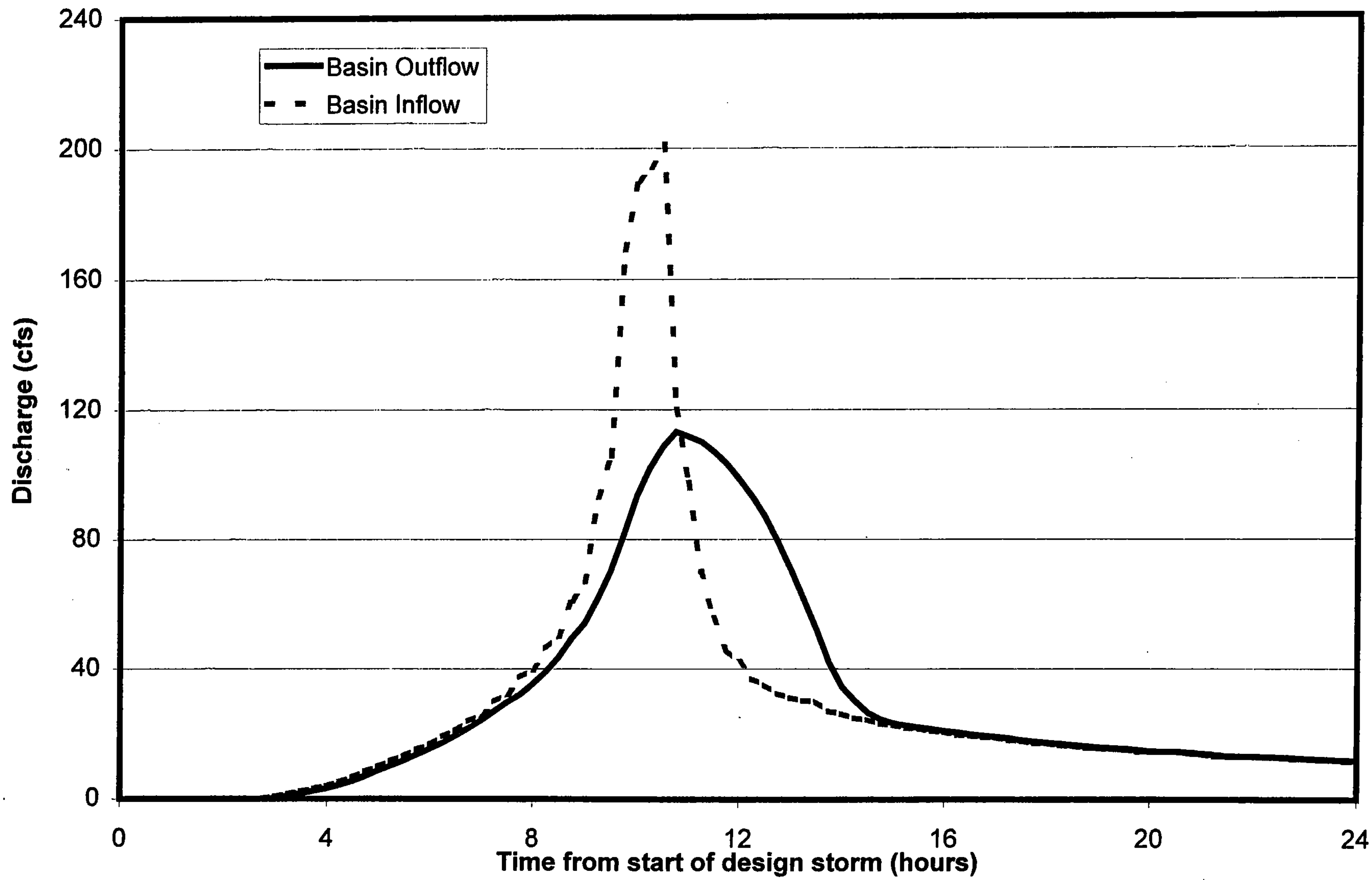
Figure 5. **Estimated rating curve for the existing upper detention basin, Leona Quarry, City of Oakland.**
Note that the outlet onsists of a single 30-inch corrugated metal pipe without a trash rack or other protection from obstructions. The basin will be overtopped at water elevations greater than 544 feet.



Balance Hydrologics, Inc.

Figure 6. **Estimated rating curve for the hypothetical stormwater basin, Leona Quarry, City of Oakland.**

Note that this basin would provide slightly more than the minimum 12 acre-feet of active detention volume. The outlet discharge is based on twin 48-inch CMP risers with crest elevations of 312.5 feet and 1.5' X 2.0' square orifices having a flowline elevation of 296.0 feet.



Balance Hydrologics, Inc.

Figure 7. **Inflow and outflow 25-year design storm hydrographs for the hypothetical stormwater basin, Leona Quarry, City of Oakland.** This relationship applies for the assumed basin and outlet parameters as shown in Figure 6. Note that peak discharge is predicted to be reduced by almost one half. The total discharge at I-580 is higher due to the additional runoff from the Mountain Boulevard sub-watershed that does not flow through the basin.

APPENDIX A
Field observer's log, Leona Quarry, City of Oakland

Appendix A. Field observer's log, Leona Quarry, City of Oakland

Site Conditions				Streamflow			Water Quality Observations				Remarks
Date/Time (mm/dd/yr)	Observer	Stage (feet)	Hydrograph (R/F/S/B)	Measured Discharge (cfs)	Instrument Used (AA/PY)	Estimated Accuracy (e/g/f/p)	Water Temperature (°C)	Field Specific Conductance (µmhos/cm)	Adjusted Specific Conductance (at 25 °C)	Additional sampling? (Qbed, etc.)	
South sedimentation/catch basin on lower quarry level											
6/22/00 17:05	eb,dls	---	---	0.0	---	---	25.7	233	226	...	Outlet pipe is 34-inch RCP
North central sedimentation/catch basin on lower quarry level											
6/22/00 17:00	eb,dls	---	---	0.0	---	---	27.5	538	504	...	Outlet pipe is 24-inch RCP
North sedimentation/catch basin on lower quarry level											
6/22/00 17:15	eb,dls	---	---	0.007	visual	f	18.9	700	796	...	Outlet pipe is 24-inch RCP
2/15/01 14:35	eb	---	---	0.300	float	g	14.8	580	733	...	
6/2/01 9:45	eb	---	---	---	---	---	---	---	---	pH	pH = 7.3 using pH papers
6/28/01 8:20	eb	---	---	0.066	float	g	21.0	1000	1081	Title 22	Float test in outflow trench
7/11/01 8:05	eb	---	---	0.066	float	g	17.5	1080	1272	...	Float test in outflow trench
North detention basin on lower quarry level											
6/22/00 17:25	eb,dls	---	---	0.0	---	---	23.9	1319	1333	...	Must be draining by infiltration
Outflow from 18-inch CMP coming down from "bowl area"											
6/22/00 17:30	eb,dls	---	---	0.028	visual	f	19.5	1319	1478	...	Steady flow of 10 to 12 gpm by visual estimate
7/21/00 13:30	dls	---	---	0.078	visual	f	20.5	1416	1549	...	Approx 30 to 40 gpm by visual estimate
2/15/01 14:00	eb	---	---	0.122	visual	f	17.8	1150	1345	...	Approx 50 to 60 gpm by visual estimate
Inflow to upper detention basin up north slope toward Ridgemont Road											
6/22/00 17:30	eb,dls	---	---	0.002	visual	f	15.1	246	308	...	Approx 1 gpm by visual estimate
7/21/00 13:30	dls	---	---	0.027	visual	f	15.0	205	258	...	Approx 10 to 15 gpm by visual estimate
2/15/01 14:15	eb	---	---	0.089	visual	f	13.2	190	250	...	Approx 40 gpm, inflow somewhat milky, basin outlet half blocked
6/28/01 8:35	eb	---	---	0.016	visual	f	15.5	265	329	...	6 to 8 gpm by vis est
Chimes Creek at off Hillmont at Edenvale											
6/7/01 16:00	eb	---	---	0.156	visual	f	---	---	---	---	Approx 60 to 80 gpm by vis est, depth of incision = 12 ft
Chimes Creek at end of Nairobi Place											
6/28/01 9:25	eb	---	---	0.055	float	g	17.3	630	746	---	Much incision, many knickpoints (see field notebook)
7/11/01 8:35	eb	---	---	0.044	visual	f	15.0	520	653	---	Definitely have water in the creek, notes say Q as previous visit

Appendix A. Field observer's log, Leona Quarry, City of Oakland

Site Conditions				Streamflow			Water Quality Observations				Remarks
Date/Time (mm/dd/yr)	Observer	Stage (feet)	Hydrograph (R/F/S/B)	Measured Discharge (cfs)	Instrument Used (AA/PY)	Estimated Accuracy (e/g/f/p)	Water Temperature (°C)	Field Specific Conductance (µmhos/cm)	Adjusted Specific Conductance (at 25 °C)	Additional sampling? (Qbed, etc.)	
Chimes Creek at Seminary and Hillmont											
7/21/00 14:30	dls	---	---	0.2	visual	f	17.0	500	597	...	Bankfull stage approx at 2.5 ft depth, heavy erosion and debris
6/28/01 10:30	eb	---	---	0.055	visual	f	---	---	---	Title 22	Est same Q as at Nairobi, channel reconstruction upstream
7/11/01 8:52	eb	---	---	0.044	visual	f	15.3	560	698		Q as before, approx 10 gpm enter under Lundholm, SC = 350 at 17.
Lion Creek at Mills College (north of Main Building)											
6/22/00 16:09	eb,dls	---	---	0.4	visual	f	18.1	700	812	...	Well developed alluvial channel
6/28/01 11:00	eb	---	---	0.125	visual	f	19.5	790	885	Title 22	
Palo Seco Creek at Palo Colorados trailhead											
5/22/01 15:30	eb	---	---	0.1	visual	f			757	pH	pH = 7.7 using pH papers
Horsheshoe Creek at Leona Heights Park											
5/22/01 16:00	eb	---	---	0.15	visual	f			549		fully alluvial channel
Rifle Range Branch of Arroyo Viejo at Leona Open Space											
5/22/01 16:15	eb	---	---	0.011	visual	f			377	pH	pH = 7.0 using pH papers

Observer Key: (eb) is Ed Ballman, (dls) is Donald Song
Stage: Water level observed at outside staff plate
Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), or baseflow (B)
Instrument: If measured, typically made using a standard (AA) or pygmy (PY) bucket-wheel ("Price-type") current meter. If estimated, from rating curve (R) or visual (V).
Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given
Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation (1.8813774452 - [0.050433063928 * field temp] + [0.00058561144042 * field temp^2]) * Field specific conductance
Additional Sampling: Qbed = Bedload, Qss = Suspended sediment, Nutr = nutrients; other symbols as appropriate

APPENDIX B
Results of water quality analyses, Chimes Creek watershed, City of Oakland

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY

A Division of Control Laboratories Inc.

Tel: 831 724-5422
FAX: 831 724-3188

In any reference, please quote Certified Analysis Number appearing hereon.

155095-3-4205

Balance Hydrologics Inc.
900 Modoc Street
Berkeley CA 94707-2208

16 JUL 01

CERTIFIED ANALYTICAL REPORT

Sampled at Leona Quarry North Sedimentation Basin 06/28/01 at 8:20 hrs

MATERIAL: Water sample received 29 June 2001
IDENTIFICATION: Leona, Project 200057, LQ010628
REPORT: Quantitative chemical analysis is as follows expressed as milligrams per liter (parts per million):

			PUBLIC HEALTH DRINKING WATER LIMITS[1]
pH value (units)		7.9	10.6
Conductivity (micromhos/cm)		1150	1600
Carbonate Alk.	(as $CaCO_3$)	0	120
Bicarbonate Alk.	(as $CaCO_3$)	250	-
Total Alkalinity	(as $CaCO_3$)	250	-
Total Hardness	(as $CaCO_3$)	600	-
Total Dissolved Solids		850	1000
Nitrate	(as NO_3)	4.0	45
Chloride	(Cl)	19	250
Sulfate	(SO_4)	430	250
Fluoride	(F)	0.21	1.0
Calcium	(Ca)	160	-
Magnesium	(Mg)	49	-
Potassium	(K)	1.4	-
Sodium	(Na)	36	-
Total Iron	(Fe)	< 0.05	0.3
Manganese	(Mn)	0.26	0.05

[1] California Administrative Code; Title 22

The undersigned certifies that the above is a true and accurate report of the findings of this Laboratory.

Analyst

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

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FAX: 831 724-3188

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE

A Division of Control Laboratories Inc.

In any reference, please quote Certified Analysis Number appearing hereon.

155095-3-4205

Balance Hydrologics Inc.
900 Modoc Street
Berkeley CA 94707-2208

16 JUL 01

CERTIFIED ANALYTICAL REPORT

MATERIAL: Water sample received 29 June 2001
IDENTIFICATION: Leona, Project 200057, LQ010628
REPORT: Quantitative chemical analysis is as follows expressed as milligrams per liter:

		PUBLIC HEALTH DRINKING WATER LIMITS[1]
Arsenic (As)	< 0.002	0.05
Barium (Ba)	< 0.1	1.0
Boron (B)	0.21	-
Cadmium (Cd)	< 0.001	0.005
Chromium (Cr)	< 0.01	0.05
Copper (Cu)	< 0.05	1.0
Cyanide (CN)	< 0.05	0.2
Lead (Pb)	< 0.005	0.05
Mercury (Hg)	< 0.0002	0.002
Selenium (Se)	< 0.005	0.05
Silver (Ag)	< 0.010	0.1
Zinc (Zn)	< 0.05	5.0
MBAS (Surfactants)	-	0.5
Aluminum (Al)	< 0.05	1.0
Antimony (Sb)	< 0.006	0.006
Beryllium (Be)	< 0.001	0.004
Nickel (Ni)	< 0.01	0.1
Thallium (Tl)	< 0.001	0.002
Nitrite (as NO_2)	< 0.5	-

[1] California Administrative Code; Title 22

The undersigned certifies that the above is a true and accurate report of the findings of this Laboratory.

Analyst

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

Tel: 831 724-5422
FAX: 831 724-3188

42 HANGAR WAY

A Division of Control Laboratories Inc.

In any reference, please quote Certified Analysis Number appearing hereon.

155095-3-4205

Balance Hydrologics Inc.
900 Modoc Street
Berkeley CA 94707-2208

16 JUL 01

CERTIFIED ANALYTICAL REPORT

MATERIAL: Water sample received 29 June 2001
IDENTIFICATION: Leona, Project 200057, LQ010628
REPORT: General Physical Analysis is as follows:

TEMPERATURE (°C)	COLOR (Co/Pt) (Units)	ODOR (Threshold (Number)	TURBIDITY (NTU)	pH value (units)
-	< 3	< 1	1.2	7.9

-not determined
Odor test performed at 60°C

The undersigned certifies that the above is a true and accurate report of the findings of this Laboratory.

Analyst

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Balance Hydrologics Inc.
900 Modoc Street
Berkeley CA 94707-2208

16 JUL 01

CERTIFIED ANALYTICAL REPORT

Sample from Chimes Creek at Lundholm, taken at 9:25 hrs on 6/28/01

MATERIAL:	Water sample received 29 June 2001	
IDENTIFICATION:	Leona, Project 200057, CC010628	
REPORT:	Quantitative chemical analysis is as follows expressed as milligrams per liter (parts per million):	PUBLIC HEALTH DRINKING WATER LIMITS[1]
pH value (units)	8.0	10.6
Conductivity (micromhos/cm)	710	1600
Carbonate Alk. (as $CaCO_3$)	0	120
Bicarbonate Alk. (as $CaCO_3$)	190	-
Total Alkalinity (as $CaCO_3$)	190	-
Total Hardness (as $CaCO_3$)	305	-
Total Dissolved Solids	500	1000
Nitrate (as NO_3)	5.3	45
Chloride (Cl)	24	250
Sulfate (SO_4)	170	250
Fluoride (F)	0.24	1.0
Calcium (Ca)	71	-
Magnesium (Mg)	31	-
Potassium (K)	1.4	-
Sodium (Na)	37	-
Total Iron(Fe)	< 0.05	0.3
Manganese (Mn)	< 0.015	0.05

[1] California Administrative Code; Title 22

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SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE

A Division of Control Laboratories Inc.

In any reference, please quote Certified Analysis Number appearing hereon.

155095-3-4205

Balance Hydrologics Inc.
900 Modoc Street
Berkeley CA 94707-2208

16 JUL 01

CERTIFIED ANALYTICAL REPORT

MATERIAL: Water sample received 29 June 2001
IDENTIFICATION: Leona, Project 200057, CG010628
REPORT: Quantitative chemical analysis is as follows expressed as milligrams per liter:

		PUBLIC HEALTH DRINKING WATER LIMITS[1]
Arsenic (As)	< 0.002	0.05
Barium (Ba)	< 0.1	1.0
Boron (B)	0.34	-
Cadmium (Cd)	< 0.001	0.005
Chromium (Cr)	< 0.01	0.05
Copper (Cu)	< 0.05	1.0
Cyanide (CN)	< 0.05	0.2
Lead (Pb)	< 0.005	0.05
Mercury (Hg)	< 0.0002	0.002
Selenium (Se)	< 0.005	0.05
Silver (Ag)	< 0.010	0.1
Zinc (Zn)	< 0.05	5.0
MBAS (Surfactants)	-	0.5
Aluminum (Al)	< 0.05	1.0
Antimony (Sb)	< 0.006	0.006
Beryllium (Be)	< 0.001	0.004
Nickel (Ni)	< 0.01	0.1
Thallium (Tl)	< 0.001	0.002
Nitrite (as NO_2)	< 0.5	-

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Balance Hydrologics Inc.
900 Modoc Street
Berkeley CA 94707-2208

16 JUL 01

CERTIFIED ANALYTICAL REPORT

MATERIAL: Water sample received 29 June 2001
IDENTIFICATION: Leona, Project 200057, CC010628
REPORT: General Physical Analysis is as follows:

TEMPERATURE (°C)	COLOR (Co/Pt) (Units)	ODOR (Threshold (Number)	TURBIDITY (NTU)	pH value (units)
-	20	< 1	0.9	8.0

- not determined
Odor test performed at 60°C

The undersigned certifies that the above is a true and accurate report of the findings of this Laboratory.

Analyst

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Balance Hydrologics Inc.
900 Modoc Street
Berkeley CA 94707-2208

16 JUL 01

CERTIFIED ANALYTICAL REPORT

Sample from Lion Creek at Mills College, taken 11:00 hrs on 6/28/01

MATERIAL: Water sample received 29 June 2001
IDENTIFICATION. Leona, Project 200057, LC010628
REPORT: Quantitative chemical analysis is as follows expressed as milligrams per liter (parts per million):

		PUBLIC HEALTH DRINKING WATER LIMITS[1]
pH value (units)	7.5	10.6
Conductivity (micromhos/cm)	940	1600
Carbonate Alk. (as $CaCO_3$)	0	120
Bicarbonate Alk. (as $CaCO_3$)	255	-
Total Alkalinity (as $CaCO_3$)	255	-
Total Hardness (as $CaCO_3$)	430	-
Total Dissolved Solids	610	1000
Nitrate (as NO_3)	4.3	45
Chloride (Cl)	52	250
Sulfate (SO_4)	210	250
Fluoride (F)	0.23	1.0
Calcium (Ca)	54	-
Magnesium (Mg)	72	-
Potassium (K)	16	-
Sodium (Na)	27	-
Total Iron(Fe)	< 0.05	0.3
Manganese (Mn)	0.03	0.05

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Analyst

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155095-3-4205

Balance Hydrologics Inc.
900 Modoc Street
Berkeley CA 94707-2208

16 JUL 01

CERTIFIED ANALYTICAL REPORT

MATERIAL: Water sample received 29 June 2001
IDENTIFICATION: Leona, Project 200057, LC010628
REPORT: Quantitative chemical analysis is as follows expressed as milligrams per liter:

		PUBLIC HEALTH DRINKING WATER LIMITS[1]
Arsenic (As)	< 0.002	0.05
Barium (Ba)	< 0.1	1.0
Boron (B)	< 0.1	-
Cadmium (Cd)	< 0.001	0.005
Chromium (Cr)	< 0.01	0.05
Copper (Cu)	< 0.05	1.0
Cyanide (CN)	< 0.05	0.2
Lead (Pb)	< 0.005	0.05
Mercury (Hg)	< 0.0002	0.002
Selenium (Se)	< 0.005	0.05
Silver (Ag)	< 0.010	0.1
Zinc (Zn)	< 0.05	5.0
MBAS (Surfactants)	-	0.5
Aluminum (Al)	< 0.05	1.0
Antimony (Sb)	< 0.006	0.006
Beryllium (Be)	< 0.001	0.004
Nickel (Ni)	< 0.01	0.1
Thallium (Tl)	< 0.001	0.002
Nitrite (as NO_2)	< 0.5	-

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In any reference, please quote Certified Analysis Number appearing hereon.

155095-3-4205

Balance Hydrologics Inc.
900 Modoc Street
Berkeley CA 94707-2208

16 JUL 01

CERTIFIED ANALYTICAL REPORT

MATERIAL: Water sample received 29 June 2001
IDENTIFICATION: Leona, Project 200057, LC010628
REPORT: General Physical Analysis is as follows:

TEMPERATURE (°C)	COLOR (Co/Pt) (Units)	ODOR (Threshold (Number)	TURBIDITY (NTU)	pH value (units)
-	40	< 1	1.4	7.5

-not determined
Odor test performed at 60°C

The undersigned certifies that the above is a true and accurate report of the findings of this Laboratory.

Analyst

APPENDIX C
HEC-HMS model output for existing and proposed conditions, Leona Quarry, City of Oakland

HMS * Summary of Result

Project : 200057 Leona Quarry   Run Name : Run 6

Start of Simulation : 01Jan10 0000   Basin Model : Existing
End of Simulation : 02Jan10 0400   Precip Model : 2-yr 24-hr Storm
Execution Time : 16Jul01 2148   Control Specs : 24-hr Control

Hydrologic Element	Discharge Peak (cfs)	Time of Peak		Total Volume (ac ft)	Drainage Area (sq mi)
Ridgemont Road	32.634	01 Jan 10	1031	7.7309	0.1312
Upper Detention	30.586	01 Jan 10	1034	7.7309	0.1312
Quarry	78.114	01 Jan 10	1000	22.310	0.1781
Quarry + Ridgemont	105.81	01 Jan 10	1030	30.040	0.3093
Mountain Blvd	21.949	01 Jan 10	1031	4.9346	0.1188
I-580	127.75	01 Jan 10	1030	34.975	0.4281

HMS * Summary of Result

Project : 200057 Leona Quarry   Run Name : Run 1

Start of Simulation : 01Jan10 0000   Basin Model : Existing
End of Simulation : 02Jan10 0400   Precip Model : 25-yr 24-hr Storm
Execution Time : 16Jul01 2148   Control Specs : 24-hr Control

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Total Volume (ac ft)	Drainage Area (sq mi)
Ridgemont Road	82.027	01 Jan 10 1030	21.345	0.1312
Upper Detention	70.522	01 Jan 10 1035	21.345	0.1312
Quarry	149.77	01 Jan 10 1000	45.030	0.1781
Quarry + Ridgemont	212.48	01 Jan 10 1030	66.375	0.3093
Mountain Blvd	63.943	01 Jan 10 1030	15.768	0.1188
I-580	276.42	01 Jan 10 1030	82.143	0.4281

HMS * Summary of Result

Project : 200057 Leona Quarry Run Name : Run 5

Start of Simulation : 01Jan10 0000 Basin Model : Existing
End of Simulation : 02Jan10 0400 Precip Model : 100-yr 24-hr Storm
Execution Time : 16Jul01 2149 Control Specs : 24-hr Control

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Total Volume (ac ft)	Drainage Area (sq mi)
Ridgemont Road	109.38	01 Jan 10 1030	29.412	0.1312
Upper Detention	102.65	01 Jan 10 1034	29.412	0.1312
Quarry	187.51	01 Jan 10 1000	57.339	0.1781
Quarry + Ridgemont	279.75	01 Jan 10 1030	86.752	0.3093
Mountain Blvd	88.222	01 Jan 10 1030	22.512	0.1188
I-580	367.97	01 Jan 10 1030	109.26	0.4281

HMS * Summary of Result

Project : 200057 Leona Quarry   Run Name : Run 7

Start of Simulation : 01Jan10 0000   Basin Model : Post-proj
End of Simulation : 02Jan10 0400   Precip Model : 2-yr 24-hr Storm
Execution Time : 16Jul01 2152   Control Specs : 24-hr Control

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Total Volume (ac ft)	Drainage Area (sq mi)
Ridgemont Road	36.141	01 Jan 10 1031	8.5618	0.1453
Upper Detention	33.851	01 Jan 10 1034	8.5618	0.1453
Outlet Pipe	33.851	01 Jan 10 1035	8.5618	0.1453
Quarry	57.077	01 Jan 10 1030	14.462	0.1781
Pre-detention	90.400	01 Jan 10 1031	23.023	0.3234
New Basin	73.611	31 Dec 09 2400	25.922	0.3234
Mountain Blvd	21.949	01 Jan 10 1031	4.9346	0.1188
I-580	90.733	01 Jan 10 1032	30.857	0.4422

HMS * Summary of Result

Project : 200057 Leona Quarry   Run Name : Run 2

Start of Simulation : 01Jan10 0000   Basin Model : Post-proj
End of Simulation : 02Jan10 0400   Precip Model : 25-yr 24-hr Storm
Execution Time : 16Jul01 2153   Control Specs : 24-hr Control

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Total Volume (ac ft)	Drainage Area (sq mi)
Ridgemont Road	90.842	01 Jan 10 1030	23.638	0.1453
Upper Detention	76.465	01 Jan 10 1035	23.638	0.1453
Outlet Pipe	76.465	01 Jan 10 1036	23.638	0.1453
Quarry	127.23	01 Jan 10 1003	34.994	0.1781
Pre-detention	201.17	01 Jan 10 1031	58.633	0.3234
New Basin	113.39	01 Jan 10 1047	61.532	0.3234
Mountain Blvd	63.943	01 Jan 10 1030	15.768	0.1188
I-580	172.69	01 Jan 10 1031	77.300	0.4422

HMS * Summary of Result

Project : 200057 Leona Quarry   Run Name : Run 3

Start of Simulation	: 01Jan10 0000	Basin Model	: Post-proj
End of Simulation	: 02Jan10 0400	Precip Model	: 100-yr 24-hr Storm
Execution Time	: 16Jul01 2153	Control Specs	: 24-hr Control

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Total Volume (ac ft)	Drainage Area (sq mi)
Ridgemont Road	121.14	01 Jan 10 1030	32.573	0.1453
Upper Detention	115.72	01 Jan 10 1033	32.573	0.1453
Outlet Pipe	115.72	01 Jan 10 1034	32.573	0.1453
Quarry	166.27	01 Jan 10 1003	46.648	0.1781
Pre-detention	277.47	01 Jan 10 1031	79.221	0.3234
New Basin	253.82	01 Jan 10 1036	82.120	0.3234
Mountain Blvd	88.222	01 Jan 10 1030	22.512	0.1188
I-580	335.00	01 Jan 10 1032	104.63	0.4422

APPENDIX F

BALANCE HYDROLOGICS, INC., MEMORANDUM TO DAVID CHAPMAN AND GRANT GIBSON, OCTOBER 23, 2001B

Memo

To: David Chapman, The DeSilva Group
Grant Gibson, Carlson, Barbee & Gibson

From: Ed Ballman

Date: October 23, 2001

Subject: Assessment of required stormwater detention capacities at Leona Quarry

Per David's request, we have examined the impact that adding the Ridgemont drainage has on required detention capacities at Leona Quarry.

It is important to note that our July 2001 report was based on the pond dimensions indicated in the July 6, 2001 conceptual grading plan prepared by CBG. The only change that we made was to extend the basin floor down to an elevation of 296 feet to gain incremental storage volume. With this change, we calculate that the total basin volume is 13.4 acre-feet at an elevation of 314 feet. Therefore, the basin does meet the 12 acre-feet volume goal for detention purposes.

We ran the hydrologic models for the post-project conditions without the additional 9.0 acres from Ridgemont. The results are summarized in the table below, values in parentheses are with the extra Ridgemont area:

	Peak Q at I-580 (cfs)	**Maximum Basin Volume (ac-ft)**	**Maximum Basin Water Surface Elevation (ft)**
25-year Storm	172 (173)	10.2 (10.7)	311.7 (312.0)
100-year Storm	315 (335)	13.1 (13.3)	313.8 (313.9)

As shown in the table, the impact of the extra acreage depends on the design storm investigated (remembering that the overriding concern is the 25-year storm event). For the 25-year storm, removing the extra Ridgemont acreage has essentially no impact on the total peak discharge predicted at I-580. However, the maximum basin volume increases by roughly five percent and the maximum water surface elevation increases by 0.3 feet. The latter point may prove important since we will probably have some restrictive freeboard requirements for whatever size basin is actually built.

The situation is almost reversed for the 100-year storm. The change in predicted peak discharge is significant, but the change in total basin volume required and maximum water surface is minor.

In any case, taking out the extra Ridgemont drainage doesn't seem to resolve anything in a clear way. The key point seems to be that the conceptual grading provides a basin size that can mitigate for peak flows and net the significant beneficial impact of limiting flooding in the canyons below Ridgemont. The modeling also shows that the post-project runoff from the graded and restored site can reasonably be expected to be lower, even without the large detention basin. The conclusion that the project creates a significant adverse impact on peak flows in Chimes Creek is not supported.

It is very important to note that the total capacity of 16 acre-feet was suggested as a very liberal allowance (4 acre-feet) for water quality treatment. This would provide a level of treatment that we feel goes well beyond the current Regional Board expectations and was only put forth as a design goal for conceptual planning, **<u>not</u>** a water quality standard that must be met. Stormwater quality management should be a multi-faceted approach wherein water quality ponds or basins are one element. In fact, the Regional Board expects as much. The EIR should recognize that a restored Quarry will have significant beneficial impacts as well (e.g. a much-reduced potential for sediment or turbidity impairments downstream). The conclusion that post-project water quality impacts (of metals, oils and greases, pesticides) are potentially significant should not be surprising, but it is certainly a mitigable impact regardless of whether 4 acre-feet of additional volume is provided or not.

APPENDIX G

BALANCE HYDROLOGICS, INC., LETTER TO DAVID CHAPMAN, DESILVA GROUP, REGARDING MODELING OF ALTERNATIVE BASIN DESIGN, OCTOBER 16, 2003

Balance
Hydrologics, Inc.

841 Folger Avenue • Berkeley, CA 94710-2800
(510) 704-1000 • *(fax) 704-1001* • email: office@balancehydro.com

October 16, 2003

Mr. David Chapman
The DeSilva Group
11555 Dublin Boulevard
Dublin, California 94568

RE: Modeling of Alternative Detention Basin Design

Dear Mr. Chapman:

Per your request, we have modeled a potential alternative design for the proposed detention basin at Leona Quarry to accommodate removal of the Pond 4 (Ridgemont pond) and inclusion of additional water-quality volume. This letter describes a configuration of the alternative design and summarizes the findings of the hydrologic modeling.

Alternative Basin Design

The modeling runs were based on an alternative basin configuration that includes several design modifications to significantly increase the potential detention volume while maintaining the same basin footprint as the base basin design analyzed in the SEIR. The design modifications include using 2.5:1 slopes on the interior of the basin, constructing a 3-foot high interior wall, and raising the top of berm to 318.5 feet. The bottom elevation of the basin would remain at 296 feet. Other combinations of design option elements could also be utilized with similar results.

The stage-storage relationship for the alternative design was taken from tables provided by Carlson, Barbee & Gibson, Inc. The storage capacity of this alternative as analyzed is 23.5 acre-feet at an elevation of 317.5 feet, with the total available volume being 25.4 acre-feet at an elevation of 318.5 feet.

Modeling Parameters

The HEC-1 modeling of the alternative design uses the input parameters for the SCS methodology as confirmed by PWA. All post-project modeling continues to include the addition of 4.5 acres of drainage area from the Ridgemont sub-division that is presently drained over the hillside toward the Leona Heights neighborhood.

Integrated Surface and Ground Water Hydrology • Water Quality and Sediment Quality • Erosion and Sedimentation • Wetlands

Routing of Design Storms through the Alternative Detention Basin

There are two significant differences in the routing of the design storms between the base basin design summarized in the SEIR and this alternative configuration:

1. Removal of Pond 4. The modeling of the post-project conditions for the alternative basin includes only the proposed alternative detention basin and not the existing Pond 4. This represents the anticipated post-project conditions if Pond 4 is removed or otherwise modified to the extent that it provides no detention. This contrasts with the base case in the SEIR where the post-project modeling includes detention from the existing Pond 4 (with modifications) and the modified plan basin with 15.6 acre-feet of detention volume.

2. Increase in water-quality volume. The modeling is also based on an outlet configuration that would have the lowest detention orifice at an elevation of approximately 303.2 feet. This allows the volume between elevations 296 and 303.2 feet, a total volume of 3.0 acre-feet, to function as a water-quality pond that would drain through a separate low-flow outlet in 48 hours. This volume was selected to exceed the new treatment BMP requirements of the San Francisco Bay Area Regional Water Quality Control Board (RWQCB) as recently adopted in the revised General Discharge Permit for Alameda County. In all cases, the water-quality volume is assumed to be completely filled at the start of the design storm.

Modeling Results

The HEC-1 modeling shows that the alternative basin design would reduce peak flows at I-580 for all the design storms examined in the SEIR.[1] The following table summarizes the results in terms of peak flow at I-580 in relation to the existing peak flow values taken from the October 2003 PWA report utilizing the same hydrologic parameters.

Design Storm		Existing Flow (cfs)		Post-project Flow (cfs)
2-year		71		70
5-year		112		99
10-year		139		122
25-year		168		159
100-year		224		223

For the 25-year event, the predicted maximum water surface elevation is 314.8 feet, at which point the total utilized volume would be 18.2 acre-feet (15.2 acre-feet of detention plus 3.0 acre-

[1] Although the guidelines of the Alameda County Flood Control and Water Conservation District only require analysis for the 25- and 100-year design storms, these analyses have also examined the 2-, 5-, 10-, 25- and 100-year events in order to configure the basin to reduce peak flows for the more frequent storms capable of causing localized flooding as well.

feet of water-quality volume). The maximum predicted water surface elevation for the 100-year design storm is 317.4 feet, equivalent to a total utilized volume of 23.3 acre-feet (20.3 acre-feet of detention volume) The HEC-1 model output for the 25-year event is attached for reference.

Closing

The modeling of the alternative basin design summarized here shows that this basin configuration exceeds CEQA requirements for mitigation of hydrologic impacts. This is true even under the assumption that you may choose to remove the existing Pond 4 in addition to the other ponds at the site. Additionally, the alternative basin design can provide water-quality treatment volume that exceeds the requirements of the RWQCB.

Do not hesitate to contact Balance Hydrologics if you have questions or comments related to the modeling work performed.

BALANCE HYDROLOGICS, INC.

Sincerely,

Edward D. Ballman, P.E.
Civil Engineer / Hydrologist

Attachments: HEC-1 output for the 25-year design storm

100803A

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1*****************************************                          ***************************************
 *                                       *                          *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                          *    U.S. ARMY CORPS OF ENGINEERS     *
 *            JUN   1998                 *                          *   HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                 *                          *         609 SECOND STREET           *
 *                                       *                          *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   16OCT03  TIME  16:15:52   *                          *          (916) 756-1104             *
 *                                       *                          *                                     *
*****************************************                           ***************************************


                                   X     X  XXXXXXX   XXXXX         X
                                   X     X  X        X     X       XX
                                   X     X  X        X              X
                                   XXXXXXX  XXXX     X       XXXXX  X
                                   X     X  X        X              X
                                   X     X  X        X     X        X
                                   X     X  XXXXXXX   XXXXX        XXX


           THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

           THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
           THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
           NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
           DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
           KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                   HEC-1 INPUT                                                 PAGE  1

 LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1        ID   LEONA QUARRY POST DEVELOPMENT 25-YEAR STORM
            *  MODEL PARAMETERS FROM DISCUSSIONS W/ PWA
   2        IT       5 01JAN10    0000     300
   3        IO       5       0
            *DIAGRAM
            *  ************************************

   4        KK   RIDG1
   5        KM   RIDGEMONT SUB-BASIN WITH ADDITIONAL ACREAGE
   6        BA    .085
   7        PB    5.05
   8        IN      30 01JAN10    0000
   9        PC       0   .0135   .0251   .0382   .0518   .0660   .0810   .0967   .1131   .1304
  10        PC   .1491   .1690   .1903   .2135   .2389   .2675   .3001   .3385   .3862   .4570
  11        PC   .5806   .6975   .7304   .7552   .7760   .7935   .8093   .8246   .8379   .8502
  12        PC   .8616   .8724   .8826   .8923   .9016   .9104   .9188   .9269   .9347   .9422
  13        PC   .9494   .9565   .9633   .9698   .9762   .9824   .9884   .9943   1.000
  14        LS       0    85.5       0
  15        UD   0.132
            *  ************************************

  16        KK   RIDG2
  17        KM   RIDGEMONT OPEN SPACE AREA DRAINING TO BASIN 4
  18        BA   0.041
  19        LS       0    79.0       0
  20        UD   0.145
            *  ************************************
```

```
 21             KK   RIDGE
 22             KM   COMBINE THE TWO RIDGEMONT HYDROGRAPHS
 23             HC       2
                *  ***********************************

 24             KK   LQDEV
 25             KM   QUARRY POST-PROJECT CONDITIONS
 26             BA    .152
 27             LS       0    90.8       0
 28             UD    .128
                *  ***********************************

 29             KK  PREDET
 30             KM   COMBINE HYDROGRAPHS FROM RIDGEMONT AND QUARRY PRIOR TO NEW DETENTION BASIN
 31             HC       2
                *  ***********************************

 32             KK   LQTOT
 33             KM   ROUTE THROUGH NEW DETETION BASIN
 34             RS       1    STOR    2.97       0
 35             SV     3.0     3.6     4.5     5.5     6.6     7.7     9.0    10.4    11.8    13.4
 36             SV    15.0    16.7    18.5    20.5    21.4    22.4    23.5    24.5
 37             SE   303.2     304     305     306     307     308     309     310     311     312
 38             SE     313     314     315     316   316.5     317   317.5     318
 39             SQ     0.0     5.4    16.5    32.3    40.3    46.9    52.7    58.0    62.8    67.2
 40             SQ    77.2    91.5   100.8   108.7   112.4   130.6   153.7   170.6
                *  ***********************************
1                                                 HEC-1 INPUT                                            PAGE  2

      LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 41             KK     MTN
 42             KM   MOUNTAIN SUB-BASIN EXISTING CONDITIONS
 43             BA   .0830
 44             LS       0      87       0
 45             UD    .230
                *  ***********************************

 46             KK    I580
 47             KM   I-580 SUB-BASIN
 48             BA   0.011
 49             LS       0    84.9       0
 50             UD   0.148
                *  ***********************************

 51             KK     ALL
 52             KM   COMBINE ALL HYDROGRAPHS TO GIVE TOTAL AT I-580 CROSSING
 53             HC       3
 54             ZZ
1
            SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.       (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   4        RIDG1
                .
                .
  16            .        RIDG2
                .            .
                .            .
  21        RIDGE............
                .
                .
```

```
24          .       LQDEV
            .           .
            .           .
29    PREDET.............
            V
            V
32     LQTOT
            .
            .
41          .          MTN
            .           .
            .           .
46          .           .          I580
            .           .             .
            .           .             .
51       ALL.......................

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*           JUN   1998                  *
*         VERSION 4.1                   *
*                                       *
*  RUN DATE   16OCT03  TIME  16:15:52   *
*                                       *
*****************************************

*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************


              LEONA QUARRY POST DEVELOPMENT 25-YEAR STORM

 3 IO         OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE     1JAN10  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     2JAN10  ENDING DATE
                   NDTIME       0055  ENDING TIME
                    ICENT         19  CENTURY MARK

               COMPUTATION INTERVAL     .08 HOURS
                    TOTAL TIME BASE   24.92 HOURS

         ENGLISH UNITS
              DRAINAGE AREA           SQUARE MILES
              PRECIPITATION DEPTH     INCHES
              LENGTH, ELEVATION       FEET
              FLOW                    CUBIC FEET PER SECOND
              STORAGE VOLUME          ACRE-FEET
              SURFACE AREA            ACRES
              TEMPERATURE             DEGREES FAHRENHEIT
1
                                   RUNOFF SUMMARY
                             FLOW IN CUBIC FEET PER SECOND
                          TIME IN HOURS,  AREA IN SQUARE MILES

                                 PEAK   TIME OF   AVERAGE FLOW FOR MAXIMUM PERIOD    BASIN   MAXIMUM   TIME OF
      OPERATION      STATION     FLOW    PEAK                                        AREA     STAGE   MAX STAGE
```

+					6-HOUR	100803A 24-HOUR	72-HOUR			
+	HYDROGRAPH AT	RIDG1	56.	10.08	21.	8.	8.	.09		
+	HYDROGRAPH AT	RIDG2	24.	10.50	8.	3.	3.	.04		
+	2 COMBINED AT	RIDGE	80.	10.50	29.	11.	11.	.13		
+	HYDROGRAPH AT	LQDEV	111.	10.08	42.	16.	16.	.15		
+	2 COMBINED AT	PREDET	191.	10.08	72.	27.	26.	.28		
+	ROUTED TO	LQTOT	99.	10.75	65.	27.	26.	.28		
+									314.84	10.75
+	HYDROGRAPH AT	MTN	56.	10.50	21.	8.	8.	.08		
+	HYDROGRAPH AT	I580	7.	10.50	3.	1.	1.	.01		
+	3 COMBINED AT	ALL	159.	10.58	88.	36.	35.	.37		

*** NORMAL END OF HEC-1 ***

APPENDIX H

BERLOGER GEOTECHNICAL CONSULTANTS, LETTER TO DAVID CHAPMAN, DESILVA GROUP, REGARDING LOWER DETENTION BASIN, SLOPE STABILITY ANALYSIS, LEONA QUARRY

BGC
BERLOGAR
GEOTECHNICAL
CONSULTANTS

Via Facsimile and Mail

September 26, 2003
Job No. 2420.000

Mr. David Chapman
The DeSilva Group
11555 Dublin Boulevard
P.O. Box 2922
Dublin, California 94568

Subject: Lower Detention Basin
Slope Stability Analysis
Leona Quarry
Mountain Boulevard
Oakland, California

Dear Mr. Chapman:

INTRODUCTION

Per your request we have performed slope stability analyses on the proposed lower detention basin at Leona Quarry in Oakland, California. Two basin configurations prepared by Carlson Barbee Gibson (CBG), Alternative 1 and Alternative 4A, were analyzed. Generally, Alternative 1 has the shallowest basin and most moderate inboard slopes of all of CBG's alternatives, and Alternative 4A includes the deepest basin and steepest inboard slopes. We also performed a third analysis on a modified version of Alternative 4A. A description of the three basin configurations, the results of their stability analyses, and our conclusions are presented as follows.

DESCRIPTION OF BASIN ALTERNATIVES

The proposed project (Alternative 1) is the least critical of all of the basin configurations provided by CBG. On the southwest side, it includes 15½ foot high, 3 horizontal to 1 vertical (3H:1V) inboard and outboard slopes with a 10 foot wide road at the top of the berm. On the northeast side, the inboard slope is 15½ feet high and 3H:1V steep from the bottom of the basin to a 10 foot wide bench/road, after which it continues further upslope at 2H:1V to the proposed development.

Alternative 4A utilizes 6+/- foot high retaining walls and 2H:1V slopes inboard, and a basin depth of 29.5 feet. This basin provides a capacity of about 34 acre-feet.

The modified version of Alternative 4A consists of a 1½H:1V outboard slope (reinforced with geogrid), 2H:1V inboard slope, no in-board retaining wall and roughly the same depth as

Alternative 4A. No bench is included on the inboard slope on the northeast side, therefore, the slope is about 30 to 50 feet high from the bottom of the basin up to the nearest proposed residence. This modified version allows for nearly the same capacity as Alternative 4A.

SLOPE STABILITY ANALYSIS

The model for our slope stability analysis included groundwater and subsurface soil conditions encountered in our borings, and basin cross sections (A and B) provided by CBG for each alternative. Three material types were utilized in our stability model as follows.

Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
Existing Fill	125	35	300
New Fill	130	37	300
Rhyolite Bedrock	165	52	0

The computer program UTEXAS3 was utilized for our slope stability analyses which included static, seismic, and rapid drawdown conditions. The following tables summarize the results of our analyses for each of the alternatives.

ALTERNATIVE 1

Section	Location of Slip Plane	Factors of Safety		
		Static	Seismic k=0.15	Rapid Drawdown
A	Southwest Inboard Slope	5.29	2.77	2.93
	Northeast Inboard Slope	4.17	2.35	2.72
B	Southwest Inboard Slope	5.99	3.08	3.36
	Northeast Inboard Slope	2.39	1.62	2.22

ALTERNATIVE 4A

Section	Location of Slip Plane	Factors of Safety		
		Static	Seismic k=0.15	Rapid Drawdown
A	Southwest Inboard Slope	3.08	1.95	1.42
	Northeast Inboard Slope	3.06	1.90	1.46
B	Southwest Inboard Slope	3.26	2.20	1.59
	Northeast Inboard Slope	2.16	1.51	1.47

ALTERNATIVE 4A MODIFIED by BGC

Section	Location of Slip Plane	Factors of Safety		
		Static	Seismic k=0.15	Rapid Drawdown
A	Southwest Inboard Slope	3.25	1.95	1.77
	Northeast Inboard Slope	2.96	1.81	1.52
B	Southwest Inboard Slope	3.59	2.14	1.82
	Northeast Inboard Slope	2.12	1.48	1.69

CONCLUSIONS

Based on the results of our analyses, we believe that each of the alternative basin configurations evaluated are stable under static, seismic, and rapid drawdown conditions. Alternative 4A has the highest and steepest slopes compared to the other alternatives proposed by CBG, therefore, it is our opinion that the other alternatives would also be stable.

The modified version of Alternative 4A would create a relatively high northeast inboard slope, therefore, we recommend that a concrete-lined J-ditch be installed at about mid-slope. The J-ditch would break-up the slope runoff and would, therefore, reduce the erosion potential of the slope runoff. It is our opinion that the 1.5H:1V southwest outboard slope could be reinforced with geogrids such as Tensar UX1500 (or approved equivalent) spaced vertically 3 feet apart with lengths of about 15 feet.

Additionally, the use of a synthetic pond liner may be waived in lieu of a minimum 3 foot thick layer of compacted clayey soil. The clayey soil liner should have a permeability not greater than 10^{-06} cm/sec, at least 40 percent passing the #200 sieve, and a Plasticity Index between 15 and 25. The use of a synthetic liner would require maintaining a 2 to 3 foot thick soil cover over the liner to protect the liner and allow for planting. Additionally, synthetic liners have relatively low interface (liner to soil) friction and would have to be installed on slopes of not steeper than 3H:1V.

We trust this letter provides you with the information you require at this time. If you have any questions or require additional information, please contact us.

Respectfully submitted,

BERLOGAR GEOTECHNICAL CONSULTANTS

Michael G. Matusich
Project Engineer
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word/letter/13744