# City of Palo Alto (ID # 6268)

## Policy and Services Committee Staff Report

**Report Type: Agenda Items** **Meeting Date: 12/1/2015**

**Summary Title: Basement Construction Dewatering**

**Title: Consider Tentative Staff Recommendations On Further Requirements for Basement Construction Dewatering Program for 2016**

**From: City Manager**

**Lead Department: Public Works**

### Recommendation

Staff recommends that the Policy & Services Committee direct staff to continue considering five program enhancements, presented in the "Discussion" section below, on basement construction dewatering; and implement those found to be feasible and practical by Spring 2016 to address public concerns raised during the summer of 2015.

### Executive Summary

Over the years, basement construction groundwater pumping has generated public concern in Palo Alto; the ongoing drought and mandated water restrictions this past summer escalating those concerns. Public concerns relate to the apparent wasting of water by discharging to storm drains, potential impacts on groundwater elevation and flow volume, as well as potential impacts on neighboring properties, such as subsidence and cracks, and impacts on trees and other landscaping.

In response to these concerns, staff has developed potential enhancements to the City's existing regulations regarding construction dewatering for review and discussion.

### Background

Basement construction is often required for non-residential, mixed use and multifamily residential buildings, particularly if underground parking is included in the proposal.[1] Additionally, the high value of land and housing in Palo Alto translates into residential property owners seeking to increase their single family homes by constructing basements. Basements constructed in R-1 districts do not count towards allowable square footage (regulated by floor area ratio) and can be quite large when located underneath the entire building footprint (PAMC Section 18.12.090). In 2015, 13 residential sites were conducting basement construction groundwater pumping, with 12 of these sites constructing a basement as well as a second story.

Basement construction groundwater pumping occurs when a basement is constructed in areas of shallow groundwater, typically in the neighborhoods closer to the bay or near former creek beds. Perimeter wells are established to draw down the groundwater allowing for construction of the basement. Dewatering continues until enough of the house has been constructed to keep the basement in place. The groundwater being pumped is not potable (i.e. drinkable). The Santa Clara Valley Water District regulates the groundwater basin in Santa Clara County, but does not regulate incidental pumping associated with basement dewatering.

*Summary of Current Regulations*

The City of Palo Alto has long regulated several aspects of basement groundwater pumping for both residential and commercial sites. Geotechnical investigations are required for basement construction and dewatering permits must be obtained when groundwater is likely to be encountered and dewatering needed. The permit is used, in part, to prevent pumping from October to April ensuring adequate storm drain system capacity during winter months. City of Palo Alto staff verifies that construction dewatering meets requirements for pH and sediment prior to allowing discharge to the storm drain system, meeting State of California stormwater regulations.

Unlike most Bay Area cities, Palo Alto does not allow drains around basement foundations, collecting water and pumping to the storm drain continuously; instead basements must be constructed to be waterproof.

[1] In commercial and multi-family zones, basements used for parking are generally not counted towards allowable floor area, but basement space containing usable space is. This report focuses on basements in R-1 neighborhoods which have been the subject of most of the community concern.

In 2008, the Planning and Transportation Commission held hearings on the dewatering issue and a literature review prepared by EIP Associates was presented (Attachment A).

In Summer 2014, the City's Public Works Department (PWD) piloted a truck fill station at a dewatering site to address public concern regarding the apparent wasting of pumped water to storm drains during the drought. Following the success of this first truck fill station, all basement groundwater pumping sites, except those located in known groundwater contamination areas, were required to install truck fill stations based on PWD specifications (Attachment B). The stations accommodate large diameter and garden hoses as well as bucket filling. Outreach includes dewatering sites published and mapped on the City website (http://www.cityofpaloalto.org/gov/depts/pwd/pollution/recycled_n_other_non_potable_water.asp), informational door hangers provided to contractors for distribution to neighbors of the construction dewatering site (Attachment C), and a Frequently Asked Questions document (Attachment D). Usage tracked with log sheets showed some sites used extensively by neighboring properties, while others saw little use. The City's water truck utilized dewatering sites for tree and median irrigation.

During the summer 2015 staff met with contractors to discuss additional ideas to address public concerns. Contractors advised staff of the uniqueness of Palo Alto in imposing standards on dewatering and requiring use of the pumped groundwater, believing the requirements increase pumping duration and project cost. One contractor stressed users could be injured at the fill stations, leading to potential liability. Other than increasing public outreach, no new solutions to decrease pumping or increase utilization of groundwater were identified.

**Discussion**

In Summer 2015, sites beginning the permit process were required to develop a Use Plan to maximize the use of the pumped groundwater. Additional requirements suggested by members of the public include a moratorium on basements until further study is performed, more detailed review of basement construction projects, minimizing pumping by using other methods for dewatering or increasing weight on basement slab, requiring use of all the water being pumped, payment for water pumped and directing water to the sanitary sewer. See Attachment E for correspondence from the public and Attachment F for a petition submitted regarding the basement construction moratorium.

Using adaptive management based on learnings from this past summer, staff is proposing to investigate the following program enhancements for basement dewatering in 2016:

1. Encouraging greater fill station use by distributing more door-hangers and enlisting other public outreach regarding dewatering, fill stations and trees. This will be a contractor requirement and City activity.

2. Strengthening outreach on the water cycle and value of fresh water flows to storm drains, creeks and bay.

3. Refining requirements for contractor Use Plans, including maximizing on-site water use, one day per week water truck hauling service for neighbor and City landscaping and piping to nearby parks or major users where feasible. Contractors will be responsible for implementation of Use Plans.

4. Expanding fill station specifications to address water pressure issues resulting from multiple concurrent users, including separate pumps for neighbors where needed and sidewalk bridges for hoses to reduce tripping hazards. Contractors will be responsible for implementation.

5. Broadening the City's Basement Pumping Guidelines to specifically require a determination of impacts of groundwater pumping on adjacent buildings, infrastructure and trees or landscaping. Applicants would determine the approximate location of the temporary groundwater cone of depression caused by pumping. Avoidance measures would be required if impacts are anticipated. Urban Forestry staff may develop guidelines for avoidance measures such as soil enhancement and supplemental watering (by project applicant) of neighboring landscaping. Additional measures could include adjusting the location, depth or duration of pumping or altering construction methods.

In addition, staff will request assistance from the Santa Clara Valley Water District to continue to evaluate any potential effects of basement pumping on deep groundwater levels, particularly related to the City of Palo Alto emergency wells. This issue is partially addressed in a previously provided 2003 report to the City by Carollo Engineers (Attachment G). If additional actions by the City are needed, they will be forwarded to the Policy and Services Committee prior to the 2016 construction season, along with the finalization of the above five recommendations.

## Resource Impact

Testing and refining the suggested measures to improve the dewatering program or any other measures suggested by the Committee will require staff time that is currently allocated elsewhere. These measures may increase basement construction project costs.

Staff is seeking approval of Staff exploration of the named activities. One of the elements to be explored is the amount of staff time needed for implementation, and whether the additional time can be absorbed into existing staffing levels. While Staff time is not expected to be large, Staff will be reporting back to the Committee on this issue.

## Environmental Review

The suggested program enhancements are minor modifications to an existing regulatory program designed to be protective of the environment. They would be covered by the general rule that California Environmental Quality Act (CEQA) does not apply where there is no possibility an action could have a significant effect on the environment (State CEQA Guidelines Section 15601(b)(3).

**Attachments:**

- Attachment A: 2008 Planning and Transportation Division Study Session Regarding Basement Construction Impacts (PDF)
- Attachment B: New Aquifer Filling Station Specifications (PDF)
- Attachment C: Doorhanger (PDF)
- Attachment D: Groundwater Pumping from Building Sites FAQ (PDF)
- Attachment E: Correspondence (PDF)
- Attachment F: Basement Moratorium Petition (PDF)
- Attachment G: Groundwater_Supply Report (PDF)

Attachment A

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# PLANNING & TRANSPORTATION DIVISION

## STAFF REPORT

**TO:** PLANNING & TRANSPORTATION COMMISSION

**FROM:** Curtis Williams, Interim Director **DEPARTMENT:** Planning & Community Environment

**DATE:** September 24, 2008

**SUBJECT:** Study Session Regarding Basement Construction Impacts

## RECOMMENDATION

Staff recommends that the Planning and Transportation Commission (PTC) provide comments regarding how the identified basement-related issues should be addressed. No action may be taken at the study session.

## BACKGROUND AND PURPOSE

On March 12, 2008, the PTC reviewed proposed requirements for a Green Building ordinance for residential and nonresidential development in the city. The regulations were then considered and recommended for approval by the PTC on April 9, 2008. One of the concerns voiced by Commission members and the public at both meetings was that the sustainability implications of basements should be considered, particularly with respect to dewatering and the extent of concrete used for basement construction (see Attachments H, I and J). On May 12, 2008, the City Council reviewed and adopted the City's Green Building regulations, and referred the basement issue back to the PTC for further consideration and recommendation.

On June 9, 2008, the Public Works Department provided an informational memo to the City Council, entitled "Basement Construction and Dewatering Impacts," addressing several of the concerns raised regarding basement construction, groundwater impacts, and dewatering discharges, as well as impacts on adjacent properties.

The purpose of this study session is to provide the Commission with further information about some of those issues and about the green building implications of the use of concrete for basement construction, and to explore options for modifications to policies or codes that address public concerns and provide for an enhanced green building strategy. The review is not intended to address zoning criteria for light wells and below grade patios, but the pertinent code section is provided and some of the issues may affect those provisions.

## DISCUSSION

The discussion below summarizes recent basement construction statistics, the issues addressed in the Public Works memo, the existing Public Works dewatering policy, potential impacts on neighboring properties, and the use of concrete in basement construction and its implications for the City's Green Building program. A few options for addressing public concerns are provided at the end of the section.

### Recent Basement Construction

The City's Building Division reports that there were permits for 65 new single family residential basements issued over the past 2 years (through June 30, 2008). In that timeframe, there were a total of 181 new single family home permits, excluding the detached condos for Sterling Park (96 units). Ten (10) of the basements (of the total 65) were constructed for major renovations/rebuilds. Basement construction has increased as compared to prior years, with an average of about 22 basement permits issued from 2001-2004.

The Public Works Department estimates that, of the total number of permits for basements in recent years, approximately 5 per year require dewatering permits. In calendar year 2008 thus far, the Department has issued 3 dewatering permits, and does not anticipate issuing any others, given the proximity to the wet weather season. Attachment G provides a map of the depth of groundwater in Palo Alto, as mapped by the Santa Clara Valley Water District.

### June 9 Public Works Informational Memo

The June 9, 2008 Informational Memo from Public Works (Attachment A) addresses many issues raised by the Council, Commission, and the public, including discharge volume of dewatering, pump noise, water table impacts, subsidence, tree impacts, contaminated groundwater migration, discharge of groundwater after basement construction, basement excavation, and storm drain capacity. In some areas of technical impact, such as water table and subsidence impacts, the memo refers to a study prepared by EIP Associates, Inc. in 2004 (Attachment D), which staff feels adequately addresses those specific concerns. Other concerns regarding pump noise, contaminated groundwater contamination, and discharge of groundwater after basement construction, are addressed in the Council memo but not discussed further here. The discussions below focus on the key issues of discharge volumes and dewatering policy, the impacts of basement excavation on neighboring sites, and the green building implications of basement construction.

### Discharge Volumes

The Public Works Department's "Basement Excavation Dewatering and Basement Drainage Rules" (Attachment B) require a dewatering plan and permit for each site where dewatering during basement construction is proposed. Groundwater levels must be identified in a geotechnical report prior to permit review. Drawdown wells are typically installed around the perimeter of the excavation and pump water out of the shallow aquifer to draw down the level of the groundwater so the basement can be constructed without water filling the excavation. Public Works estimates that drawdown well systems for dewatering during basement construction can pump approximately 30-50 gallons per minute of water non-stop for 3-6 months or more while the basement is constructed. The rules now have been revised to limit dewatering to the months of April through October. The total volume of water pumped into the storm drain system from a dewatering operation is substantial, typically a few million gallons. However, the groundwater level is re-established rapidly after dewatering ceases and the discharged water ultimately remains within the water regime and may replenish aquifers downstream or may flow to a creek or the Bay. Nevertheless, some water is surely lost in the process and the storm drain system is burdened by the additional flow.

The Public Works Department's Basement Exterior Drainage Policy (Attachment C), last revised October 1, 2006, prohibits the use of perforated pipe systems for basement drainage and requires that all new basements be designed so that ongoing discharge after construction is not required (with limited exceptions for basement-level exterior spaces).

The key issue for Commission discussion is whether it is appropriate to further limit or prohibit basement construction where dewatering is required.

Impacts on Neighboring Properties

Another set of concerns about basement construction relates to potential impacts to neighboring properties, including subsidence, effects on trees, and site stability.

- *Site stability* – Residents have reported concerns about the proximity of basement excavation to their property line, which might result in erosion or undermining of the property or nearby buildings. Various excavation shoring restrictions exist to protect neighboring sites, and shoring plans are required by the Building Division. The Zoning Code only allows basements below the main structure, so setbacks should be met, but light wells are permitted to encroach up to 3 feet from a side property line (for a distance of not more than 15 feet), and excavation for the basement wall may then extend to the property line. Attachment F outlines the zoning code provisions for basements in the R-1 zone district.
- *Trees* – Tree impacts on the subject property or an adjacent site could occur from either excavation damage to roots or from dewatering to a point where the roots dry out. The Planning Arborist, however, reviews all projects to determine whether basements would adversely impact an adjacent tree's root system, and plans would need to be revised if impacts are identified. The Zoning Code requires that basement design would not adversely impact any mature trees. The Planning Arborist has also noted that water sources for most trees' roots are not as deep as the groundwater table.
- *Subsidence* – Staff believes that subsidence impacts, if any, are negligible from dewatering, as the water table quickly returns to pre-dewatering levels and the duration of dewatering is not long enough for soils to compress. Staff is aware of no demonstrated subsidence impacts from basement construction dewatering, though some residents have maintained that such an impact has occurred. The EIP study and contact with USGS have also indicated negligible impact.

The key issue for Commission discussion is whether some change in policy or codes, such as a minimum setback for excavation, would better protect neighboring properties without unduly infringing on the potential for property owners to construct basements.

Green Building Regulations and Implications of Basement Construction

Basement construction has been identified as a "green building" issue due to the extensive amount of energy required to produce the concrete used for basements. Concrete creates more than 5 percent of the world's $CO_2$ emissions, at a rate of about 400 pounds of $CO_2$ for each cubic yard of concrete (3,900 pounds). The cement component of concrete (7-15%) is the major source of greenhouse gas emissions, and about 0.9 pound of $CO_2$ is created per pound of cement produced, according to the Portland Cement Association. A second sustainability issue is the amount of water discharged during dewatering during basement construction (discussed above).

The City's Green Building regulations (Attachment E) became effective on July 3, 2008. The regulations include requirements to comply with green point rating systems for both nonresidential (Table A) and residential (Table B) development. The definition of "square footage" includes basement square footage, and the green points required for residential development increase with each 70 additional square feet of house size. Thus, the ordinance does not directly limit basement construction, but does require compensation in the form of increased green point rating for a home with a basement. It should also be noted, however, that due to the insulating qualities of the surrounding earth, basements are often more energy efficient than above grade floor space.

For the Commission's information, Attachment K is an article that outlines work currently underway by a Stanford professor to produce a "green" cement that would not only eliminate $CO_2$ emissions from cement production, but could also use $CO_2$ emitted from other sources, reducing those gases as well. A ways off, perhaps, but a potential solution to the adverse impacts of concrete use in basements.

The key issue for the Commission is whether there is a basis for either limiting basement construction or requiring further increases in green points criteria for basement construction to minimize the carbon emissions impacts of basements.

## POTENTIAL OPTIONS

Staff believes that the City's review policies generally protect neighboring properties from deleterious effects of basement dewatering and that dewatering does not have substantial effects on groundwater or result in the discharge of contaminated groundwater. However, water discharge from dewatering can be substantial and there may be opportunities for the City to enact policies or regulations to further minimize the loss of water from local sites as an enhanced sustainability effort. Similarly, the City's Green Building regulations already require compensation for basement construction in the form of additional green building measures to achieve the stipulated point totals, but there may be revisions that would provide further green building benefits where basements are constructed or to encourage retention of existing basements in commercial areas. Some of the options available to the City may include, but are not limited to:

1. Continuing to permit basements, with continued staff analysis of technical data and impacts.
2. Prohibiting basement excavation within 3 feet of a low density residential property line.

3. Limiting basement construction based on the amount of water to be discharged or further limit the timeframe for basement dewatering.
4. Modifying green building requirements to double basement square footage to determine the number of GreenPoint Rated points required, and/or allowing reductions for the use of basement construction materials that reduce the embedded energy of concrete.
5. Allowing existing basements for nonresidential properties to be excluded from floor area calculations if restricted to non-habitable uses, even if the basement meets Building Code requirements for habitable space.

Subsequent to comments by the Commission, staff will return with specific recommendations for policy or code changes to address basement issues. The Commission would then forward these changes to Council for review and approval.

**ENVIRONMENTAL REVIEW**

No environmental review is required for a study session. The level of environmental review required, if any, for potential code or policy actions will be determined once those actions are identified.

**ATTACHMENTS**

A. June 9, 2008 "Basement Construction and Dewatering Impacts" Informational Memo to City Council from Public Works Department
B. Public Works "Basement Excavation Dewatering and Basement Drainage Rules"
C. Public Works "Basement Exterior Drainage Policy," dated October 1, 2006
D. "New Basement Construction and the Groundwater Regime in Palo Alto," Technical Memorandum prepared by EIP Associates, Inc., 2004
E. Green Building Tables for Residential and Nonresidential Development
F. Section 18.12.090 of the Zoning Ordinance re: Basements in R-1 District
G. Map of Depth to First Water, Santa Clara Valley Water District, October 15, 2003
H. May 8, 2008 E-mail from Steve Broadbent
I. July 19, 2008 E-mail from David Stonestrom
J. April 22, 2008 E-mail from Jody Davidson
K. "Green Cement May Set $CO_2$ Fate in Concrete." San Francisco Chronicle. September 2, 2008.

**COURTESY COPIES**

Architectural Review Board
Jody Davidson
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REVIEWED BY: Julie Caporgno, Chief Planning and Transportation Official

DEPARTMENT/DIVISION HEAD APPROVAL: Curtis Williams

Curtis Williams
Interim Director

# City of Palo Alto
# City Manager's Report

**TO:** HONORABLE CITY COUNCIL

**FROM:** CITY MANAGER **DEPARTMENT: PUBLIC WORKS**

**DATE:** JUNE 9, 2008 **CMR:266:08**

**SUBJECT:** BASEMENT CONSTRUCTION AND DEWATERING IMPACTS

This is an informational report and no Council action is required.

**BACKGROUND**

Residential and commercial basements and underground parking garages are constructed throughout Palo Alto, except where they are disallowed in the flood zones. If a basement or underground garage site has high groundwater, the contractor will need to dewater the site so they can construct the basement or garage without groundwater filling the excavation. Accordingly, the contractor prepares and submits a dewatering plan to Public Works. The plan typically includes pumping water from the shallow aquifer below the site to a settlement tank and then via a pipe or hose to the closest storm drain inlet in the street. Public Works reviews and approves the dewatering plan, charges a dewatering fee and issues a street work permit. Public Works inspectors confirm the dewatering is done per approved plans and with minimal impact to the community. Public Works currently issues 5-10 dewatering permits for residential basements annually.

Recently, a number of citizens have voiced their concerns to the Public Works Department that dewatering has many negative impacts on the community and should potentially be disallowed, especially in residential areas. The concerns have been about the discharge of large volumes of water into the storm drain system, pump noise, land subsidence, tree impacts, groundwater impacts and contaminated groundwater migration.

**DISCUSSION**

Public Works and Planning Division staff have been aware of construction dewatering impacts and concerns for a number of years. They have conducted research and sought the advice of experts to address these concerns. In 2004, the Planning & Transportation Commission raised some of the same concerns about dewatering that citizens recently have. Consequently, the Planning Division retained an environmental consultant, EIP Associates, to research and report on these concerns. In 2004, EIP prepared the attached report titled, "Draft Technical Memorandum: Correlation between New Basement Construction and the Groundwater Regime in Palo Alto, California." Further, Public Works Engineering staff has consulted with representatives of the Santa Clara Valley Water District (SCVWD), the California Regional Water Quality Control Board (CRWQCB), the United States Geological Survey (USGS), dewatering contractors, basement contractors, architects, geotechnical engineers, and staff from Public Works' Environmental Compliance Division and the Planning and Community Environment's Planning and Building Divisions about dewatering impacts and concerns.

To assist Council in understanding the differences between shallow and deep aquifers (described more completely in EIP's attached report), staff provides the following descriptions.

Shallow aquifers are formed by rain seeping through the ground and pooling close to the ground surface. The top surface of the shallow aquifer is called the water table and is typically 10-30 feet below the ground surface in most areas of Palo Alto other than the hills. This is the aquifer that basement excavations may extend into, necessitating dewatering. Shallow aquifer water is nonpotable as it does not meet drinking water standards.

Deep aquifers are separated from the shallow aquifers by impermeable sediment layers, like rock or clay, called aquicludes that prevent shallow aquifer water from reaching the deep aquifers. In Palo Alto, the deep aquifers are approximately 200 feet below the ground surface. Dewatering basement excavations has virtually no effect on the deep aquifers.

Certain layers of permeable sediment, like sand or gravel, may trap and hold pockets of groundwater temporarily between shallow and deep aquifers, but these are typically not affected by basement dewatering operations.

Below is a brief summary of the above research organized by community key concerns.

Discharge Volume

A soils report is required for all projects with basements or underground garages. This report determines the depth to the shallow aquifer below the ground surface. If a contractor believes the excavation will go into the groundwater, they will typically submit a drawdown well dewatering plan to Public Works. Drawdown wells are typically installed around the perimeter of the excavation and pump water out of the shallow aquifer to draw down the level of the groundwater so the basement can be constructed without groundwater filling the excavation. These drawdown well systems pump approximately 30-50 gallons per minute into the storm drain system non-stop for 3-6 months while the contractor constructs the basement.

The volume of water pumped into the storm drain system from a drawdown well dewatering operation is substantial, typically a few million gallons. It could be used as landscaping water, but it is too large a volume for individual use and too impractical to capture and reuse for other use.

The water pumped out of the ground is discharged into the storm drains, which typically discharge into the creeks. San Francisquito Creek is a losing creek, meaning that water is lost by seeping through the creek bed and into the shallow aquifers. So, in this case, water pumped out of the shallow aquifers is added back to it. For water pumped into lined creeks, the water flows to the bay and is lost to the aquifer.

The volume of groundwater pumped out of an excavation site is a small fraction of the total volume of the aquifer and does not deplete or lower the aquifer, except, of course, in the immediate vicinity of the excavation. The USGS reports that due to natural (rain) and manmade (irrigation, leaking sewer pipes, and the SCVWD's groundwater recharge program) methods, more water is recharged into the shallow aquifers than is pumped out of it by all pumping in the Santa Clara Valley. The EIP report also confirmed that the water table is only drawn down locally (within tens of feet of the excavation) and reestablishes itself quickly after dewatering ceases. Therefore, the cumulative effect of dewatering on the shallow aquifers is negligible.

Pump Noise

Dewatering pumps can make excessive noise if installed improperly, and this is a concern for neighboring residents since the pumps run 24 hours a day. Public Works is tightening the requirements for pump operation to eliminate this problem.

Water Table Impacts

While the City currently prohibits basements in flood zones, there is no blanket prohibition against construction in areas with shallow aquifers. Basements are not typically constructed so deep that they actually go into the water table, but they do in some cases. In other cases, the water table might rise up, as at the end of a particularly wet winter, and surround a basement. However, in these cases, the water table level and the flow of the groundwater are not changed due to the presence of basements, as reported by EIP.

Subsidence

Land settlement, or subsidence, caused by temporary (such as 6 months) construction dewatering is negligible, as reported by EIP and USGS. For subsidence to occur, dewatering needs to occur over a number of years.

Tree Impacts Relative to Water Table Changes

The Planning Division arborist reports that in most of the developed areas of Palo Alto the preponderance of absorbing tree roots are *not* found in lower soil horizon levels below seven feet. Therefore, the majority of temporary dewatering projects are not expected to impact trees. If a tree's roots are however deep enough and have been determined, on the basis of a certified arborist report or other qualified assessment, to be dependent on the water table, then the mitigation would be for the contractor to provide separate irrigation for the tree(s) during the dewatering period.

Contaminated Groundwater Migration

Citizens have expressed a concern that large volumes of groundwater being pumped out of the aquifers might cause nearby contaminated groundwater plumes to migrate towards the pumping site. When an application is submitted, staff checks dewatering sites against known contaminated groundwater plume maps. If a site is within a certain proximity to a known plume, staff requires the water to be tested for contaminants prior to and during discharge. The contractor must retain an independent testing service, test for the contaminants Public Works specifies, and submit those results to Public Works. If the water is contaminated, as it was in one case near the Stanford Research Park superfund site, it must be treated before it can be released or discharged to the sanitary sewer under permit from Public Works. The CRWQCB is drafting requirements for contractors to test groundwater discharged to the storm drain system. Staff awaits the adopted version of these requirements, scheduled for this summer, and will implement them at that time. To date, there has been no evidence that contaminated groundwater has been discharged into the storm drain system or that contaminated groundwater plumes have migrated.

Discharge of Groundwater after Basement Construction

A few years ago, Public Works allowed the use of perforated drain pipes to be installed behind basement walls and under basement slabs when the geotechnical engineer reported that groundwater would not rise to the level of these pipes. The pipes are installed to capture rainwater that filters through the ground and collects behind basement walls in order to minimize the chance of the water leaking through the walls. The pipes drain to a sump where a pump then pumps the water to the street gutter. Unfortunately, after some wet winters, groundwater did rise up to these pipes and was then pumped continuously into the street gutter for long periods of time, creating a number of public nuisance and safety concerns. Accordingly, Public Works adopted a policy two years ago that prohibits the use of perforated drain pipes for basements in areas of the City with relatively high groundwater (east of Foothill Expressway) to eliminate these potential nuisances. Public Works also recommends that applicants for new basement projects retain a waterproofing consultant to ensure the basement does not leak.

Older basements that were permitted with perforated drain pipes still may occasionally discharge groundwater into the street gutter. Public Works addresses these cases by working with the homeowners to eliminate the discharge, typically accomplished by having the homeowner raise the pump in the sump above the level of the groundwater.

Basement Excavation

Some residents have expressed a concern that the excavation pit for a basement comes too close to adjacent properties, potentially jeopardizing the stability of these properties. Although this strictly does not relate to dewatering, staff recognizes it as a legitimate concern. As previously mentioned, the Building Division requires geotechnical reports for all projects that involve basements or underground structures. A standard feature of these reports is recommendations and requirements from the geotechnical engineer that specify measures to stabilize the excavation during construction. The Building Division inspects all basement construction to ensure conformance with the geotechnical report and to verify all recommended stabilization measures are implemented. In addition, Building Inspectors will require the contractor to install extra precautionary measures before work can continue.

Storm Drain Capacity

Staff is concerned that dewatering basement excavations may take up too much capacity in the City's storm drain pipes, minimizing the system's ability to accommodate storm water and potentially causing or exacerbating flooding. This is not a concern raised by citizens, nor has there been any incidents where dewatering has caused flooding, but staff is developing some guidelines for wintertime dewatering in an effort to avoid a problem. The draft guidelines currently disallow dewatering during the winter unless an exemption is granted by the Director of Public Works.

## CONCLUSION

Staff has researched and analyzed each of the concerns about dewatering raised by citizens. Based on that research, staff believes that the cumulative effects of dewatering basement excavations has minimal impacts on the City and that the practice should be allowed to continue. The attached EIP report essentially comes to the same conclusion. The number of residential basements permitted in the City has increased from approximately 20 a year at the start of the decade to approximately 30 a year currently. However, Public Works only issues about 5-10 dewatering permits a year. So, most basements are built without requiring dewatering. Public Works will continue to monitor dewatering activities to ensure the City's procedures remain sound and protective of Palo Alto.

**POLICY IMPLICATIONS**

Staff is currently updating dewatering requirements to ensure that dewatering has minimal impacts to the community. Limitations beyond those discussed in this report would likely result in a wholesale prohibition of basements where groundwater is present, which would be a major policy issue to be decided by Council.

Per direction from Council at the May 12, 2008 council meeting, staff will prepare a report on the array of basement construction impacts and issues, including dewatering, and present it to the Planning and Transportation Commission in the near future.

**ATTACHMENTS**

Attachment A: Draft Technical Memorandum: Correlation between New Basement Construction and the Groundwater Regime in Palo Alto, California

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Director of Public Works

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# Draft Technical Memorandum: Correlation between New Basement Construction and the Groundwater Régime in Palo Alto, California

## 1. Statement of the Planning and Transportation Commission's concerns.

At the 14 January 2004 Commission meeting, the planning staff presented a number of proposed changes to the existing regulation of basements in the R-1 zones. During the ensuing discussion, several Commission members expressed concerns about the impact of basement construction on groundwater levels and flow directions. Eight specific, interrelated issues were identified.

- Is groundwater pumping causing or contributing to land subsidence?
- What are the effects of pumping for months to dewater a basement construction site?
- Are basements being permitted in some inappropriate areas [where the water table is only a few feet below the ground surface], creating the need for continuous pumping?
- What groundwater effects occur if water is withdrawn from the water table and pumped into the sewers or creeks?
- What groundwater diversion effects occur if basement walls are built along creeks and/or perforate aquifers?
- What are the effects on landowners adjacent to, and down gradient from, pumping sties?
- What are the cumulative effects of basements on the groundwater régime?
- Can basement regulations be crafted to address the hydro-geology of specific building sites?

The general concern underlying these issues was expressed by Commissioner Annette Bailson: the Commission does not have the information needed to identify whether these are issues of concern, or to make informed decisions on the issues. The remainder of this technical memorandum seeks to respond to that underlying concern by provide some background information about the listed issues and about groundwater hydrology of the City relative to the construction of basements.

## 2. Differences between shallow (surface) and deep (confined) groundwater aquifers.

### Defining the Aquifers

An aquifer is a body of geologic material, usually rock or some mixture of gravel, sand, silt and clay, that is sufficiently permeable to conduct groundwater. Some definitions include the stipulation that the body produce an economically significant flow of water before it may be considered an aquifer. For the purposes of this technical memorandum, the broader definition is applied to allow for easier discussion of the water-bearing formations underlying the City.

Of the various types of aquifers, two are of particular interest in this discussion: the shallow or surface aquifer, and the deep or confined aquifer. The relative terms 'shallow' and 'deep' refer to the depth of the aquifer below the surface of the ground (usually expressed as 'number of feet bgs' in hydrology studies).

**A surface aquifer** is so named because it is open to the surface of the ground. Rain falling on the ground surface seeps through the soil (infiltration) to some depth where it pools to form a more or less continuous body of water occupying the spaces between sediment particles or rock fragments (groundwater). The top of this body of groundwater is the water table. In the Santa Clara Plain, which forms the lowlands of Palo Alto, the water table occurs at depths of as little as ten feet below the ground surface.

Being open to the surface of the ground, the surface aquifer is subject to the influences of overlying land cover and land uses. Modern stream channels, such as the numerous reaches of San Francisquito Creek, intersect or overlie the surface aquifer, extracting water from it or adding water to it. Paving and construction create artificially impermeable surfaces that prevent local direct infiltration to the surface aquifer. Chemical constituents in urban and agricultural runoff enter the surface aquifer through infiltration from channels or detention basins, lowering the quality of the groundwater. Leaking landfill cells, leaking underground storage tanks, and liquid spills also contribute to the reduction of water quality in the surface aquifer. Although current stewardship has slowed water quality deterioration, the surface aquifer still cannot be used as a source of potable water.

**A confined aquifer** is one that is separated hydrologically from the overlying and underlying sediments and rock and from other aquifers. Usually the separating agent (called an aquiclude) is formed by a layer of impermeable sediment, such as clay, or by impermeable rock, such as unfractured granite. The confined aquifer is not connected directly to the overlying ground surface and is separated from the surface aquifer by an aquiclude. It is, in effect, a separate hydrologic system, gaining water from some distant source (i.e., not local rainfall) and transmitting it to some other relatively distant discharge area. Because the confined aquifer is below, and hydrologically separated from, the surface aquifer, it is, by definition, a deep aquifer, irrespective of the number of feet it is below the ground surface.

Several aquifers may underlie each other. This is the case beneath the Santa Clara Plain where geologically recent stream-laid (alluvial) gravel, sand, silt, and clay form a sequence of deposits nearly 1500 feet thick between the foothills of the Coast Ranges and San Francisco Bay. Channels of ancient rivers depositing this material have been cut off and filled by succeeding intersecting channels, which, in turn, have been buried by the deposits of more modern channels. In this way a complex series of sediment layers of unconsolidated (loose), partially consolidated (dense), and consolidated (very dense) material has been built up as the Santa Clara Plain. The layers are discontinuous and of greater or lesser permeability, depending on their density and clay of silt content.

A complicating factor in examining such a series of aquifers is that often they are not completely confined. The aquicludes separating the aquifers may not be totally impermeable (in which case they are called aquitards) allowing water to seep from one aquifer to another. The aquifers may be connected within or outside the local area, arising from a common source or flowing to a common discharge area. The aquifers may be connected artificially through leaks in wells or along pilings passing through the aquifers. Beneath the portion of the Santa Clara Plain in Palo Alto, there is a confining clay layer that separates the surface aquifer from the deeper aquifers, but, on a regional level, this separation attenuates and, eventually, disappears farther south in San Jose.

Being separated from the surface aquifer in this part of the Santa Clara Plain, the confined aquifers beneath the City are not subject to the direct influences previously described for land cover and land uses above the surface aquifer. To the extent that groundwater migrates from the southern part of the Santa Clara Plain groundwater basin to the northern part, the effects of similar land cover and land uses in areas toward San Jose may affect water quality in the deep aquifers beneath Palo Alto.

### Construction-period Dewatering Effects

In general, construction-period dewatering effects are limited to the **surface aquifer**. This would not necessarily be the case for major high-rise construction where foundations and below-grade levels may extend 100 or more feet beneath the ground surface, increasing the chances of encountering **confined aquifers**. It is, however, the case for the type of relatively shallow basement construction being considered in the Zoning Ordinance Update. In the Santa Clara Plain portion of Palo Alto, the uppermost sequence of unconsolidated and partially consolidated alluvium is about 200 feet thick. This sequence contains the surface aquifer, the base of which is the previously mentioned clay aquiclude identified by the Santa Clara Valley Water District (SCVWD) in its 2001 *Groundwater Management Plan*. The general direction of groundwater flow in this area is northeast toward the Bay, so the surface aquifer and the deeper, confined aquifers tend to remain separated in Palo Alto until they reach the vicinity of the Bay margin.

The removal of groundwater from an excavation during below-ground-level construction is necessary to provide safety for the construction workers, and is a prerequisite for waterproofing the building's foundation and subsurface floors. One method for accomplishing this is to dig a small pit below the base of the foundation excavation, slope the excavation so groundwater drains to the pit, and then pump the water out of the pit and into the storm drainage system. Another method is to drill temporary wells around the building footprint and pump directly from the groundwater body to the storm drainage system until the local water table drops below the base of the excavation. In either case, groundwater flowing into the area of drawdown created by the dewatering process is deflected toward the base of the excavation, whence it is pumped to the storm drainage system. Groundwater beyond the influence of the dewatering process continues to flow normally.

Dewatering pumping continues until the foundation and subsurface floors are completed and the excavation is filled. The amount of water deflected depends on the level of the water table, the permeability of the material adjacent to the excavation, and the length of time the excavation needs to be kept open and dry. An increase in any of these factors increases the amount of water deflected. This amount is small when compared to the total volume of available groundwater directly beneath the Santa Clara Plain (see below). Because the deflection is temporary and very localized, and because groundwater levels at the sites recover rapidly once pumping has ceased, there appears to be no discernable long-term effect on the surface aquifer.

In the areas adjacent to the site being dewatered, the water table would be lowered temporarily by the dewatering process. This effect could extend from several feet to several tens of feet beyond the excavation depending on the method used, the level of the water table at the time dewatering began, the permeability of the material adjacent to the excavation, and the length of time the excavation needed to be kept open and dry. The possibility exists that adjacent landscaping could be experience deterioration from reduced groundwater availability.

## Deflection or Reduction of the rate of Groundwater Flow

Although the amount of water pumped from an excavation may appear substantial as it flows along a street to a storm drain inlet, it is small compared to the amount of groundwater directly beneath the Santa Clara Plain. The SCVWD's current estimate is that there is more than 350,000 acre-feet of groundwater available in the Santa Clara Subbasin. An excavation dewatering flow of 1 cubic foot per second would deflect 1.98 acre-feet of water per day. Because groundwater would be pumped out of the excavation faster than could flow in, the alteration in groundwater flow rate would be less than the rate of dewatering. Because the resultant groundwater flow deflection is temporary, small, and very localized, there appears to be no discernable long-term effect on the **surface aquifer**. Because dewatering for basement construction occurs only in the uppermost portion of the surface aquifer, there would be no effect on the **deep aquifer**.

In a typical 3-month excavation period the 1.98 acre-feet per day dewatering flow would amount to 0.05% (one-twentieth of one percent) of the minimum known groundwater resource in the subbasin. No published information about the subbasin's water budget has been found, so any to attempt to predict how quickly the water would be replaced through recharge would be speculative. It is known, however, that the importation of potable water and the SCVWD controlled recharge program have assisted groundwater levels in the subbasin to rise 200 feet during the last 40 years. Most of that rise has been in the surface aquifer. The implication is that the subbasin is being recharged at a rate substantially higher than the rate of withdrawal from all pumping, including dewatering for basement construction. Consequently, it appears that the amount of flow from one, or even several, dewatering operations would not have long-term effects on the surface aquifer.

In the areas adjacent to the site being dewatered, the rate and flow directions of the groundwater would be altered temporarily by the dewatering process. Groundwater in the influenced area would move toward the base of the excavation at a rate lower than the rate of dewatering discharge. This effect could extend from several feet to several tens of feet beyond the excavation depending on the method used, the level of the water table at the time dewatering began, the permeability of the material adjacent to the excavation, and the length of time the excavation needed to be kept open and dry. Flow directions and rates would revert to near normal when dewatering ceased.

There would be some displacement of groundwater flow around the newly constructed basement, depending on the permeability of the surrounding soil materials. The volume of space displaced by the basement could be several thousand to several tens of thousands of cubic feet, which, although small compared to the volume of the surface aquifer, could be significant locally, especially if there were other similarly sized basements in the immediate vicinity. The flow of groundwater would readjust to this condition, possibly altering the level of the water table in the vicinity of the site for several weeks or months, but is unlikely to experience any major permanent change. The groundwater level in the surface aquifer undergoes more significant changes during the rainy season than would be expected from long-term flow deflection caused by basements.

**Saltwater Intrusion and Subsidence**

Saltwater intrusion and subsidence in the Santa Clara Subbasin are documented regional effects of the excessive removal of groundwater from the **deep aquifer** (overdrafting) over many years. This practice was curtailed in the mid-1960s when the importation of potable water increased substantially. Since then, the SCVWD has been recharging the subbasin thereby raising groundwater levels, impeding saltwater infiltration of the **surface aquifer**, and virtually eliminating further overdraft-related subsidence (the effects of previous subsidence cannot be reversed because portions of the deep aquifer have been compressed permanently). Such basin-wide effects could recur only if the deep aquifer became overdrafted again. Because dewatering for basement construction occurs only in the uppermost portion of the surface aquifer and involves only a small amount of groundwater withdrawal, no effects would occur in the deep aquifer.

## 3. Palo Alto Public Works Department existing regulatory structure.

There are a number of policies in place that provide protection for the City's groundwater resource and for property owners in the vicinity of new basement construction.

- The Public Works Department prohibits the long-term pumping of groundwater after a basement has been constructed. This eliminates the possibility that the water table in the vicinity of the project would be lowered permanently.
- The Public Works Department requires basements to be waterproofed and strengthened structurally below the expected groundwater level. This eliminates the need for groundwater pumping.
- The Public Works Department requires permit applicants whose projects would have basements to prepare a geotechnical investigation and report that would determine, among other information, the expected highest groundwater level in the local shallow aquifer. This allows the department to make informed decisions about the advisability of basement construction at a particular site and/or to set the conditions under which basement construction may proceed.
- If dewatering is necessary for basement construction, the Public Works Department sets the dewatering permit conditions based on the hydrology of the specific site under consideration. This ensures resource and property protection where it is needed.
- The Public Works Department allows the removal of seepage water that collects along basement walls above the water table. Normally this removal would need only a minimal amount of pumping, but may need to be monitored.

## 4. Recommendation regarding the advisability of codifying groundwater effects in the Zoning Ordinance Update

The above-listed Public Works Department policies dealing with basement construction and dewatering for such construction are intended to prevent substantial impacts to groundwater, either on an area-wide basis or in the vicinity of the construction site. Although the policies and their associated construction standards appear to address the issues adequately, it may be advisable for the Public Works Department to increase the community's awareness of these issues through an out-reach program. Because these issues are, essentially, engineering concerns that are site-specific and already covered by existing regulations, there is no need to modify the zoning ordinance with respect to them.

Sincerely,

REGISTERED GEOLOGIST
GEORGE J. BURWASSER
No. 7151
Exp. 30 APR 06
STATE OF CALIFORNIA

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**ATTACHMENT B**

# BASEMENT EXCAVATION DEWATERING AND BASEMENT DRAINAGE RULES

**BASEMENT DRAINAGE:** Due to high groundwater throughout much of the City and Public Works prohibiting the pumping and discharging of groundwater, perforated pipe drainage systems at the exterior of the basement walls or under the slab are not allowed for this site. A drainage system is, however, required for all exterior basement-level spaces, such as lightwells, patios or stairwells. This system consists of a sump, a sump pump, a backflow preventer, and a closed pipe from the pump to a dissipation device onsite at least 10 feet from the property line, such as a bubbler box in a landscaped area, so that water can percolate into the soil and/or sheet flow across the site. The device must not allow stagnant water that could become mosquito habitat. Additionally, the plans must show that exterior basement-level spaces are at least 7" below any adjacent windowsills or doorsills to minimize the potential for flooding the basement. Public Works recommends a waterproofing consultant be retained to design and inspect the vapor barrier and waterproofing systems for the basement.

**BASEMENT SHORING:** Shoring for the basement excavation, including tiebacks, must not extend onto adjacent private property or into the City right-of-way without having first obtained written permission from the private property owners and/or an encroachment permit from Public Works.

**DEWATERING:** Basement excavations may require dewatering during construction. Public Works only allows groundwater drawdown well dewatering. Open pit groundwater dewatering is disallowed. Dewatering is only allowed from April through October due to inadequate capacity in our storm drain system. The geotechnical report for this site must list the highest anticipated groundwater level. We recommend a piezometer to be installed in the soil boring. The contractor must determine the depth to groundwater immediately prior to excavation by using the piezometer or by drilling an exploratory hole if the deepest excavation will be within 3 feet of the highest anticipated groundwater level. If groundwater is within 3 feet of the deepest excavation, a drawdown well dewatering system must be used, or alternatively, the contractor can excavate for the basement and hope not to hit groundwater, but if he does, he must immediately stop all work and install a drawdown well system before he continues to excavate. Public Works may require the water to be tested for contaminants prior to initial discharge and at intervals during dewatering. If testing is required, the contractor must retain an independent testing firm to test the discharge water for the contaminants Public Works specifies and submit the results to Public Works.

Public Works reviews and approves dewatering plans as part of a *Permit for Construction in the Public Street ("street work permit")*. The applicant can include a dewatering plan in the building permit plan set in order to obtain approval of the plan during the building permit review, but the contractor will still be required to obtain a street work permit prior to dewatering. Public Works has a standard dewatering plan sheet that can be used for this purpose and dewatering guidelines are available on Public Works' website. Alternatively, the applicant must include the above dewatering requirements in a note on the site plan.

# PUBLIC WORKS ENGINEERING
# BASEMENT EXTERIOR DRAINAGE POLICY
EFFECTIVE OCTOBER 1, 2006

## Policy

The Department of Public Works (Public Works) will not permit the use of basement exterior drainage systems consisting of perforated pipes located on the exterior of the basement walls or underneath the slab that collect water which is then pumped to the surface of the ground for discharge, either on-site or off-site, for all City of Palo Alto parcels northeast (the bay side) of Foothill Expressway.

## Purpose

To ensure the public safety and health by preventing the discharge of groundwater into the City gutter system. The discharge of groundwater into the gutter system causes the following public safety, health and nuisance concerns:

- gutters are constantly wet and may enhance the growth of algae, thereby creating a slippery condition for pedestrians, bicyclists and motorists
- ponded water at the low spots of the gutter may be slippery to cross for pedestrians, bicyclists and motorists
- ponded water in the gutter may become mosquito habitat
- ponded water in the gutter may seep through cracks, undermining the subgrade and degrading the gutter and adjacent pavement
- groundwater discharge into the City's storm drain system adversely affects others who need to discharge storm water run-off for which the system was designed

## Background

In the past, Public Works allowed perforated pipe basement drainage systems to collect water behind basement walls and under basement slabs and discharge it at the ground. Architects proposed these systems in order to minimize the chances of water leakage through the basement walls and slabs. These systems were permitted with the intention of only collecting and discharging small amounts of rainwater that had seeped down through the soil. For proposed basement drainage systems, Public Works required geotechnical reports that estimated the highest expected groundwater level at the site and Public Works required that the perforated pipes be placed above this level. Recent experience indicates that oftentimes the groundwater level rose above the estimated level and entered the perforated pipes, resulting in the constant pumping of groundwater into the street gutter.

## Analysis

Public Works has obtained a groundwater elevation contour map from the Santa Clara Valley Water District. These maps were established using data from numerous water monitoring wells the SCVWD maintains throughout the City. The contours are the depth below ground to the highest level the main groundwater aquifer has risen to since the monitoring wells were installed.

The area of town where there is relatively high groundwater (above 20 feet below-grade) is roughly northeast of Foothill Expressway.

The main aquifer depicted in the contour map is not the only source of groundwater. Due to soil properties, groundwater can get trapped between two relatively impermeable layers of soil. These lenses of perched groundwater can occur essentially anywhere and be of any size. Consequently, even though the SCVWD map may indicate a certain area of town has groundwater at 20 feet below-grade, for instance, there may currently be perched water closer to the surface or perched water may occur in the future closer to the surface.

Summary

Public Works feels that the public safety and health, potential nuisance, and maintenance concerns caused by the discharge of groundwater into street gutters outweigh the developers' desire for perforated pipe drainage systems. Although certain sites may seem appropriate for perforated pipe drainage systems because of current low groundwater levels, higher groundwater levels may occur in the future. Accordingly, Public Works will no longer permit perforated pipe basement drainage systems installed in order to discharge water at the ground surface northeast of Foothill Expressway.

Note

Drainage systems are required and will be permitted for basement-level exterior spaces, such as stairwells, lightwells and patios. These drainage systems consist of a sump, a sump pump, and a closed pipe from the pump to a dissipation device onsite, such as a bubbler box in a landscaped area, so that water can percolate into the soil and/or sheet flow across the site. The device must not allow stagnant water to occur that could become mosquito habitat. Additionally, the plans must show 8" of freeboard between the floor of any exterior basement-level space and any adjacent windowsills or doorsills.

Glenn Roberts, Director of Public Works

S:PWD/ENG/TYPING/Morris/Development/Basement Drainage/Basement Drainage Policy

ATTACHMENT D

EIP ASSOCIATES

# Draft Technical Memorandum: Correlation between New Basement Construction and the Groundwater Régime in Palo Alto, California

## 1. Statement of the Planning and Transportation Commission's concerns.

At the 14 January 2004 Commission meeting, the planning staff presented a number of proposed changes to the existing regulation of basements in the R-1 zones. During the ensuing discussion, several Commission members expressed concerns about the impact of basement construction on groundwater levels and flow directions. Eight specific, interrelated issues were identified.

- Is groundwater pumping causing or contributing to land subsidence?
- What are the effects of pumping for months to dewater a basement construction site?
- Are basements being permitted in some inappropriate areas [where the water table is only a few feet below the ground surface], creating the need for continuous pumping?
- What groundwater effects occur if water is withdrawn from the water table and pumped into the sewers or creeks?
- What groundwater diversion effects occur if basement walls are built along creeks and/or perforate aquifers?
- What are the effects on landowners adjacent to, and down gradient from, pumping sties?
- What are the cumulative effects of basements on the groundwater régime?
- Can basement regulations be crafted to address the hydro-geology of specific building sites?

The general concern underlying these issues was expressed by Commissioner Annette Bailson: the Commission does not have the information needed to identify whether these are issues of concern, or to make informed decisions on the issues. The remainder of this technical memorandum seeks to respond to that underlying concern by provide some background information about the listed issues and about groundwater hydrology of the City relative to the construction of basements.

## 2. Differences between shallow (surface) and deep (confined) groundwater aquifers.

### Defining the Aquifers

An aquifer is a body of geologic material, usually rock or some mixture of gravel, sand, silt and clay, that is sufficiently permeable to conduct groundwater. Some definitions include the stipulation that the body produce an economically significant flow of water before it may be considered an aquifer. For the purposes of this technical memorandum, the broader definition is applied to allow for easier discussion of the water-bearing formations underlying the City.

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- The Public Works Department requires permit applicants whose projects would have basements to prepare a geotechnical investigation and report that would determine, among other information, the expected highest groundwater level in the local shallow aquifer. This allows the department to make informed decisions about the advisability of basement construction at a particular site and/or to set the conditions under which basement construction may proceed.
- If dewatering is necessary for basement construction, the Public Works Department sets the dewatering permit conditions based on the hydrology of the specific site under consideration. This ensures resource and property protection where it is needed.
- The Public Works Department allows the removal of seepage water that collects along basement walls above the water table. Normally this removal would need only a minimal amount of pumping, but may need to be monitored.

EIP

ASSOCIATES

### 4. Recommendation regarding the advisability of codifying groundwater effects in the Zoning Ordinance Update

The above-listed Public Works Department policies dealing with basement construction and dewatering for such construction are intended to prevent substantial impacts to groundwater, either on an area-wide basis or in the vicinity of the construction site. Although the policies and their associated construction standards appear to address the issues adequately, it may be advisable for the Public Works Department to increase the community's awareness of these issues through an out-reach program. Because these issues are, essentially, engineering concerns that are site-specific and already covered by existing regulations, there is no need to modify the zoning ordinance with respect to them.

Sincerely,

REGISTERED GEOLOGIST
GEORGE J. BURWASSER
No. 7151
Exp. 30 APR 06
STATE OF CALIFORNIA

George J. Burwasser,
EIP Associates

EIP ASSOCIATES 353 SACRAMENTO STREET SUITE 1000 SAN FRANCISCO, CALIFORNIA 94111
*Telephone* 415-362-1500 *Facsimile* 415-362-1954 *E-mail* sf@eipassociates.com
*www.eipassociates.com*

Note: Applicants are advised to use this table only in conjunction with the entirety of requirements in Chapter 18.44 (Green Building Regulations)

## Table A

## City of Palo Alto
## Green Building Standards for Compliance for Private Development

### Nonresidential Construction and Renovation

| Type of Project[5] | Building Improvements | | |
|---|---|---|---|
| | Checklist Required[2] | Minimum Threshold | Verification |
| **Nonresidential Construction and Renovation[1]** | | | |
| New construction ≥ 25,000 sf | LEED-NC Checklist | LEED Silver (33 points) | LEED/USGBC verification |
| New construction ≥ 5,000 sf and < 25,000 sf | LEED-NC Checklist | LEED Silver (33 points) | Threshold verification by LEED AP |
| New construction ≥ 500 sf and < 5,000 sf | LEED-NC Checklist | LEED Pro-rated points[3] | Threshold verification by LEED AP |
| Renovation ≥ 5,000 sf and ≥ 50% of building sf and ≥ $500,000[6] valuation | LEED-NC Checklist | LEED Certified (26 points) | Threshold verification by LEED AP |
| Other renovation ≥ $100,000[6] valuation | LEED-CI Checklist | Submit checklist; include on building plans | Self verification |
| New construction < 500 sf and renovation < $100,000[6] of valuation | No requirement | | |
| **Mixed Use or Other Development** | Commercial and residential criteria as applicable[4] | | |

[1] Cumulative new construction or renovations over any 2-year period following adoption of these requirements shall be considered as a single project, unless exempted by the Planning Director as impractical for compliance.
[2] Compliance with other LEED® checklists, including but not limited to LEED-CS (Core & Shell), LEED-CI (Commercial Interiors), or LEED-EB (Existing Buildings) may be substituted for the designated rating system where deemed appropriate by the Planning Director, after recommendation by the Architectural Review Board (if ARB review is required).
[3] Pro-rated formula = (new construction sf/5,000) x 33 points, but not less than 17 points.
[4] To be determined by the Planning Director; generally the provisions of Table A will apply to the commercial portion of the development, and the provisions of Table B will apply to the residential portions of the development.
[5] Exemptions and incentives may be available for historic structures, pursuant to Section 18.44.070 of the ordinance. The Compliance Official may allow the use of alternative checklists for historic buildings or for buildings that retain or re-use substantial portions of the existing structure.
[6] To be adjusted annually to reflect changes to the City's valuation per square foot of new construction.

Note: Applicants are advised to use this table only in conjunction with the entirety of requirements in Chapter 18.44 (Green Building Regulations)

## Table B

## City of Palo Alto
## Green Building Standards for Compliance for Private Development
## Residential Construction and Renovation

| Type of Project[4] | Building Improvements | | |
|---|---|---|---|
| | Checklist Required | Minimum Threshold | Verification |
| **Multi-Family Residential[1]** | | | |
| New construction of 3 or more (attached) units[2] | Multifamily GreenPoint Checklist | 70 points[4, 6] | GreenPoint Rated verification |
| Additions and/or renovations with permit valuation ≥ $100,000[5] | Multifamily GreenPoint Checklist | Submit checklist; include on building plans | Self verification |
| Additions and/or renovations with permit valuation < $100,000[5] | No requirement | | |
| **Single-Family and Two-Family Residential[1]** | | | |
| New construction of ≥ 2,550 sf | Single-Family GreenPoint Checklist | 70 points + 1 point per additional 70 sf (150 points maximum)[4, 6] | GreenPoint Rated verification |
| New construction of ≥ 1,250 sf and < 2,550 sf | Single-Family GreenPoint Checklist | 70 points[4, 6] | GreenPoint Rated verification |
| Additions <1,250 sf and/or renovations ≥$75,000[5] | Home Remodeling Green Building Checklist | Submit checklist; include on building plans | Self verification |
| Additions and/or renovations of <$75,000[5] permit valuation | No requirement | | |
| **Mixed Use or Other Development** | Commercial and residential criteria as applicable[3] | | |

[1] Cumulative new construction or renovations over any 2-year period following adoption of these requirements shall be considered as a single project, unless exempted by the Planning Director as impractical for compliance.
[2] For any multi-family residential project with 30 or more new units proposed, a LEED-ND (Neighborhood Development) checklist shall also be completed and submitted with the application, for information only.
[3] To be determined by the Planning Director; generally the provisions of Table A will apply to the commercial portion of the development, and the provisions of Table B will apply to the residential portions of the development.
[4] Exemptions and incentives may be available for historic structures, pursuant to Section 18.44.070. The Compliance Official may allow the use of alternative checklists for historic buildings or for buildings that retain or re-use substantial portions of the existing structure, and may reduce the minimum threshold (points) required as outlined in Section 18.44.050.
[5] To be adjusted annually to reflect changes to the City's valuation per square foot of new construction.
[6] Points shall include GPR minimum points across all resource categories.

attained the compliance threshold as indicated for the Covered Project type as set forth in the Standards for Compliance outlined in Section 18.44.040.

(u) "Single-family or two-family residential" means a single detached dwelling unit or two units in a single building.

(v) "Square footage," for the purposes of calculating commercial, multi-family residential, and single-family and two-family new construction square footage, means all new and replacement square footage, including basement areas (7 feet or greater in height) and garages, except that unconditioned garage space shall only count as 50% of that square footage. Areas demolished shall not be deducted from the total new construction square footage.

(w) "Threshold Verification by LEED AP" means verification by a LEED accredited professional certifying that each LEED checklist point listed was verified to meet the requirements to achieve that point. The LEED AP shall provide supporting information from qualified professionals (e.g. civil engineer, electrical engineer, Title 24 consultant, commissioning agent, etc.) to certify compliance with each point on the checklist. Documentation of construction consistent with building plans calculated to achieve energy compliance is sufficient verification in lieu of post-construction commissioning.

**18.44.040 Standards for Compliance.**

The City Council shall establish by resolution, and shall periodically review and update as necessary, Green Building Standards for Compliance. The Standards for Compliance shall include, but are not limited to, the following:

(a) The types of projects subject to regulation (Covered Projects);

(b) The green building rating system to be applied to the various types of projects;

(c) Minimum thresholds of compliance for various types of projects; and

(d) Timing and methods of verification of compliance with these regulations.

The Standards for Compliance shall be approved after recommendation from the Director of Planning and Community Environment, who shall refer the Standards for recommendation by the Architectural Review Board, prior to Council action.

**18.44.050 Incentives for Compliance.**

(a) In addition to the required standards for compliance, the City Council may, through ordinance or resolution, enact financial, permit review process, or zoning incentives and/or award or recognition programs to further encourage higher levels of green building compliance for a project.

## 18.12.090 Basements

Basements shall be permitted in areas that are not designated as special flood hazard areas as defined in Chapter 16.52, and are subject to the following regulations:

**(a) Permitted Basement Area**

Basements may not extend beyond the building footprint and basements are not allowed below any portion of a structure that extends into required setbacks, except to the extent that the main residence is permitted to extend into the rear yard setback by other provisions of this code.

**(b) Inclusion as Gross Floor Area**

Basements shall not be included in the calculation of gross floor area, provided that:

(1) basement area is not deemed to be habitable space, such as crawlspace; or

(D) the cumulative length of any excavated area or portion thereof that extends into a required side or rear yard does not exceed 15 feet;

(E) the owner provides satisfactory evidence to the planning director prior to issuance of a building permit that any features or portions of features that extend into a required side or rear yard will not be harmful to any mature trees on the subject property or on abutting properties;

(F) such features have either a drainage system that meets the requirements of the public works department or are substantially sheltered from the rain by a roof overhang or canopy of a permanent nature;

(G) any roof overhang or canopy installed pursuant to subsection (F) is within and is counted toward the site coverage requirements established in Section 18.12.040;

(H) such areas are architecturally compatible with the residence; and

(I) such areas are screened to off-site views by means of landscaping and/or fencing as determined appropriate by the planning director.

(Ord. 4869 § 14 (Exh. A [part]), 2005)

(2) basement area is deemed to be habitable space but the finished level of the first floor is no more than three feet above the grade around the perimeter of the building foundation.

Basement space used as a second dwelling unit or portion thereof shall be counted as floor area for the purpose of calculating the maximum size of the unit (but may be excluded from calculations of floor area for the total site). This provision is intended to assure that second units are subordinate in size to the main dwelling and to preclude the development of duplex zoning on the site.

**(c) Lightwells, Stairwells, Below Grade Patios and other Excavated Features**

(1) Lightwells, stairwells, and similar excavated features along the perimeter of the basement shall not affect the measurement of grade for the purposes of determining gross floor area, provided that the following criteria are met:

(A) such features are not located in the front of the building;

(B) such features shall not exceed 3 feet in width;

(C) the cumulative length of all such features does not exceed 30% of the perimeter of the basement;

(D) such features do not extend more than 3 feet into a required side yard nor more than 4 feet into a required rear yard, but where a side yard is less than 6 feet in width, the features shall not encroach closer than 3 feet from the adjacent side property line;

(E) the cumulative length of any features or portions of features that extend into a required side or rear yard does not exceed 15 feet in length;

(F) the owner provides satisfactory evidence to the planning division prior to issuance of a building permit that any features or portions of features that extend into a required side or rear yard will not be harmful to any mature trees on the subject property or on abutting properties; and

(G) such features have either a drainage system that meets the requirements of the public works department or are substantially sheltered from the rain by a roof overhang or canopy of a permanent nature.

(2) Below-grade patios, sunken gardens, or similar excavated areas along the perimeter of the basement that exceed the dimensions set forth in subsection (1), are permitted and shall not affect the measurement of grade for the purposes of determining gross floor area, provided that:

(A) such areas are not located in the front of the building;

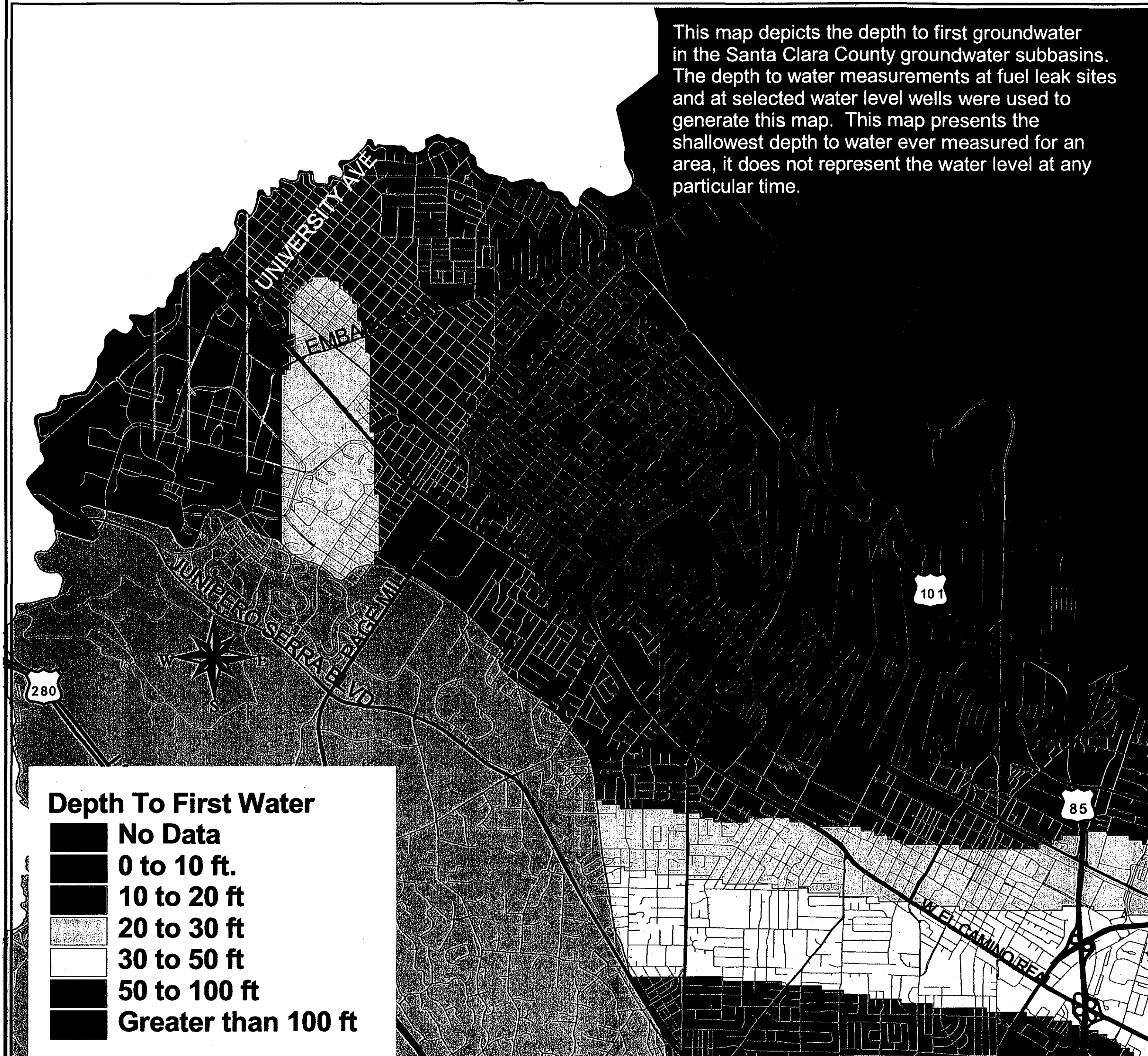
(B) all such areas combined do not exceed 2% of the area of the lot or 200 square feet, whichever is greater; that each such area does not exceed 200 square feet; and that each such area is separated from another by a distance of at least 10 feet. Area devoted to required stairway access shall not be included in the 200 square foot limitation.

(C) such features do not extend more than 2 feet into a required side yard nor more than 4 feet into a required rear yard;

# Depth To First Water

**ATTACHMENT G**

## Santa Clara County Groundwater Subbasins




The data presented in this map are regional and general in nature. The Santa Clara Valley Water District (District) does not guarantee that the groundwater data presented here accurately reflects conditions at any particular site or time. The District makes no guarantees or warranty, expressed or implied, as to the accuracy, timeliness, completeness, or adequacy of this data for any use or particular purpose. In consideration of the District making this information available, any user of the data accepts it as is and assumes responsibility for its use. User agrees to defend, indemnify and hold the District harmless from and against all damage, loss or liability arising from any use of the data. Groundwater data may vary greatly from site to site. A site-specific investigation may be necessary todetermine site-specific conditions.

groundwater management

Santa Clara Valley Water District

Map Version: October 15, 2003

**ATTACHMENT H**

**Steve Broadbent**
**575 Washington Ave**
**Palo Alto, CA 94301-4046**
steve.broadbent@hp.com
(650) 521-3958

May 8, 2008

Honorable Mayor Larry Klein and Council Members
City of Palo Alto
250 Hamilton Ave
Palo Alto, CA 94301
Via email

Re: Green Building Ordinance – Request to Prohibit Basement Construction

Honorable Mayor Klein and Council Members:

I urge City Council to strengthen City ordinances to prohibit the construction of residential basements, especially basements which require dewatering during construction.

The mechanical removal of millions of gallons of groundwater from a construction site has detrimental environmental impacts, and it is disingenuous for a construction project to be considered "green" when it builds a basement in an aquifer. One so called "green" project in Old Palo Alto pulled an estimated 100,000 gallons of water per day from our underground aquifer for a period of 6 months. The Green Building Ordinance under consideration by the City Council does not adequately address this abhorrent practice, and you should amend the ordinance to prohibit basement construction.

The Planning & Transportation Division Staff Report for the April 9, 2008, study session on the proposed Green Building Criteria for Private Development recognized basement construction as an issue needing further scrutiny, but staff has failed to pursue satisfactory resolution:

> "The Commission and the public asked several questions about basements, including a) groundwater discharged, b) the effects of dewatering on groundwater and potential toxic plumes, c) the amount of concrete used, and d) impact on trees.
>
> "The Public Works Department has, in the past few years, revised its basement policy to prohibit dewatering basements after construction. Dewatering from basements during construction is still allowed …

> "During the Zoning Ordinance Update, staff commissioned EIP Associates to study the impacts of extensive basement construction on groundwater …
>
> "Staff believes that the use of basements deserves continued scrutiny … Planning has included provision in the green building criteria that larger homes (including basement floor area) must achieve a greater number of green point credits than smaller homes to help compensate for these resource impacts. Other approaches would require extensive discussion as to when or whether to continue to allow basements … In recent ordinance discussions, this issue was broached but not pursued."

I agree with staff that the use of basements deserves continued scrutiny, but I am disappointed that staff believes green point credits can mitigate the serious impacts basement construction has on our city. Public Works has attempted to dismiss concerns raised by many residents by declaring the impacts as "negligible" or by disavowing specific knowledge. A response that "staff is not aware" should not be considered closure on the issues raised.

I take exception to a number of the conclusions put forth by Public Works, and I ask that Council direct staff to reconsider their findings, including but not limited to:

- Impact to neighboring properties
- Land subsidence
- Impact on trees and landscaping
- Waste of water
- Other detrimental impacts

**Impact to Neighboring Properties**

Staff asserts "the study concluded that the impacts of basement construction were negligible on the groundwater system and on the groundwater on neighboring sites." However, the EIP study clearly stated that

> "In the areas adjacent to the site being dewatered, the rate and flow directions of the groundwater would be altered temporarily by the dewatering process. Groundwater in the influenced area would move toward the base of the excavation … This effect could extend from several feet to several tens of feet beyond the excavation."

My concern is not with the long term impact on the broader Santa Clara Valley groundwater system. My issue is with the site-specific impacts on neighboring properties and the local community. You should not allow macro responses to obscure the micro view of real damage that residential basements cause.

There may be no discernable long-term effect on the broader surface aquifer beneath the Santa Clara Plain (macro view), but the prolonged extraction of groundwater from 2164

Webster Street most certainly sucked the groundwater from underneath neighboring properties, including mine (micro view).

Although small compared to the volume of the surface aquifer (macro view), the volume of space displaced by a basement could be several tens of thousands of cubic feet which would displace groundwater flow around a newly constructed basement. This could be significant locally (micro view), especially if there were other similarly sized basements in the immediate vicinity (refer to EIP study, page 5). Several residents have horror stories of how the utility basements in their established homes began flooding after the construction of neighboring basements.

The Foundation Engineering Handbook, by Hsai-Yang Fang (1991), confirms that "... the process of dewatering can have side-effects that are harmful to the project under construction, the other facilities nearby, or to the environment ... Improper dewatering ... can cause damage to the structures being built or to adjacent structures."

**Land Subsidence**

It is well established that subsidence can occur with groundwater extraction, and the effects of subsidence cannot be reversed where portions of the aquifer have been compressed.

> "Saltwater intrusion and subsidence in the Santa Clara Subbasin are documented regional effects of the excessive removal of groundwater from the deep aquifer over many years ... the SCVWD has been recharging the subbasin [with potable water] thereby raising groundwater level ... and virtually eliminating further overdraft-related subsidence. Such basin-wide effects could recur only if the deep aquifer became overdrafted again. Because dewatering for basement construction occurs only in the uppermost portion of the surface aquifer and involves only a small amount of groundwater withdrawl [relative to the broader Santa Clara Subbasin], no effects would occur in the deep aquifer." (macro view, refer to EIP study, page 6)

Take that "macro view" and bring it up to the surface aquifer underlying my home. My "micro view" is that the drawdown of the groundwater under adjacent properties can and does cause localized subsidence depending on the soil properties in the area. After 75 years, my home shouldn't be "settling" any more, but cracks in the plaster and cracks in the pavement developed during the extended dewatering at 2164 Webster.

Fang confirms that "ground settlement can occasionally be a problem. Lowering the water table increases the effective stress in the soil. The stress increase is usually modest, and most soils are not affected significantly. But if there are compressible soils in the vicinity ... settlement may occur. Whether the settlement causes significant damage depends on the thickness and consolidation characteristics of the compressible deposit, the depth of drawdown and the duration of pumping, the foundations of the structures within the zone affected, and the type of their construction."

**Impact on Trees and Landscaping**

Not only do I disagree with the Planning Arborist's assertion that "the localized drawdown of the water table during dewatering does not impact trees as their roots do not typically extend to that depth," the EIP study contradicts that assertion:

> "The possibility exists that adjacent landscaping could experience deterioration from reduced groundwater availability." (refer to EIP study, page 4)

Fang also confirms that, "trees or other plantings in urban parks may be affected [by dewatering]." Regardless of whether tree roots extend into the aquifer or not, the strong pull of drawdown wells during a dewatering operation accelerates the percolation of surface waters and induces drought-like conditions as the soil dries out. Landscape irrigation cannot and should not be considered sufficient mitigation of the drought-like stress inflicted on trees during prolonged dewatering.

**Waste of Water**

The City has been studying the use of recycled water for landscape irrigation and other non-potable uses, and a multimillion dollar recycled water project is being considered. The City clearly recognizes the need for water conservation, yet it permits the intentional discharge of millions of gallons of water into our storm drains. That simply doesn't make sense.

Public Works has stated that the water pumped from the shallow aquifers typically goes into the storm drain system and then into the creeks, some of which are "losing" creeks, meaning they lose their water back to the shallow aquifers. Public Works asserts that the water is pumped out of the aquifer and then added back to it. But Public Works fails to acknowledge that there are no "losing" creeks in my neighborhood, only engineered channels.

- Adobe is all concrete bottom and sides from Hwy 101 to Alma.
- Matadero is all concrete bottom and sides from Hwy 101 to Alma, except from Greer to hwy 101
- Barron is all concrete bottom and sides from Hwy 101 to Alma except for about 800 feet just upstream of hwy 101.

Concrete channels are not "losing" creeks, and since the natural aquifer flow is from the foothills to the bay, any recharge in the short sections near Hwy 101 does not replenish the impacted neighborhood.

## Other Detrimental Impacts

In addition to the unnecessary waste of water, the large volume of water pumped into our storm drains could rupture our aging storm drains, damage streets and underground utilities, and cause a sinkhole to develop.

Fang also notes that groundwater in the vicinity of a dewatering operation may be affected "by temporary reduction in the yield of supply wells, by salt water intrusion, or by the expansion of contaminant plumes."

## Call for Action

Mayor Klein and Council Members, I call upon you to take action to restrict residential basement construction and stop the destructive practice of dewatering. Palo Alto wants to be a leader in the Green Building movement. Please amend the Green Building Ordinance to prohibit residential basement construction in Palo Alto.

Sincerely,

Steve Broadbent

To: Palo Alto City Council & Planning & Transportation// Re: Dewatering and Basement Construction// Date: July 19, 2008

Honorable Council and Planning and Transportation Committee Members:

I am writing to express my concerns about dewatering and basement construction in Palo Alto. I am a professional scientist who has specialized in groundwater hydrology since 1975. I have a BS in Geology from Dickinson College and MS and PhD degrees in Hydrology from Stanford University. I have lived in Palo Alto for 31 years. The following statements are my personal views as a resident.

I recently received a call from another Palo Alto resident who purchased an older home near property that was being outfitted with a new house. Excavation for the new home's basement required pumping over 18-million gallons of groundwater 35 feet to land surface, where the water was discarded into the City's storm sewer. According to the caller, this dewatering was carried out with the approval of the City, without the need for a variance. The resident reported that dewatering volumes on the order of millions of gallons have been produced in multiple instances in Palo Alto, as mega basements have become popular.

I do not advocate a complete ban on basement construction. Nevertheless, it is clear that large parts of the City are unsuitable for the sorts of basements being built. Projects that require large-scale dewatering should not be allowed. The reasons are simple:

(1) Construction of finished (dry) space where any part of that space is below the water table is not advisable and should rarely if ever be allowed. This is necessary not only to protect the newly constructed space, but also to conserve energy and water resources and to prevent overloading of the storm-sewer system. Building codes prohibit basements that would be "subject to flooding." The maximum elevation of the water table during normal rainy seasons, plus a reasonable safety margin, sets the limit for allowable subsurface construction. The need for large-scale dewatering indicates that the structure being built is *subject to flooding* by groundwater. It is not to anyone's advantage to build basements in unsuitable locations. The City must uphold existing law.

(2) Extensive low-lying areas of Palo Alto have shallow water tables, rendering them unsuitable for basements. These areas were prone to flooding prior to "reclamation" projects that "channelized" the downstream reaches of creeks and diked off the Palo Alto Baylands. Sea-level rise from global warming is underway. Sea-level rise will increase water-table elevations in low-elevation areas of the City. Empirical projections based on ICPP scenarios call for 0.5 to 1.4 meters (1.6 to 4.6 feet) of sea-level rise by 2100 (http://www.sciencemag.org/cgi/content/abstract/315/5810/368). These projections are likely low (http://www.sciencemag.org/cgi/content/abstract/317/5841/1064).

(3) The cone-of-depression from construction dewatering involving extraction wells with only a few feet of horizontal setback from adjoining properties will definitely extend beneath the adjoining properties, with potentially harmful effects from desiccation and differential settling. Palo Alto's soils are heavily textured "adobes" in which the dominant minerals of the fine fraction are montmorillonitic (smectitic) clays. Smectitic clays swell with wetting and shrink with drying. Although modern foundations are designed to avoid

failure in soils that shrink and swell, older structures are vulnerable to harm. Dewatering *removes water from adjacent properties*. It seems prudent to avoid situations where one person's allowed dewatering can harm neighboring properties.

(4) Wasteful consumption of City water resources is a serious issue. Eighteen million gallons of water is about 24-*thousand* CCF (hundred cubic feet). If applied to a medium-sized City park with 200,000 square feet of irrigated turf—roughly the size of the Mitchell Park soccer fields—the depth of the applied water would be about 12 feet. This represents *one hundred weeks* of irrigation—five years' worth at 20 irrigation weeks per year. Virtually all water removed during construction ends up in the Bay via lined storm-runoff conveyances. Virtually none of it recharges groundwater or soil moisture. Waste on this scale is unconscionable.

(5) The possibility of groundwater contaminants being captured by construction wells poses risks at multiple locations throughout the City. As more commercial and industrial areas are rezoned to residential uses, the number of risks increases. Many contaminant plumes are mapped, but others are poorly characterized. Such risks additionally weigh against construction dewatering.

In summary, basements must be restricted to areas that have adequately thick unsaturated zones—not all areas of Palo Alto are suitable. Large-scale dewatering should not be permitted. Preservation of property and avoidance of contaminant entrainment are compelling reasons to reassess current practices. The public costs of construction dewatering are unacceptably high. Groundwater is a City resource so precious that no one should be permitted to squander it on grand scales.

Prudent restriction of dewatering and basement construction will protect all parties.

My only interest in this matter was a promise to a fellow Palo Altan—concerned by groundwater impacts—to assess the situation and communicate my findings to you.

With best regards,

David A. Stonestrom

David A. Stonestrom
1000 S. California Ave.
Palo Alto, CA 94306

**From:** Williams, Curtis
**Sent:** Monday, September 15, 2008 5:55 PM
**To:** Williams, Curtis
**Subject:** FW: Basement Excavation Photos
**From:** Jodyldavidson@aol.com [mailto:Jodyldavidson@aol.com]
**Sent:** Tuesday, April 22, 2008 6:02 AM
**To:** Williams, Curtis
**Cc:** French, Amy
**Subject:** Basement Excavation Photos

Hi Curtis,

These are some photos to help explain what I meant when I was trying to explain that the underground footprint of basements was too large.

On the smaller size lots, the builders often excavate closer to the allowed set backs.

Many often excavate right up to the lot line, and then the builders start putting in the concrete and rebar.

I have seen this many times.

People in adjacent homes have told me that they believe that the excavation has ruined the foundation of their homes. Since the side yard is all concrete, there is no where for the water to flow, except laterally.

This causes flooding to neighboring homes. Additionally, there is simply not enough side yard to allow for planting, and the rear set backs are really too small to allow for tree planting when the tree grows.

Basically, the homes on these lots are all home and no yard.

I hope that the city will consider reviewing their policies on the allotted size of a new home on these smaller lots.

Allowing this building practice has caused a lot of disharmony within our community.

Many residents feared that their homes could actually fall into the adjacent excavation site, and in many cases they had to pay for fencing to protect their property.

Many felt that the chain link fence was simply not enough protection when the builders excavate to the lot line.

Please remember that some of the adjacent older homes on the smaller lots may not have this 6 foot side allowance.

Regards,

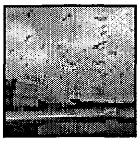
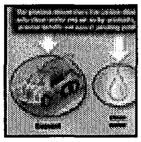
Jody Davidson

Attachment K

SFGate.com

# Green cement may set CO2 fate in concrete

Carrie Sturrock, Chronicle Staff Writer
Tuesday, September 2, 2008

**(09-01) 19:18 PDT** -- Call him cement man.

Back when Stanford Professor Brent Constantz was 27 he created a high-tech cement that revolutionized bone fracture repair in hospitals worldwide. People who might have died from the complications of breaking their hips lived. Fractured wrists became good as new.

Now, 22 years later, he wants to repair the world.

Constantz says he has invented a green cement that could eliminate the huge amounts of carbon dioxide spewed into the atmosphere by the manufacturers of the everyday cement used in concrete for buildings, roadways and bridges.

His vision of eliminating a large source of the world's greenhouse CO{-2} has gained traction with both investors and environmentalists.

Already, venture capitalist Vinod Khosla is backing Constantz's company, the Calera Corp., which has a pilot factory in Moss Landing (Monterey County) churning out cement in small batches.

And Carl Pope, executive director of the Sierra Club, says it could be "a game changer" if Constantz can do it quickly, on a big scale and at a decent price.

"It changes the nature of the fight against global warming," said Pope, who has talked with Constantz about his work.

That might sound like hyperbole, but the reality is that for every ton of ordinary cement, known as Portland cement, a ton of air-polluting carbon dioxide is released during production. Worldwide, 2.5 billion tons of cement are manufactured each year, creating about 5 percent of the Earth's CO{-2} emissions.

When Constantz learned about the high CO{-2} levels, he thought he could do better. After all, the majority of his 60 patents have to do with medical cement.

He claims his new approach not only generates zero CO{-2} , but has an added benefit of reducing the amount of CO{-2} power plants emit by sequestering it inside the cement.

To make traditional cement, limestone is heated to more than 1,000 degrees Celsius, which turns it into lime - the principal ingredient in Portland cement - and CO{-2}, which is released into the air.

Constantz uses a different approach, the details of which remains secret pending publication of his patent.

At his pilot factory, a former magnesium hydroxide facility that made metal for World War II bombs, magnesium crunches underfoot as Constantz, wearing a pressed, blue button-down shirt with rumpled shorts and sandals, outlines how the process works.

He pointed to two enormous smokestacks billowing flue gases full of carbon dioxide next door at Dynegy, one of the West's biggest and cleanest power plants.

Constantz takes that exhaust gas and bubbles it through seawater pumped from across the highway. The chemical process creates the key ingredient for his green cement and allows him to sequester a half ton of carbon dioxide from the smokestacks in every ton of cement he makes.

Constantz believes his cement would tackle global warming on two fronts. It would eliminate the need to heat limestone, which releases CO{-2}. And harmful emissions can be siphoned away from power plants and locked into the cement.

The same process can also be used to make an alternative to aggregate - the sand and gravel - that makes up concrete and asphalt, which would sequester even more carbon dioxide from power plants.

"The beauty here is we're taking this old industrial polluting infrastructure and turning it into something that will save the environment," Constantz said.

On a per-person basis, the United States is the world's worst CO{-2} polluter from all sources. But according to the Netherlands Environmental Assessment Agency, China just surpassed the U.S. for total carbon dioxide emissions.

China is expected to produce 47 percent of the world's 2.5 billion tons of cement this year, Constantz said.

To power its new buildings and sustain its building boom, China constructs at least one coal-fired power plant a week. Each one belches out enough CO{-2} to cancel the benefits of every hybrid on U.S. roadways, said Constantz.

A CO{-2} molecule can travel from Beijing to San Francisco in less than a day through atmospheric circulation, he said. So even with California mandating that CO{-2} emissions fall to 1990 levels by 2020, a crisis remains.

"Carbon dioxide is a global problem, not a regional problem," he said.

As far as cost, Constantz estimates his cement would retail for \$100 a ton versus roughly \$110 for Portland.

The reason no one invented it before now, he said, is that people didn't truly understand the dangers of CO{-2} until less than a decade ago.

### Skeptics question product

He has skeptics.

Portland cement has a track record of more than 100 years, and any new material would have to get incorporated into building codes, noted Rick Bohan, director of construction and manufacturing technology for the Portland Cement Association in Skokie, Ill.

And Tom Pyle, a Caltrans engineer who serves on the cement subgroup of Gov. Arnold Schwarzenegger's Climate Action Team, acknowledged that the technology is possible, but he still wants to examine Constantz's cement.

"We hope they have a carbon-reducing viable construction material," he said. "They need to show up with a bag of this so we can test it."

Constantz is confident he will prove himself. Initially, he proposes mixing his new invention with Portland cement to ease a conservative industry into a new product. Concrete bigwigs have invited him to speak about Calera cement at their annual World of Concrete in Las Vegas next February.

### Power plant partnerships

Constantz envisions building cement factories next to power plants the world over. A team is scouting out U.S. locations. While Dynegy has supplied Constantz with some flue gas, it hasn't entered into a formal agreement.

"As we're looking into the future, we're very interested in technology that would help capture CO{-2} from the flue gases and turn it into a product that offers a benefit," said Dynegy spokesman David Byford.

It could be good for business. California has mandated emissions reductions. And Congress is working on legislation that would allow high polluters to buy credits from those with low emissions. Power plants would have a huge incentive to sequester their CO{-2} in cement.

But even if Constantz succeeds, the world would still need to do much more to fight CO{-2} emissions, said Chris Field, director of the department of global ecology at the Carnegie Institution for Science at Stanford. "It's a big, long complicated game," he said. "As we develop each new segment of the solution we need to embrace it and deploy it and work hard to develop the next segment of the solution."

### Coral basis of idea

Big ideas can form in haphazard ways. The one for bone cement began during a televised football game, when Constantz read an osteoporosis article in the New England Journal of Medicine. Three weeks later, as he studied a coral reef, it occurred to him he could maybe synthesize coral skeletons in human bones.

His new cement mimics how coral reefs form, too. Coral uses the magnesium and calcium present in seawater to create carbonates much as he's using CO{-2} and seawater to make carbonate.

This latest invention took 18 months to conceive and execute. He feels it's one of the most important things he's ever done.

"Climate change is the largest challenge of our generation," he said.

### Who is brent constantz?

**Profession**: An associate consulting professor in Stanford's department of geological and environmental sciences and founder of the Calera Corp. Created and sold three other companies - Norian Corp., Corazon Technologies Inc. and Skeletal Kinetics.

**Education**: UC Santa Barbara, bachelor's of science (1981); UC Santa Cruz, doctorate (1986)

**Family**: Married and father of four.

**Pastime**: Surfing and rock climbing.

### Concrete facts about cement

**2.5 billion tons** of hydraulic cement is produced worldwide annually. Add sand and gravel and that makes more than **9,000 million cubic yards** of concrete. That's more than enough concrete to pave an **eight-lane highway** from the Earth to the moon and back again - twice.

If you stayed on the planet, that same eight-lane highway would circle the Earth almost 40 times.

*Source: Portland Cement Association*

E-mail Carrie Sturrock at csturrock@sfchronicle.com.

http://sfgate.com/cgi-bin/article.cgi?f=/c/a/2008/09/02/MNGD12936I.DTL

Attachment B

# New Aquifer Filling Station

Revised 5/26/2015

# Piping System

- Arrange piping system to draw water from settling tank being careful to keep the inlet a minimum of 1-2 feet above the bottom of the tank to avoid settlement residue.

# Locate the Filling Station

- Filling station should be located at the property line outside of the construction fence.
- Try to locate the station in a place where parked vehicles will not prevent equipment from using it, i.e. on a corner, near at the edge of a driveway, etc.
- The filling station should be accessible 24/7.

# Filling System

- Piping runs from the settling tank to a pump capable of providing a minimum of 150-200 gpm.
- Outlet of pump runs to lockable box where a standpipe is constructed.
- Standpipe contains a valve and outlet fitted with a **MALE 2 ½" NH** threaded fitting (Fire Hydrant threads).
- Inside the box is also located a switched GFI outlet to which the pump is plugged into. When the switch is thrown, the pump turns on. This switched outlet is connected to the construction site's temporary power. The GFI power outlet may be placed somewhere outside the box, however, the switch should be inside. An "in-use" cover must cover the switch/outlet.
- A hose with a male connection shall be stored in the box to allow the water to be used for dust control onsite and for filling tanks without pre-attached hoses or fittings.
- A standard hose bibb shall be installed next to the box to allow for *gravity-fed* filling of smaller "neighbor containers".

# Plumbing Signage

- The piping outside of the property lines needs to comply with California Plumbing Code Section 603.5.11:
- Each outlet on the non-potable waterline shall have posted: “CAUTION: NONPOTABLE WATER, DO NOT DRINK.” This would apply to the hose bibb utilized by neighbors for non-potable purposes. The CPC also requires that exposed portions of the piping be properly identified to the satisfaction of the AHJ. CPC Section 601.2 provides identification for non-potable systems within a building. Although the proposed work is not within a building, the method would adequately identify the piping system.
- Section 601.2 Non-Potable Water System Identification
- The system shall have a yellow background and black uppercase letters, with the words “CAUTION: NONPOTABLE WATER, DO NOT DRINK.” The required piping identification shall be every 20 feet. The sizing of this lettering should be per CPC Table 601.2.2.
- This ‘signage’ comes in the form of stickers and can be easily found online.

**TABLE 601.2.2**
**MINIMUM LENGTH OF COLOR FIELD AND SIZE OF LETTERS**

| OUTSIDE DIAMETER OF PIPE OR COVERING (inches) | MINIMUM LENGTH OF COLOR FIELD (inches) | MINIMUM SIZE OF LETTERS (inches) |
|---|---|---|
| ½ to 1¼ | 8 | ½ |
| 1½ to 2 | 8 | ¾ |
| 2½ to 6 | 12 | 1¼ |
| 8 to 10 | 24 | 2½ |
| Over 10 | 32 | 3½ |

For SI units: 1 inch = 25.4 mm

# Fill Point and Discharge Signage

- The contractor shall provide a sign according to Public Works specifications and attach it to the outside of the fill station box.
- The contractor shall also provide signs to be mounted on a standard “A-frame” barricade to be placed at the dewatering discharge point (usually a catch basin).
- Upon completion of dewatering activities, the signs shall be returned to the Public Works Inspector for recycling.

# Water Station
# Sign Specifications

- These specifications are provided as guidance to produce/order consistent signs:

- This sign is aluminum, 20.5” tall by 14” wide. The margin is 0.25” and the border is also 0.25” wide.
- “Water Filling Station” is 1.5” tall, Highway Series E font.
- “Suitable For Irrigation Purposes” is 0.75” tall, Highway Series B font.
- “Do Not Drink” is 1.2” tall, (font as it is part of the symbol). The red circle and slash has a circumference of 4.5”.
- The city logo is 4.2” tall by 2.2” wide.

- Mount this sign to the water station door.

# Discharge Point
# Sign Specifications

- These specifications are provided as guidance to produce/order consistent signs:

- This sign is aluminum, 24” tall by 24” wide. The margin is 0.375” and the border is 0.625” thick.
- “Non-Potable Water Discharge” is 2”tall, Highway Series C font.
- “Do Not Drink” is 1.2” tall, (font as it is part of the symbol). The red circle and slash has a circumference of 4.5”.
- “To Use This Water…” is 1” tall, Highway Series C font.
- The city logo is 4.2” tall by 2.2” wide.
- Mount this sign to each side of an A-frame barricade (2 signs total) and place it at the discharge point.

# Log Sheets

- Copies of the following log sheets with a pen shall be attached to the inside of the door of the filling station.
- All users of the water filling station shall fill out the form for each use.

# Log Sheet: Available from Public Works

CITY OF PALO ALTO

PUBLIC WORKS

Dewatering Water Usage

Month of ___________

| Date/Time | Vehicle Type & # | Agency | Gallons |
|---|---|---|---|
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Prepared by:____________________ TOTAL:______________________

# Instructions

- Attach a copy of operating instructions to the inside of the box.
- Sample instructions:

# Security

- Box should be sturdy and locked with a combination lock.
- Provide the lock combination to Public Works – Engineering Services.

# Inspection

- NO DISCHARGE IS ALLOWED WITHOUT A DEWATERING PERMIT.
- Once there is groundwater in the settling tank, contact the Environmental Compliance division at (650) 329-2122 or (650) 329-2430 to have the water tested.
- Public Works will contact you to inform you of the results.
- Once the station is constructed and ready to operate, contact Public Works Inspection at (650) 496-6929 to schedule an inspection.
- Once the Inspector has approved of the station installation, Public Works - Engineering Services can issue you the dewatering permit.

# Important Notification

- Contractor shall notify Public Works – Engineering Services ONE WEEK prior to ending dewatering operations.
- This will allow City staff to adjust vehicle operations and routes accordingly.

# Final Notes

- The New Aquifer Filling Station is a quickly evolving program - changes, modifications, revisions, and additional conditions, policies, and equipment required may occur at any time.
- This handout is a living document and will be revised as the program develops.

# Questions?

- Contact:

Mike Nafziger, P.E.

Senior Engineer

Public Works – Engineering Services

(650) 617-3103

mike.nafziger@cityofpaloalto.org

Or,

Public Works – Engineering Services

(650) 329-2152

Attachment C

# GROUNDWATER PUMPING HAPPENING IN YOUR NEIGHBORHOOD


**A BASEMENT CONSTRUCTION PROJECT** in your neighborhood is pumping water to a stormdrain which leads to a creek. This groundwater cannot be used as drinking water, but it can be pumped to creeks or used for irrigation and dust control. Creeks would ultimately receive this same water if it was not pumped there first. This water is important to the creek and Bay ecosystems.

The construction project in your neighborhood offers a residential filling station to access some of this pumped water for use on landscaping.

Visit **cityofpaloalto.org/recycledwater** or call **(650) 329-2151, Press option #8** for filling station locations and additional information.

CITY OF
PALO
ALTO

# Groundwater Pumping From Building Sites

## Frequently Asked Questions

During this time of severe drought, our community is working hard to conserve water. So when community members observe water pumping from construction sites, they want to know what is happening. Here are answers and information to help address the most frequently asked questions we have heard.

**Q. What is the water that I see running into the storm drain from construction sites?**

A: During the construction of a basement or underground garage there is sometimes a shallow upper groundwater aquifer that must be temporarily pumped down to allow construction to move forward. This groundwater is not the same water that would be used for drinking.

**Q: Does the City regulate the pumping and discharge of this water?**

A: The City permits the discharge of this water to either the storm drain or the sanitary sewer, depending on the water quality. The water is sampled and tested for cloudiness, salinity and acidity. Only very clear, high quality water can go to the storm drain. Temporarily pumping this water is standard practice in areas with groundwater closer to the surface to allow construction to proceed, and no practical alternative has been found. Using the water for irrigation and dust control is possible, and the owners and construction managers are strongly encouraged to find uses for the water.

**Q: Given the high quality of the water and the severity of the drought, why does the City allow it to be "wasted" by discharging it into the storm drain system?**

A: The shallow water aquifer being pumped contributes to the flow of our creeks and to the Bay. The groundwater is part of the water cycle for the Bay and enhances the habitat and improves the quality of the creeks and lower South San

Francisco Bay. When the shallow aquifer is pumped from basement construction sites into storm drains, it travels a different path, but ends up in the same place: the lower South Bay. So, the water is not wasted, but rather is used to improve the Bay's habitat and ecosystem, whichever pathway it takes.

**Q: Can't this water be used for other purposes?**

A: The pumped water hasn't been disinfected or sufficiently tested to drink or use inside the home. Palo Alto's emergency drinking water wells tap into a much lower and more protected aquifer. However, the pumped water could be used for irrigation, dust control or similar uses. Palo Alto now requires that contractors have the pumping system fitted with valves and connections so that City crews and others can fill water trucks, street sweepers and other containers. For truck fill stations, the water is tested for acidity and salinity. Private parties can also fill trucks and containers. Such "fill-stations" are now in place at the Palo Alto active basement construction pumping sites listed below:

- 1405 Harker
- 1820 Bret Harte
- 804 Fielding
- 713 Southampton
- 3832 Grove
- 2230 Louis

View our map of FREE Water Filling Stations.

The site owners and construction managers are encouraged to find more water users, but this will continue to be a small fraction of the total pumped water.
Call 650-617-3103 for more information about accessing the fill stations.

The volume of water being pumped is large compared to pump truck capacities, but is too small and too shallow to impact the very deep and very large Palo Alto emergency ground water aquifer.

**Q. What happens after construction?**

A: In recent years, Palo Alto has required that structures be built as water tight so that groundwater flows around a building, rather than into it. But a number of older buildings leak, and water is pumped out of the building basement/garage into the storm drain or sanitary sewer. Palo Alto City Hall and 525 University are two of the largest "dischargers". We have looked at utilizing the water from City Hall, but it has not proven to be cost effective. With new water restrictions in place, this issue is being reexamined once again. However, the City Hall water does go through the storm drain to San Francisquito Creek where it supports habitat, including for fish, especially in the summer when there is no rainfall.

**Q. What can I do if I see water being wasted?**

A: The City has hired a part-time Water Waste Coordinator who is specifically dedicated to drought response actions. Need to report a leak, runoff or waste? We have many communications means for you! Please let us know!

- Report water use incidents through the City's PaloAlto311 web or mobile app at cityofpaloalto.org/services/paloalto311/ or go visit to www.cityofpaloalto.org/water to access the link directly.
- Contact the City's Water Waste Coordinator at 650-496-6968 or Martin.Ricci@CityofPaloAlto.org - or -
- Call Customer Service at (650) 329-2161 - or –
- Email UtilitiesCommunications@CityofPaloAlto.org - or –
- Call Utilities Emergency Dispatch at (650) 329-2579

# GROUNDWATER PUMPING FOR RESIDENTIAL BASEMENT CONSTRUCTION
# Frequently Asked Questions

## Save Palo Alto's Groundwater, a Community Resource

**Is groundwater pumped for residential basement construction?**
Yes. Very large amounts of groundwater from the shallow surface aquifer are pumped to build basements when below ground soils are saturated to provide dry soils using a commercial-scale construction process termed "dewatering." This technique is now being permitted for constructing residential basements in Palo Alto at a rapidly increasing rate, from an average of five (5) per year (2006 – 2008) to at least 14 this year. Dewatering is used only at those sites with water saturated soils; it is not used at drier sites.

**Why should I care about groundwater pumping for basement construction?**
Aquifers and groundwater are a community and public trust resource that, although unseen, play an important role literally supporting structures and infrastructure, draining storm water, and storing and providing moisture for our canopy and plants.

**What are the effects of removing groundwater?**
Removing groundwater has a variety of impacts. The forces exerted by groundwater literally support the ground, structures and infrastructure and through capillary action, provide water to our trees.

The shallow surface aquifer pressure increases the recharge of the deeper aquifer which is used for irrigation and on which Palo Alto relies for emergency water.

Lowering the water table locally causes ground settling. This settling may not be uniform across structures, which may then develop either tight doors or windows, or permanent cracks in foundations, walls or masonry. Settling of even less than an inch is adequate to cause permanent structural damage. Lowering the water table below the seasonal normal fluctuation can cause irreversible compression of the soil (hysteretic soil compaction).

**What are the effects of lowering the water table on vegetation?**
Water available for trees and plants is reduced. Soils wick water up, much like sponges, resulting in increased soil moisture several feet above the water table, well into the root zones of trees in much of the area in which dewatering is occurring.

**What are the impacts of these basements after construction?**
Both the City of Palo Alto and the Santa Clara Valley Water District provide incentives to install permeable pavement to reduce the amount of storm water entering storm drains and instead soak into the ground, thereby reducing flood risks and recharging aquifers.

Basements displace soils that would otherwise be available to absorb rain water, increasing the probability that rain water will flow into the storm drains.

Much of Palo Alto is known to have covered gravel beds from former creekbeds. Basements are dams in the unseen rivers that flows through the soils, gravel beds and aquifer beneath Palo Alto. Water needs to flow around these basements. If water cannot flow through the soil fast enough, it will flow above the soil, into the storm drain system, and if the storm drain capacity is exceeded, will flood our streets and properties.

The water table/water pressure surrounding a basement is locally higher, in the same manner as water in a flowing river is higher as it flows around an obstacle. The locally higher water table increases the risk that basements in neighboring properties will flood.

**What can I do if my property is damaged by ground settling caused by groundwater pumping?**

You're on your own. You must resolve any damage claims directly with the party that caused the damage. The City will neither order the dewatering to stop nor help you with any damage claims. You may sue. In that case it will be necessary for you to prove that the specific dewatering operation was the cause of the damages, and most likely pay attorney's fees, which might be reimbursed if you obtain a judgement in your favor.

**How much water is pumped?**

In total, it is estimated that 126 million gallons (16,000,000 $ft^3$) of groundwater has or will be pumped out for the construction of 14 basements in Palo Alto in 2015 alone. This is enough to cover a football field 275 feet deep, or fill 50,400 water tank (2,500 gallon) trucks, or provide enough water for 18,000 average Palo Alto residences for the entire month of July, 2015 (equivalent to 40-50% of the state-mandated water conservation goal for all single family residences in Palo Alto for a year) or lower the aquifer by more than 1 foot over an area of 1 square mile.

This estimate is based upon the midpoint of City's estimate of 8 – 10 million gallons (1.2 million cubic feet) per basement. For some basements, more than 20 million gallons is pumped. The amount of water being pumped out is not metered.

**Where is groundwater pumping occurring?**

Most of the residential dewatering projects are concentrated in an area of approximately 1 square mile bounded by Webster Street, Louis Road, Colorado Avenue and Channing Avenue, although two are near Middlefield Road further south.

**From where is the water pumped?**

Groundwater is typically pumped from 15 to 25 feet below grade, and the groundwater table locally lowered about 2 feet below the bottom of the basement in the area to be excavated. The "bottom" of the basement is generally 10 – 20 feet below grade; some are below sea level.

Groundwater is typically pumped at a rate of 50 – 100 gallons per minute continuously for 3 – 6 months.

**How much do government agencies collect in fees and permits for construction dewatering?**
The City of Palo charges approximately $710 for a dewatering permit for 6 months.
There is no usage-based fee or assessment for discharging the groundwater pumped out for construction into the storm drain. The total cost to the developer for removing this resource from our aquifer is about $710.

**How much do residents pay for equivalent water disposal in the storm drain?**
The Storm Drain Fee for 1 equivalent residential unit (ERU) is $12.63 / month ($151.56 / year). A single dewatering site will dump as much water down the storm drains as the city estimates would go into the storm drains from 480 residences (1 ERU / residence) in a year. Developers are not currently required to pay any additional fees to compensate for the heavy use of the city's storm drains, even though a "fair share" payment would be $72,748 for a typical basement.

**How much would Santa Clara Valley Water District charge for a resident to pump non-potable groundwater for irrigation?**
Santa Clara Valley Water District charges about $600 / acre-foot (43,560 $ft^3$) for a permit to pump groundwater. For the amount of water pumped for a typical basement, the cost would be approximately $16,500. However, a specific exemption from fees is provided for construction dewatering in the shallow aquifer. The fee to builders is zero.

**Is this groundwater pumping sustainable?**
The amount of water removed from the aquifer in 2015 is roughly the same as would be available to recharge the aquifer from average (not drought) rainfall for one year, after allowing for runoff and evaporation over an area of 1 square mile.

**What happens to the pumped groundwater?**
Approximately 99% is dumped into the storm drains, which then flows to the Bay.

**Isn't this pumped water available for irrigation for free?**
The City requires faucets with hose connections and fill stations for water tank trunks at each dewatering site. There are no requirements for the actual use of the water or the pressure supplied to hose connections for neighborhood use; City policy effectively condones wasting water. In practice, the water is not substantially used. Although the water is of high quality and usable, it is wasted.

**How and when is the shallow surface groundwater replenished?**
Primarily from rain and landscape irrigation. Precise recharge rates are not known, but it is believed to be in the range of months to years.

**Doesn't the water flow to the Bay anyway, and therefore doesn't pumping the groundwater improve the environment of the Bay?**
The aquifer and soils have an important role in transporting storm water to the Bay; more water flows in the unseen river beneath our homes to the Bay over the course of a year than

down the creeks. However, during the summer, there is little flow in the aquifer (there almost no flow in creeks either). Dewatering locally lowers the water table below its normal historical low level, and in some cases below sea level, much as pumping water from a lake could lower the lake level below the outlet level.

**Hasn't the City already carefully studied dewatering?**
The City commissioned a study in 2004, and City staff reviewed the study in 2008 after receiving citizen complaints. Not only are several important issues not addressed, especially related to local effects, there are important differences between the current situation and the time of the original study. Existing City dewatering policy does not anticipate the current number or water volume of dewatering activities within the City. Despite acknowledgment by the study that there will be "temporary and local effects," the study does not meaningfully address localized impacts, including ground settling, reduced soil moisture for trees, flood risks and storm water management, public compensation for the use of the water, or public policy in an era of climate change. Furthermore, it is incorrectly assumed that short-term effects will not cause permanent damage.

**From where did this information come?**
All information in this document is either provided by or derived from the City of Palo Alto, the Santa Clara Valley Water District, USGS topographical maps, the US National Oceanographic and Atmospheric Administration, and materials provided by degreed professionals in soil sciences or hydrology, including documents in the Public Record for the City of Palo Alto.

**What is the objective of Save Palo Alto's Groundwater?**
Palo Alto's groundwater is a community resource too valuable to freely pump and dump down storm drains simply for the construction of residential basements. We are requesting that the City of Palo Alto enact an immediate moratorium on new permits for the pumping out of our groundwater ("dewatering") for the construction of residential basements in Palo Alto to further study the effects of dewatering. Dewatering should only be permitted if the study shows negligible impacts, including effects on storm water management and flood risks, and policy is updated to require minimization and complete mitigation of all impacts including requiring full use of the pumped water, payment for use of infrastructure and resources, protection of infrastructures, properties, and the canopy, with all costs to be assumed by the developing party.

**Is a more detailed document available?**
Yes, a White Paper including references is available upon request.

**How do I obtain further information or help with this effort?**
Send an e-mail with your name and contact information to
**PAgroundwater@luxsci.net**

# Questions related to the City of Palo Alto policies on permitting the pumping of groundwater for the construction of residential basements

**Keith Bennett**
**8/11/2015**

**Background:** My concerns relate to the documented local and transient impacts of new basements and their construction, as well as the permanent impacts of new, large basements on the capability of local soils to handle rainwater during periods of heavy rain, such as has been experienced in 1982 and 1998.

My primary concern is not the apparent "waste" of a groundwater resource during a drought (although the amount of water pumped for basement construction is about 10% of the total 24% conservation goal for the City, and report indicates that the surface aquifer being pumped has partly been replenished by imported water from the Delta). Aside from considerations of water quality, I am aware that City has far more water that could be used for irrigation (aside from delivery cost) available from the Water Treatment Plan

I have read the 2004 report by EIP, as well as the Staff Report from Curtis Williams dated 9/24/2008. **From my reading of these reports, they do not support the conclusions that dewatering on the current scale in Palo Alto is not without significant adverse effects.**

1. My understanding is that the two documents listed above, plus soils reports generated from the construction of new buildings, especially buildings with basements are the primary bases for City Policies. The City has prepared a map showing groundwater depth based upon measurements related to construction. This map is available in electronic format. The soils reports from new construction are copyrighted, and may be viewed, but may not be copied. I assume, however, that the City could, if desired, use the information in the soils reports for analysis and modelling purposes.

   **Is my understanding correct and substantially complete?**

2. **Importance of recharge rates and source on the overall impacts of dewatering on the shallow aquifer. Long term impacts are only negligible if they aren't offset by recharge.**

   The 2004 Report primarily focuses on the impact on the level of the **entire** Santa Clara Subbasin surface aquifer, and simply *assumes* that the water pumped in a year will recharge the next year.

   **Shouldn't the basis for policy consider not only the fraction of the total available aquifer pumped, but also critically consider recharge?**

   The report states the following:

In a typical 3-month excavation period, the 1.98 acre-feet per day dewatering flow would amount to 0.05% (one-twentieth of one percent) of the minimum known groundwater resource in the subbasin. No published information about the subbasin's water budget has been found, so any to attempt to predict how quickly the water would be replaced through recharge would be speculative. It is known, however, that the importation of potable water and the SCVWD controlled recharge program have assisted groundwater levels in the subbasin to rise 200 feet during the last 40 years. Most of that rise has been in the surface aquifer. The implication is that the subbasin is being recharged at a rate substantially higher than the rate of withdrawal from all pumping, including dewatering for basement construction. Consequently, it appears that the amount of flow from one, or even several simultaneous, dewatering operations would not have long-term effects on the surface aquifer.

a. There are 5 – 10 basements / year constructed with dewatering in Palo Alto, and as the aquifer extends beyond Palo Alto, and other cities may also pump groundwater, the total impacts on the aquifer would be far more significant. It would appear that annually >1% of the aquifer / year or 10% per decade could be depleted. This is not insignificant. **To avoid long-term effects, the groundwater must be recharged**.
b. The **subsurface aquifer** has been **significantly recharged** by **IMPORTED** (i.e. purchased) water (Pg 6, see above):
*"It is known, however, that the importation of potable water and the SCVWD controlled recharge program have assisted groundwater levels in the subbasin to rise 200 feet in the last 40 years. Most of the rise has been in the surface aquifer."*
*Note: it is the surface aquifer that is being depleted for dewatering.*

A January, 2015 document from the SCVWD "Where does our water come from?" (attached) lists three primary sources for groundwater replenishment: "3. Water importation from the Delta, which the district also releases to creeks and recharge ponds for managed groundwater recharge."

**Should Palo Alto have a policy that accelerates sending of water to the Bay through groundwater pumping in a drought when replacement supplies are restricted, and furthermore, it appears from public documents that some of the water being pumped for basement construction may, in fact, may in fact be due to SCVWD groundwater recharge programs?**

Is it reasonable that those dewatering be permitted to use this resource without compensation based upon consumption, i.e. shouldn't the dewatering amount be metered and charged for example to pay SCVWD for replacement water?

3. **Local Effects**
The EIP report does not provide any basis to support the statement (Pg. 5) regarding the

geographical extent of local lowering of the groundwater, and provides no information on the volume profile of the dewatering:

In the areas adjacent to the site being dewatered, the water table would be lowered temporarily by the dewatering process. This effect could extend from several feet to several tens of feet beyond the excavation depending on the method used, the level of the water table at the time dewatering began, the permeability of the material adjacent to the excavation, and the length of time the excavation needed to be kept open and dry. The possibility exists that adjacent landscaping could experience deterioration from reduced groundwater availability.

a. Assuming a dewatering of 1,000,000 $ft^3$, well below the 7,000,000 $ft^3$ mentioned as typical in the report, but comparable to the *lower end* of the pumping rates and durations mentioned in the City Staff report corresponds to a volume of 500 x 500 x 8 feet, assuming 50% porosity of the soil. It is clear that some effects must extend well beyond "several tens of feet." It is also clear that the extent of dewatering must depend upon local soil composition, the depth of pumping and the time (and rate) that the water is removed.
b. The 2004 states "local settlement on the order of fractions of an inch could occur." (pg 7.) Settlement (either temporary or permanent) of even fractions of an inch is adequate to break windows, cause cracks in masonry and plaster, or require doors to be reworked to open and close properly. There is no guarantee that settling will be perfectly level across a nearby property, which is likely the case if a gradient is created in the soil moisture content. Furthermore, the dewatering may extend below the depth of normal "seasonal" water table variation and therefore may affect the supporting capacity of soils between the dewatering depth and the normal "low level" of seasonal water table fluctuation.

Because dewatering for basement construction occurs only in the uppermost portion of the surface aquifer, which is separated hydrologically from the deep aquifer, no subsidence effects would occur in the deep aquifer. Because this type of dewatering involves a small amount of groundwater withdrawal, mainly from the zone of seasonal water-table fluctuation (the uppermost portion of the surface aquifer), local settlement on the order of fractions of an inch could occur around the construction site (see above), but no regional subsidence would occur.

Reports by homeowners (including the letter in the 2008 Staff Report from the resident at 575 Washington), myself of home damage and a broken water main on N. California several hundred away from, but particularly correlated in time with dewatering events. Could these events provide evidence that dewatering is, in fact, causing at least temporary settlement large enough to affect infrastructure and homes, and that the extent may be further than assumed?

c. There is no discussion on the **impacts of dewatering on soil moisture** (used by plants) above the aquifer. The Santa Clara County Water District leaflet compares soils to a sponge:

> Groundwater is water found in aquifers, geological formations below the ground surface. Water seeps through the surface of the earth in much the same way that water saturates a sponge, to fill the cracks and pores of sand and gravel layers beneath our feet. The

The relevant question is the extent to which **dewatering reduces soil moisture in the surrounding area not whether or not tree or plant roots are below the water level of the aquifer** (generally, plants desire moist, but not saturated soils, as they need air, therefore the roots of land plants are generally _not_ in saturated soils. Like sponges, soils wick water upwards from the aquifer. **Is soil moisture unchanged above the aquifer when the water table is locally and temporarily lowered?** It is important to consider the effects of dewatering in the spring, when soil moisture and the water table are both higher. **Isn't reducing soil moisture earlier in the year in the root zone of plants is more or less equivalent to an artificial drought?**

Of course, it is possible to compensate for lower soil moisture by watering plants more, however this is quite expensive during conditions such as the current drought, and furthermore the expense is borne by the affected homeowners and city plants (e.g. trees). If dewatering does increase the need for supplemental watering, then, isn't dewatering in practice indirectly increasing demand for potable water (as it's 1/10$^{th}$ the price of recycled water).

4. **Long term impacts of basements on flooding risks during storms**

A simple analysis shows that basements extending into a zone of saturated soil (once constructed) will significantly and negatively affect the **ability of local soils to hold and drain rainwater** during heavy storms, with increased risks of flooding, either in neighboring homes and in wider areas.

a. The construction of basement means that there is no soil in the removed volume to absorb rainwater. As basement and lightwell can cover 35% of the lot, and any basement that requires dewatering for construction by definition extends to saturated soils, the local reduction in the capacity of soils to hold rainwater is significant. The result is a locally higher water table / water pressure, at least temporarily until the water can drain. The locally higher water table increases the risk that neighboring properties, especially those with older basements will flood.

The 2008 letter from the resident of 575 Washington mentioned the same concern.

Complications of basement flooding can be significant. In 1998, basement flooding triggered a fire at 595 N. California (a pilot light was extinguished by the water; the escaped gas then exploded when lit by a different pilot light). Additionally many basements of older homes were flooded. Basements only rarely flood.

During the 1998 storm, the saturated water line along Webster St. near N. California was about 3- 4' below street grade, indicating that there is no significant extra capacity in the soils, at least in some parts of the city. It is likely that soils were saturated closer to the surface in lower areas.

If the soils become saturated to the surface, rainwater will no longer be absorbed and instead will flow into the storm drains. If the storm drains cannot handle the additional water, localized street flooding will occur.

The City provides rebates for the use of permeable paving materials to reduce the load on the storm drains. This assumes that the soils can absorb the water and release it more slowly.

**Is the construction of large (and deep) basements in areas that have risk of soil saturation above the basement level consistent with this policy?**

**Is a policy that increases the risk of flooding wise? Is it appropriate for Green Building Certifications?**

b. **Basements are like dams in the unseen river through the soils (and aquifer) beneath Palo Alto**, and impede the discharge of water during periods of heavy rain, increasing the level of saturated soils, and the risks of flooding. We would not think of blocking any creek, yet basements are doing so for the channel that carries the most water to the Bay.
    i. The soils and aquifer under Palo Alto surely carry significantly more water to the Bay than San Francisquito Creek over the course of a year. This can be easily be shown by calculating the volume of water in even 12" of annual rainfall that falls on the area (about 3.3 x 1.8 miles) of Palo Alto between El Camino and San Francisco Bay and comparing the annual volume of water to that which flows in San Francisquito Creek. In addition, the soils and aquifer must carry water from lands west of El Camino, including Stanford and the foothills.
    ii. The potential of basements to block aquifer / soil water flows is very significant. Basements are now quite large (perhaps covering ½ of the property width) and a very large fraction of new construction (~70% in permitted areas) includes finished basements.

    **Have the impacts of basements on the capacity of our soils to handle rainwater during heavy storms been properly considered?**

**From:** Leah Rogers [mailto:leah.rogers@stanfordalumni.org]
**Sent:** Monday, October 26, 2015 6:38 PM
**To:** Council, City; Keith Bennett
**Subject:** re: Per request of Greg Schmid during Oral Comments at the Oct 5 2015 City Council Meeting

Dear All:

Below is my effort to put in writing what I said in the Oral Comments period of the October 5 2015 City Council Meeting. I have also included some references at the request of Greg Schmid. Thanks you for your time and listening to these thoughts about the dewatering issue.

Sincerely, Dr. Leah Rogers
(Ph.D. from Stanford in Hydrogeology)

The 2004 EIP report suggests the range of influence on the water table aquifer is on the order of tens of feet from the dewatering well. The amount of water table drawdown necessary in construction of basements in Palo Alto is approximately 15 feet (i.e. drawing down the water table from 10 ft below ground surface to 25 ft below ground surface. If we consider standard calculations of radial flow applications of Darcy's Law (Freeze and Cherry, 1979 (note Eq 8:12-8:15); Manning, 1997; Bennett et al., 1990), a lowering of the water table level approximately 15 feet an unconfined aquifer in alluvial deposits may create a cone of depression that spreads out towards a few hundred feet in any direction. This assumes some general hydraulic conductivities and other aquifer parameters that could be in alluvial deposits in this area. Note regional studies suggest hydraulic conductivity values may range between 260 and 6000 gpd/ft2 (McCloskey and Finnemore, 1996). There are many major factors that influence the drawdown of the water table: thickness of the water table aquifer, interfingering of layers that may inhibit flow (aquitards in which case coefficients would have to be assumed to account for leaky aquifers), and whether or not steady-state is reached. Precise predictive modeling would require to collection of data from time dependent well testing. However, we may say qualitatively where there were more sands and gravels the cone of depression would reach further than if there were tighter silts and clays.

When several of these projects going on in the same neighborhood, which is the case in Palo Alto, cones of depression may interact cumulatively. As the dewatering effect from multiple projects are cumulative and interact with reduced irrigation, it is difficult to assign “responsibility” for damages to property or landscaping to specific dewatering projects.

The drying out of soils is often not perfectly reversible.  This is called hysteretic soil compaction. For example, wet clay worked into a dry piece of pottery cannot simply be put back into it’s original state by submerging it in water. Imagine over a 3-4 month dewatering project that particularly the interfingering clays in the subsurface will cause unequal rewetting.  It is quite plausible that the scale of these dewatering projects are responsible for the additional cracks in walls and foundations which neighbors in the area have noted. For example, the 2008 City Manager’s Report includes a letter from Steve Broadbent raising such issues.

Overall, it would seem that the City of Palo Alto would do well to require dewatering projects to provide specific characterization and predictions of groundwater impact during the course of the proposed project before approving any dewatering especially in times of drought and water-conservation. Even better would be adoption of construction practices and project designs that significantly reduce the need for dewatering, especially considering reduced irrigation in the area during droughts.

References:


Bennett, Gordon D., Thomas E. Reilly, and Mary C. Hill. 1990. Technical Training Notes in Ground-Water Hydrology; Radial Flow to a Well. US. Geological Survey Water Resources Investigations Report 89 4134. http://pubs.usgs.gov/wri/1989/4134/report.pdf.

Freeze, R.A. and J. A Cherry. 1979. Groundwater. Prentice Hall Inc., Englewood Cliffs, NJ. 604 pp.

Manning, J.C. 1997. Applied Principles of Hydrology. Prentice Hall, third edition, 276p.

McCloskey, T.F. and E. J. Finnemore. 1996. Estimating Hydraulic Conductivities in an Alluvial Basin from Sediment Facies Models. Ground Water, Vol. 34, No. 6 November-December 1996. http://info.ngwa.org/gwol/pdf/962962189.PDF.

On Wed, Jul 15, 2015 at 4:18 PM, Bobel, Phil <Phil.Bobel@cityofpaloalto.org> wrote:

Ms. Relman:

Our Assistant City Manager, Ed Shikada has asked me to respond to your 7/14 email about the pumping of groundwater to allow the construction of basements.

A number of residents have raised issues very similar to yours, and we have created a website to address them: Recycled Water Web Page . Scroll down to the last line and click on "here" to see our "Frequently Asked Questions" about the pumped ground water.

While I know it appears to be wasting water, the shallow ground water aquifer is flowing to our creeks and Bay. The pumping and discharge of this shallow ground water to the storm drains sends the ground water to the same place, our creeks and Bay, where it supports ecosystems and their wildlife. Nonetheless, the City is working with builders to try to get as much of water used as practical. The main limitations are the very high cost of trucking the water and the lack of a piping system from the pumping sites. Farmers are just too far away to make their using it practical at this time. A portion of the water is being used to water City trees, provide dust control at construction sites, and similar non-potable uses.

With respect to the potential for drawing down the shallow groundwater and causing land subsidence, we do not have reason to believe this would occur, given the short duration pumping and the small number of wells involved here. Subsidence can occur when pumping happens over a number of years from many wells.

I hope this helps address your concerns.

Phil Bobel

Assistant Director, Public Works

**From:** Shikada, Ed
**Sent:** Wednesday, July 15, 2015 8:07 AM
**To:** Georgia Relman
**Cc:** Council, City; Bobel, Phil
**Subject:** Re: draining ground water

Dear Ms. Relman,

Thanks for contacting us with your concerns. I will ask Public Works staff to review the issue and reply directly to you. There has been quite a bit of activity on this issue recently that may interest you, specifically on the topics you raised. You may also wish to participate in future discussions.

Sincerely,

Ed Shikada

Assistant City Manager

On Jul 14, 2015, at 4:12 PM, Georgia Relman <georgiarelman@gmail.com> wrote:

Hi All,

I have a question.  Just in our neighborhood alone (around professorville), 4 construction sites building private homes are draining ground water at full blast down storm drains; this has been going on for many MONTHS now.

Why are private construction companies allowed to drain Palo Alto ground water? Wouldn't it be of benefit to use this water for Palo Alto parks etc. or sell it to farmers for Palo Alto profit (because it is needed)?

When the ground water is drained under Palo Alto, will the ground sink as it has in other areas of California as they are being drained of ground water?

Why is this not of concern to our city government? (I don't get it)

Sincerely,

Georgia

On Apr 25, 2015, at 2:32 PM, Skip Shapiro <sailorskipca@yahoo.com> wrote:

Dear Mayor Holman and City Council,

This is a request for the Planning Department and the City Council to take immediate action to stop groundwater pumping which occurs during the construction of residential basements.

As long time Palo Alto residents, we are appalled to see millions of gallons of groundwater going down storm drains in the midst of this historic California drought. At the same time, residents and businesses have been asked to curtail water use for landscape and other uses. Even worse, the pumping depletes groundwater that is essential to the health of trees, causes subsidence that can damage property, and consumes water Palo Alto relies upon for emergencies.

This morning we passed a home under construction on Harker where groundwater is being pumped. We estimated the flow rate to be 75 gallons per minute (based on the fill time of a 5 gallon bucket), which equates to 108,000 gallons – or 14,400 cubic feet – per day. From past experience monitoring similar groundwater pumping for basement construction, the pumping will continue for at least 4 weeks. That amounts to more than 400,000 cubic feet of wasted water.

Residential basement construction is a relatively recent phenomenon in Palo Alto, driven by people maximizing living space within lot coverage constraints. It has likely contributed to the steep increase in property values and encouraged buyers who raze existing houses to replace them with new ones that include basements…without considering the impact on neighbors, the community, and the environment.

We think it’s time to halt approval of residential construction that includes basements where groundwater pumping is required. Basements should not be allowed on these sites. We request an immediate moratorium on design and construction approval for any home where groundwater pumping is required. We also ask the City Council to direct the Planning Department to review and change regulations that permit residential basement construction.

Respectfully,

Barbara and Skip Shapiro

cc: Phil Bobel
Mike Nafziger
Janice Svendsen



Valoran P. Hanko
864 Fielding Court
Palo Alto, CA 94303-3645
May 19, 2015

Mr. James Keene
General Manager
City of Palo Alto
250 Hamilton Avenue
Palo Alto, CA 94301

Dear Mr. Keene,

I recently noticed a pumping operation in my neighborhood at 804 Fielding Drive that is reminiscent of an operation that occurred next door at 858 Fielding Ct in 2001. This pumping operation takes ground water from our underground aquifer and sends this to the storm drain as undesirable waste in preparation of a new residential construction. When this operation was performed in 2001, the surrounding neighborhood sank in elevation resulting in a new designation for the neighborhood to be within the 100 year flood zone, where as prior it was not. Additionally, this resulted in cracks in the pavement of our street where the sinking of the ground is still evident. Additionally, it was observed by some neighbors that their house slab foundations (characteristic of the 1940's period-build homes) had shifted and cracked. The house behind us had their garage drop in elevation in one of their corners. I estimate that non-potable water is being pumped at a rate of about 0.5 gal/sec, which equates to 30 gallons per min, 1800 gal per hour, 43,200 gal per day, 302,400 gal per week. Since this operation went for about 6 months at the next door neighbor's site, assuming a constant rate, this amount of water would be equivalent to (at 1.2 million gallons of water per month) 7.2 million gallons of underground water. Since the volume of water occupying 1 gallon is 0.134 cubic feet per gal (7.48 gal per cubic feet), 7.2 million gallons would take 970,000 cubic feet of underground aquifer space, and it is a fact that when the ground collapses into this aquifer space, it can never be retrieved again. The loss of elevation in the neighborhood places financial burden upon innocent people, causing many with mortgage payments to be required to have FEMA Flood Insurance, and even those who own their house, puts them at new risk of flooding. I believe this pumping action, apparently approved by the City Building Department, has not been seriously evaluated for its consequences by qualified engineers without bias. Furthermore, this precious water is being wasted into the storm drain during a severe drought, another irresponsible action. I am not sure about the legal consequences of halting this operation in my neighborhood, but as General Manager you must have some power to take emergency actions when severe consequences can be seen or is discovered, and thus this letter is to inform you of this matter with the hope that you can stop this pumping process and new building permit approvals, and to suspend all current operations until appropriate state-of-the-art engineers have evaluated this type of operation. Meanwhile, I intend to contact the Santa Clara County Water Resources Board about this concern, and hope you may work together with them to seek a resolution that does not adversely impact the community, one that includes the preservation of our underground aquifer.

Sincerely,

Valoran P. Hanko

Valoran P. Hanko

PUBLIC WORKS

CITY OF PALO ALTO
P.O. Box 10250
Palo Alto, CA 94303
650.329.2151

July 6, 2015

Valoran P. Hanko
864 Felding Court
Palo Alto, CA 94303-3645

Dear Mr. Hanko:

Thank you for your May 19 letter concerning the impacts of basement construction groundwater pumping. I've been asked to respond on behalf of Palo Alto City Manager Jim Keene. Your letter expresses concern about a current pumping site and one that took place in 2001, both in your neighborhood.

With respect to the earlier pumping, you expressed the belief that the pumping caused the ground to subside. We do not have reason to think that is the case. The additions to the flood zone that were made around that time were the result of new, better data, as opposed to any anticipated change in actual elevations. The earlier flood zone map had been based on a more limited set of elevation measurements. When more elevation data was collected in the 2000 time frame, it resulted in relatively small shifts in the flood zone boundary, but ones which were very important to the individual houses affected. You calculated the rough amount of ground water pumped out and postulated that that the ground level would sink to a level associated with that loss of water. We do not believe that would be the case. Rather, the groundwater is moving and new ground water would fill behind the groundwater being pumped out. Only a large number of wells operating over a long time frame would cause a relatively permanent change in the ground water elevation and an associated ground level subsidence. As you know, subsidence has occurred in a number of areas where large numbers of wells have pumped over time.

You also expressed the view that the pumped water going to the storm drain was being wasted. And yet this ground water was moving toward our creeks and Bay and ultimately would have replenished both. Pumping some of it to the storm drain results in it traveling a different path, but ultimately reaching the same locations: our creeks and Bay. Our creeks and Bay need this water to preserve ecosystems and maintain needed salinity levels.

Nonetheless, because of the strong feelings of a number of our residents, we are working to have builders minimize the amount pumped and use as much of the water as practical. Builders are now required to build "Fill Stations" at their sites so that others can fill trucks and tanks and use the water. The current pumping site at 804 Fielding near you has a Fill Station. The City, other builders and residents like you can use the water. Please see our website for the other locations and contact information: www.cityofpaloalto.org/water.

I hope this addresses your concerns. Please do not hesitate to contact Mike Nafziger (650-617-3103) for more information about 804 Fielding, or myself (650-279-0464) for broader issues we are facing in this most difficult time of drought.

Sincerely,

Phil Bobel

Phil Bobel
Assistant Director, Public Works

From: "Andrei Sarna-Wojcicki" <andreisarna@gmail.com<mailto:andreisarna@gmail.com>>
To: "Council, City" <city.council@cityofpaloalto.org<mailto:city.council@cityofpaloalto.org>>, "letters@dailynewsgroup.com<mailto:letters@dailynewsgroup.com>" <letters@dailynewsgroup.com<mailto:letters@dailynewsgroup.com>>
Cc: "Deborah Harden" <deborahrharden@gmail.com<mailto:deborahrharden@gmail.com>>
Subject: Fwd: Groundwater is wasted by pumping at construction sites and dumping into storm sewers

To: Mayor of the City of Palo Alto and the City Council:

I have sent this message to the Public Comment web site two of days ago, but have not received an answer, and the matter is urgent. I have also sent it previously to the Palo Alto daily news site (letters@dailynewsgroup.com<mailto:letters@dailynewsgroup.com>). So, I'm forwarding this email to you and the City Council. By now, three days have elapsed since I sent the first message, and an estimated minimum of 260,000 gallons of groundwater have been pumped from the construction site at 2133 Webster and dumped into the storm sewer at the corner of N. California and Byron Streets. The water continues to be pumped as I write this (I just went by there a few minutes ago).

Putting up a sign saying that the public can help themselves to the water does not solve the problem of this wasteful practice, continued with city approval during a time of extreme drought. As I mentioned in the message, this is just one of several construction sites in the city where pumping of groundwater is going on. This is a wasteful practice during ordinary times, and more so during the current severe drought. The water needs to be used for watering the trees and green areas of the city, and to maintain the level of the groundwater to keep city and residential trees from dying.

The excavation at the Webster site must be at the site of a buried old gravel channel, to account for the high discharge. The water that is being wasted by direct dumping into the storm sewers not only deprives the trees in the vicinity of the pumping and downstream in the water table, but it also depriving a whole ecosystem at lower elevations downstream in the water table to the southeast--the marshes and the city Baylands.

This is a high price to pay for allowing cellars to be built in an area that is at low elevations (the Webster St. site is at ~17 feet above sea level). Another several such construction sites have been recently finished near our house on Garland Drive. These are at an even lower elevation, 10 to 15 feet. Building cellars in these areas is a mistake, and has been historically avoided in this area since early European settlement for very good reasons. The water table here is high and irregular in elevation. Some of the new cellars actually intrude below the water table, as appears to be the case at the Webster Street site.

I urge you to take this matter under advisement. Additional comments and arguments are provided in the forwarded email.

Sincerely,

Andrei M. Sarna-Wojcici,
Resident of Palo Alto (708 Garland Drive)
Retired geologist, U.S. Geological Survey

---------- Forwarded message ----------
From: Andrei Sarna-Wojcicki <andreisarna@gmail.com<mailto:andreisarna@gmail.com>>
Date: Thu, May 7, 2015 at 10:41 AM
Subject: Groundwater is wasted by pumping at construction sites and dumping into storm sewers
To: letters@dailynewsgroup.com<mailto:letters@dailynewsgroup.com>
Cc: Deborah Harden <deborahrharden@gmail.com<mailto:deborahrharden@gmail.com>>

Dear Sir or Madam:

Groundwater is being wasted on the Peninsula by being pumped out at construction sites and dumped into city storm sewers. This practice is actively going on at at least three construction sites in Palo Alto, and probably at many more throughout the Peninsula.

I passed by one such site at 2133 Webster St. in Palo Alto at ~10:45 AM yesterday, returned by there at ~12:45 noon, and passed by there again at ~5:45 PM. The water was going full blast the whole time from the construction site, around the block to N. California and Byron streets, and down into a storm sewer. I estimated that about a gallon of water was dumped every second from a six-inch diameter pipe, which would amount to about 25,200 for the 7 hours time of my observation. This is probably a minimum for this particular site for this day. At the calculated rate, this would amount to 86,400 gallons of water for a 24 hour period. My wife observed the same practice going on a few months ago from another site, for at least a week.

This is a massive waste of groundwater during a period of severe drought. It depletes water from an already depleted water table, forming a cone-shaped depression around the pumping site, and decreasing the available groundwater in that area from flowing farther down in the water table toward lower elevations, thus lowering the water table and depriving trees from water. It's killing off our trees.

This water needs to be used for watering the trees and other plants in the municipal parks and other public grounds, and any left over water should be made available for residential use. Reservoirs need to be constructed to store this water, and a distribution system be put into place, perhaps even by temporary above-ground plastic pipe systems during this drought, to make use of this water.

At the dump site that I observed, a sign put up by the city of Palo Alto which informs the public that the water is not potable, that it is being discharged (no duh), and states that "...To use this water for irrigation pr other non-potable purposes, follow this discharge hose back to the water filling station." I presume this refers to the pumping site at 2133 Webster. And what does the Palo Alto citizen do then? Bring a Dixie Cup and help himself/herself to the water? Or back-up a tanker truck to the site and fill-up? This is obviously a large job that the Peninsula municipalities need to address.

I sent a message regarding this situation to the city of Palo Alto today.

I attach photos from the pumping and dump sites I observed yesterday.

Sincerely,

Andrei Sarna-Wojcicki,
Resident of Palo Alto

## Comments to Council regarding Dewatering Residential Basement Construction

Keith Bennett
November 9, 2015

The City of Palo Alto has a history of developing policies to protect natural resources, to protect our environment and to encourage sustainability. Water is now recognized as a valuable and limited resource, and groundwater is an important component of the City of Palo Alto's Emergency Water Supply. Climate change is predicted to increase the risks of droughts, megadroughts and floods, in addition to sea (and Bay) level rise.

https://www.washingtonpost.com/national/health-science/todays-drought-in-the-west-is-nothing-compared-to-what-may-be-coming/2015/02/12/0041646a-b2d9-11e4-854b-a38d13486ba1_story.html

1) The Groundwater Supply Feasibility Study performed by Carollo Engineers for the City of Palo Alto in 2003 provides quantitative analysis and measurements of the effects of groundwater pumping in Palo Alto. Data from the pumping in 1988 of groundwater for local domestic water use was deemed to be the most reliable and is the primary basis for the conclusions of the report, which is available at: http://www.cityofpaloalto.org/cityagenda/publish/uac-meetings/1930.pdf

   Some main points are summarized below. In this section, quotes indicate verbatim text from the study, *italic*s indicate my personal analysis using other information including map data. Text not in quotes are my personal summaries of information from the study.

   a. "Utilizing the data from the 1988 pumping, the extraction of 1,000 acre-feet from the Palo Alto area will result in basin-wide water level declines on the order of 15 feet." --- pg. 20

      *The shallow surface aquifer level, typically a few feet below the ground surface, declines in response to pumping the deeper aquifer as shown by the well level graphs.* --- pgs. 5 - 10

   b. The water levels in the Fernando, Middlefield and Matadero wells were lowered by 18, 25 and 37 feet respectively, even though water was not pumped from any of those wells. --- Table 1, pg. 13

      *An interactive map showing the locations of the wells and 2015 basement dewatering sites is attached (Map A) with this document and available online at: https://www.google.com/maps/d/edit?app=mp&hl=en_US&mid=zW7thpaYaYZI.kYzYfTCRxd_Q*

*The Middlefield well is located about 5 blocks (0.4 miles, straight line) from the Rinconada Well (from which 600 acre-feet of water was produced in 1988) and about 0.7 miles from the Hale Well (produced 400 acre-feet in 1988).*

*Peers Park (produced 400 acre-feet) is the closest well to the Fernando and Matadero wells and is 1.0 – 1.2 miles away.*

c. "Depending on the method, estimates of average annual recharge to the basin are between 38 and 3,800 acre-feet. " -- Pg. 20

d. "The year-to-year 500 AFA* extraction is intended to not lower groundwater levels substantially, which would preserve the natural groundwater flow direction and prevent saltwater intrusion. The periodic 1,500 AFA well use described above would result in transient occurrence of water levels below sea-level. While water level below sea-level will reverse the seaward gradient, the slow travel time of groundwater provides a buffer from seawater intrusion for transient use. " – Pg. 21

* AFA = Acre-feet annually.

2) The total amount of groundwater pumped for residential basement construction in 2015 is estimated to be about 400 acre-feet, based upon an average of 1.2 million cubic feet (28 acre-feet) per basement for the 14 basements dewatered in 2015.

3) The Groundwater Supply Feasibility Study estimates that the water table is lowered approximately proportionately to the amount of water pumped. Using the value in the report of 15 feet lowering for 1,000 acre-feet pumped, the estimated lowering of the water table due to dewatering for residential basement construction in 2015 would therefore be about 6 feet, and would extend over large areas of Palo Alto.

4) An advisory Measure N, "Emergency Underground Water Storage and Equipment Replacement," (November 2007) passed with 91.84% of the vote. The Emergency Water Supply Project (EWSP), WS-08002, was approved by Council in 2007 and bonds totaling $35,015,000 were sold on October 6, 2009. Of this amount, approximately $5.36 million was used for projects related to using groundwater: groundwater feasibility studies (CMR 124:06 and related), rehabilitation of existing wells (CMR 232:10) and construction of new wells (CMR 371:09). The bonds are being repaid over 25 years through water usage fees.

5) As part of the EWSP, five existing wells have been rehabilitated for use as emergency domestic water supplies. These wells are the Hale Well (999 Palo Alto Avenue), Rinconada Well (1440 Hopkins Avenue), Peer's Park Well (1899 Park Boulevard), Matadero Well (635

Matadero Avenue) and Fernando Well (410 Fernando Avenue).
http://www.cityofpaloalto.org/gov/depts/utl/eng/water/wells/faq/rehabilitation.asp

Additionally, two new wells have been constructed, one at Eleanor Pardee Park and another at (Rinconada) Library / Community Gardens.
http://www.cityofpaloalto.org/gov/depts/utl/eng/water/wells/eleanor.asp

Two 2015 dewatering sites are within the triangle formed by the two new wells (Eleanor Pardee Park and Library / Community Gardens) and the Rinconada well. See attached Maps B and C or online map.

https://www.google.com/maps/d/edit?app=mp&hl=en_US&mid=zW7thpaYaYZI.kXmqQlQLK9iM

6) Methods exist for residential basement construction that do not require dewatering. Residential basements are built in areas of high groundwater in The Netherlands without dewatering, per personal verbal communication with the mayor of Palo Alto's sister city, Enschede at the Council Meeting on November 2.

# Map A: Palo Alto Emergency Water Supply Well Map

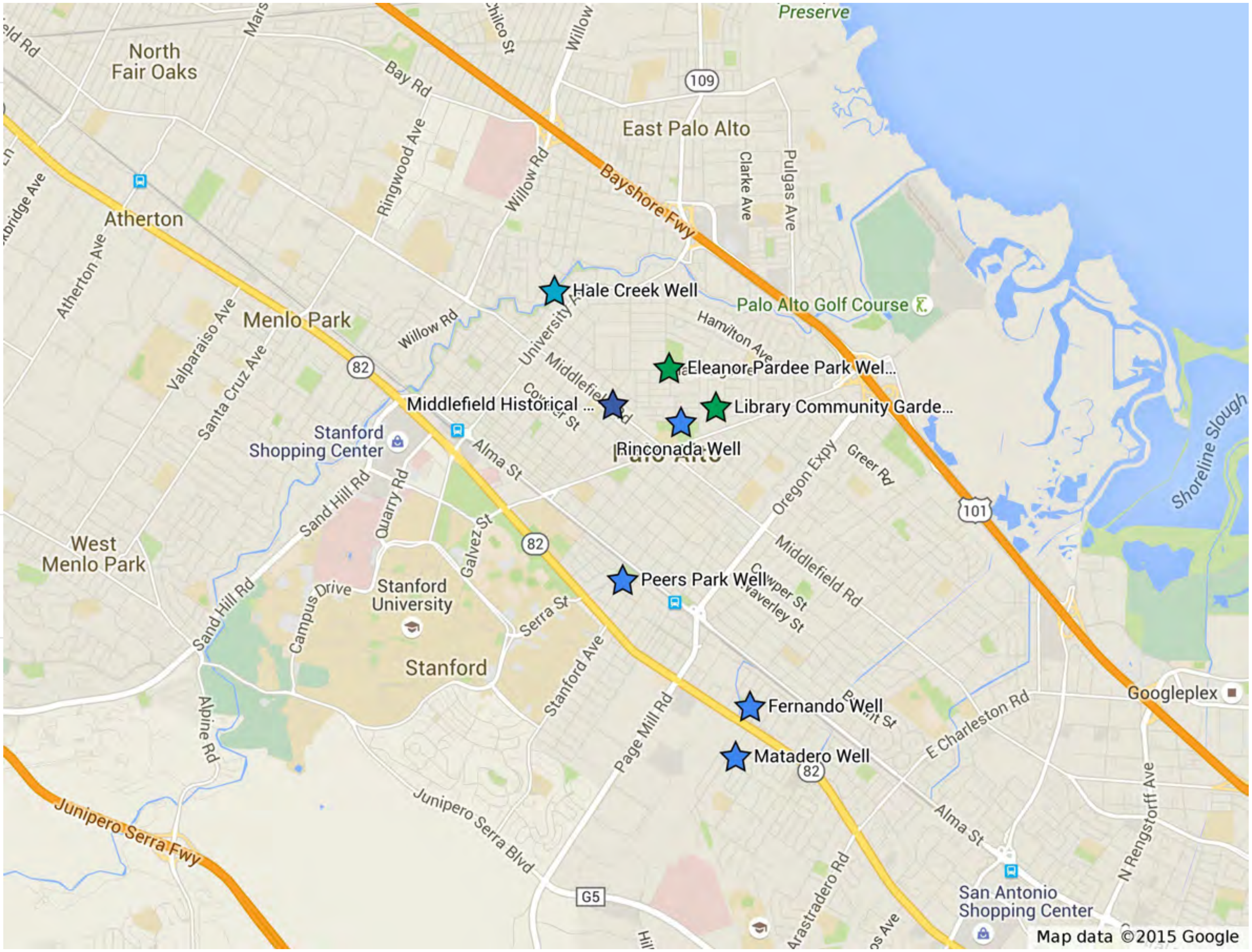
Basement dewatering sites

Emergency Water Supply Wells

- Rinconada Well
- Hale Creek Well
- Peers Park Well
- Matadero Well
- Fernando Well
- Eleanor Pardee Park Well
- Library Community Gardens Well

Historical Wells

- Middlefield Well




Locations of Palo Alto's Emergency Water Supply Wells, including the Middlefield Well.

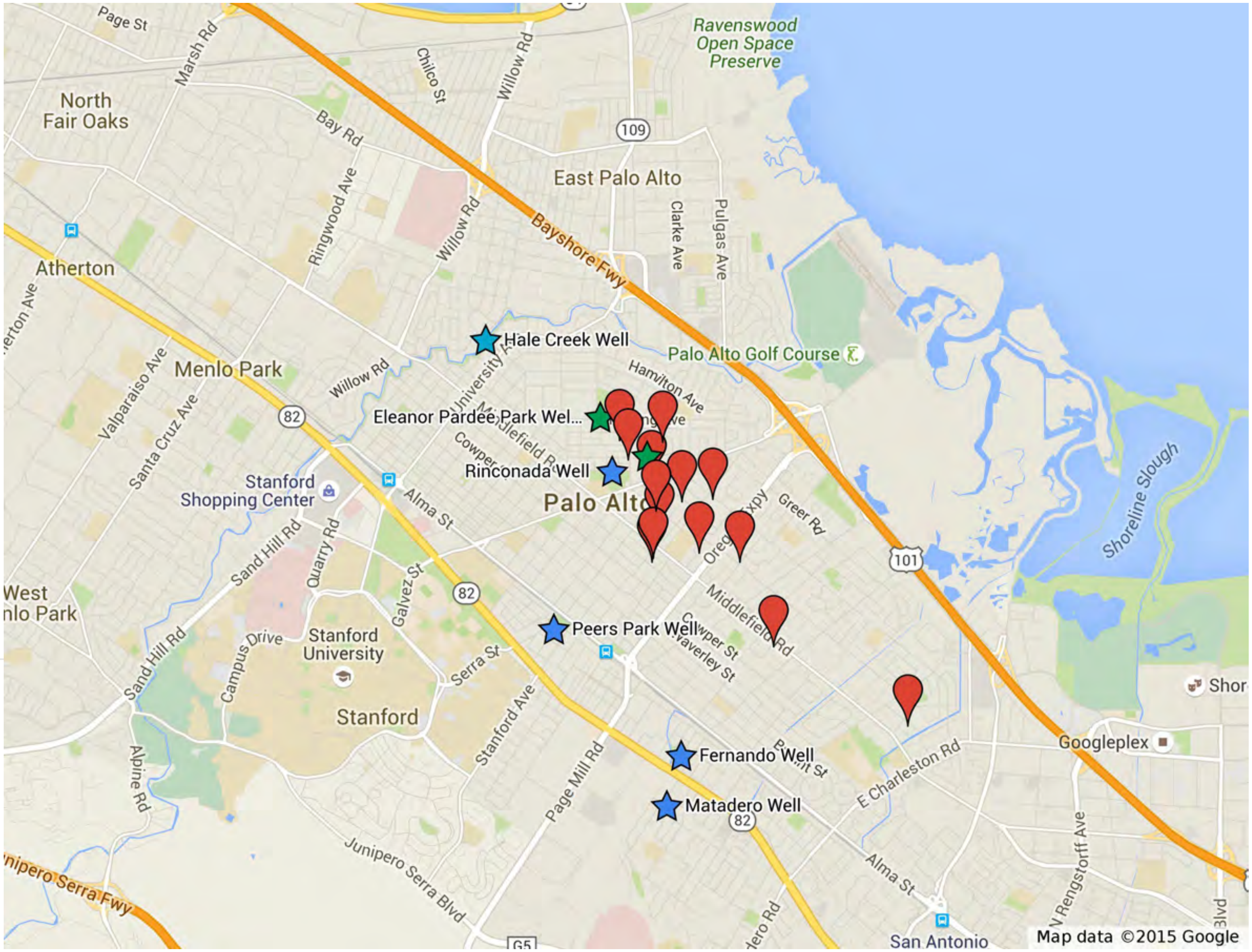
# Map B: Dewatering_Map 2015

2015 Basement dewatering sites

- 2133 Webster St
- 2130 Byron St
- 713 Southampton Dr
- 897 Southampton Dr
- 736 Garland Dr
- 684 Wellsbury Way
- 804 Moreno Ave
- 1812 Bret Harte St
- 1210 Newell Rd
- 51 Jordan Pl
- 2230 Louis Rd
- 1405 Harker Ave
- 3832 Grove Ave
- 1950 Newell Rd

Emergency Water Supply Wells

- Rinconada Well
- Hale Creek Well
- Peers Park Well
- Matadero Well
- Fernando Well
- Eleanor Pardee Park Well
- Library Community Gardens Well




Residential basement construction dewatering sites and emergency water supply well locations

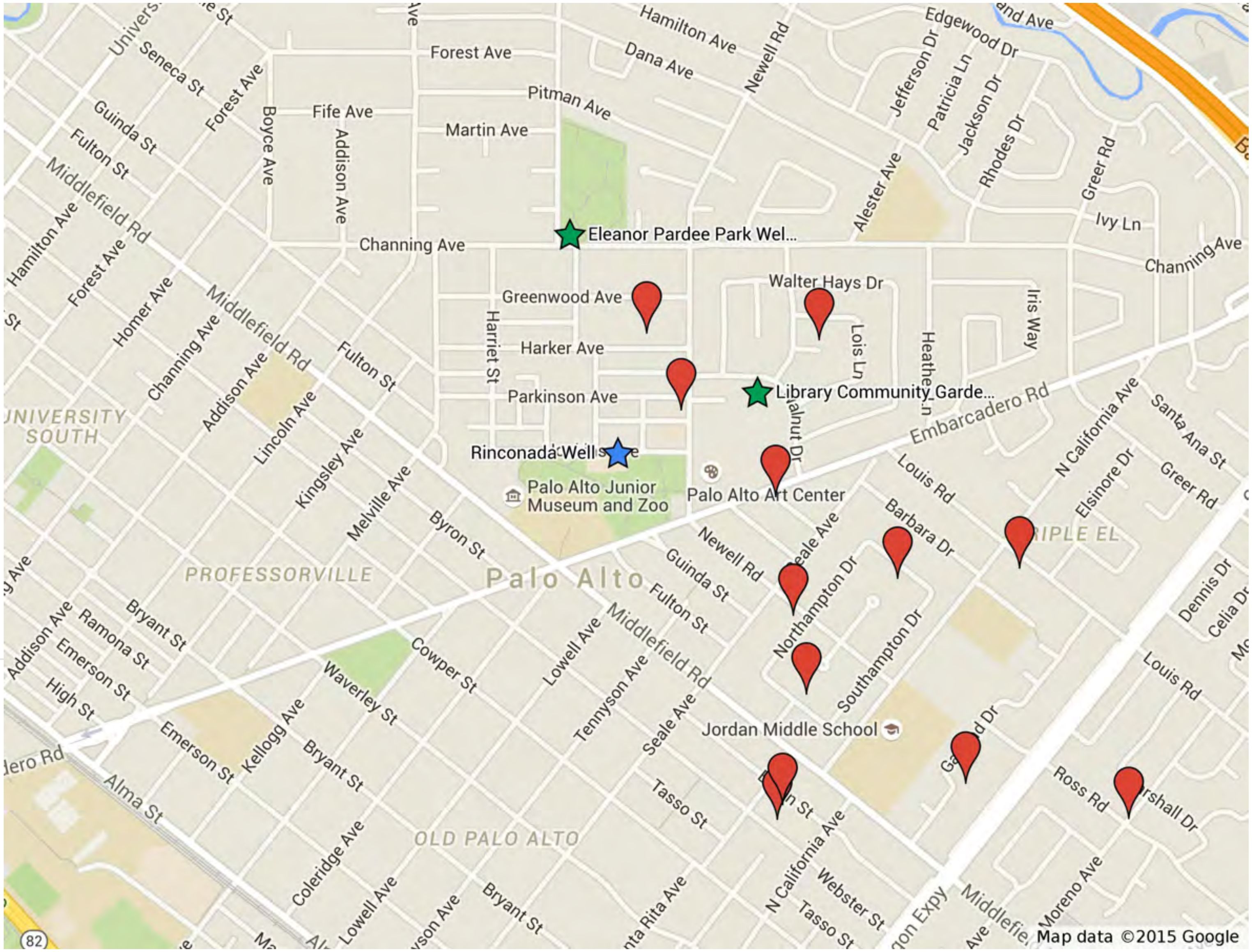
# Map C: Dewatering_Map 2015 (Community center zoom)

2015 Basement dewatering sites

- 2133 Webster St
- 2130 Byron St
- 713 Southampton Dr
- 897 Southampton Dr
- 736 Garland Dr
- 684 Wellsbury Way
- 804 Moreno Ave
- 1812 Bret Harte St
- 1210 Newell Rd
- 51 Jordan Pl
- 2230 Louis Rd
- 1405 Harker Ave
- 3832 Grove Ave
- 1950 Newell Rd

Emergency Water Supply Wells

- Rinconada Well
- Hale Creek Well
- Peers Park Well
- Matadero Well
- Fernando Well
- Eleanor Pardee Park Well
- Library Community Gardens Well




Residential basement construction dewatering sites and emergency water supply well locations

Attachment F

November 2, 2015



To: Palo Alto City Council

From: Keith Bennett
Save Palo Alto's Groundwater

Re: Petitions

Attached are petitions signed by 190 individuals specifically requesting a moratorium on new dewatering permits for residential basement construction. The signatures were mostly collected during a short 2 – 3 period in late summer by a handful of volunteers.

**We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| Gayle Carol Brugler | Gayle Carol Brugler | 2041 Webster |
| Avanelle E. Nielsen | AVANELLE E. NIELSEN | 534 Santa Rita Ave |
| JoAnn L. Meredith | JOANN L. MEREDITH | 401 Webster, #401 |
| Nancy L. Kalbrenner | Nancy Kalbrenner | 2031 Byron St. |
| Mary J. Cardelli | MARY J. CARDELLI | 85 ERSTWOOD COURT |
| Kay P. Sabin | KAY P. SABIN | 1990 Webster ST |
| Carolyn B. Schwartz | Carolyn Schwartz | 145 Walter Hays |
| Jacqueline Clark | JACQUELINE CLARK | 655 Santa Rita |
| Debby Roth | Debby Roth | 1991 Webster St |
| Patricia Parrish Davis | PATRICIA PARRISH DAVIS | 1841 MIDDLEFIELD Rd Palo Alto, Ca |
| Jane B. Holland | Jane B. Holland | 1712 Channing Ave Palo Alto CA. |
| Martha McLaughlin | MARTHA McLAUGHLIN | 40 Hannah ct |

(12)

Yes, I would like to stay informed about ground water pumping and basements in Palo Alto.

I understand that I will not get *spammed,* can be removed from the mailing list at any time, and that e-mail addresses will be kept confidential.

| PRINTED NAME: | e-mail | ADDRESS: |
|---|---|---|
| NAOMI MINDEZUN | naomimindelzun@gmail.com | 743 Southampton Dr P.A. |
| RICHARD C. BARRY | dicklorr@earthlink.net | 710 Northampton, PA. |
| Lorraine Barry | | 710 Northampton Dr. PA |
| Keith Bennett | | 2225 Webster |
| Atsuko Bennett | | 2225 Webster St. |

5 #

**We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| Robert W Jackson | Robert W Jackson | 2929 Bryant St Palo Alto 94306 |
| Barbara L Jackson | Barbara L. Jackson | 2929 Bryant St. Palo Alto, CA 94306 |
| Harvey Hewitt | HARRY HEWITT | 2830 WAVERLEY ST PALO ALTO, CA 94306 |
| A. Hewitt | AINA HEWITT | 2830 WAVERLEY ST. PALO ALTO, CA 94306 |
| Katherine B. Evans | Katherine B. Evans | 1861 Newell Rd. Palo Alto CA 94303 |
| Diane Lewiston | Diane Lewiston | 1849 Newell Rd 94304 |

6

**We hereby request that the City of Palo Alto impose an immediate moratorium on new permits for the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| [signature] | Richard J Tingey | 71 Tulip Lane |
| e-mail (optional) dtingey@aol.com | | |
| Phyllis Sherlock | Phyllis Sherlock | 1275 Dana PA |
| e-mail (optional) | | |
| Michael Strohecker | | 2076 Edgewood |
| e-mail (optional) | | |
| SRIDHAR MANJUNATHESWARAN | | 2088 EDGEWOOD |
| e-mail (optional) | | |
| Louise Beattie | | 1445 Hamilton Ave 94301 |
| e-mail (optional) LDBEATTIE@gmail.com | | |
| [signature] 4010 [illegible] | | |
| e-mail (optional) | | |
| [signature] | | 525 Homer Ave #1 |
| e-mail (optional) | | |
| LENORE GAMES | | |
| e-mail (optional) LENRAVEN1@GMAIL.COM | | |

8

**We hereby request that the City of Palo Alto impose an immediate moratorium on new permits for the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| | SUSIE SCHOLPP | 961 Lincoln |
| | Judith Fields | 2581 Park #403 |
| | UMA MENON | 1972 Ivy Ln, |
| | ZAYOSKY | 1465 Channing |
| Hilary Jones | Hilary Jones | 235 Walter Hays |
| Nancy Yamada | Nancy Yamada | 1921 Edgewood Dr. |
| Sophia Abramson | SOPHIA ABRAMSON | 1356 PITMAN AV |
| | Luigi Hugler | 1930 Ivy Lane |
| Stuart Beattie | Stuart Beattie | 1445 Hamilton |
| | YAFEI BI | 1912 Edgewood Dr. |
| J Marks | James P. Marks | 689 Wildwood Lane |
| Sara Peck | SARA PECK | 650 WILDWOOD LANE |
| | Carla Carvalho | 1924 Edgewood Dr. |
| | JOHN RATLIFF | 1924 EDGEWOOD |
| | Deborah Baldwin | 635 Wildwood Ln |

**We hereby request that the City of Palo Alto impose an immediate moratorium on new permits for the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| [signature] | JEFF LEVINSKY | 1682 HAMILTON |
| e-mail (optional) | | |
| Penny Proctor | Penny Proctor | 758 Greer Rd |
| e-mail (optional) pennyproctor@comcast.net | | |
| [signature] | Jim Fallon | 1933 Ivy Lane |
| e-mail (optional) | | |
| [signature] | Rob Moore | 1066 CHANNING AVE |
| e-mail (optional) | | |
| Jane Volk-Brew | [signature] | 587 Greer Rd |
| e-mail (optional) volkbrew2@gmail.com | | |
| [signature] | Terri Weber | 150 Southwood |
| e-mail (optional) b.brewha@gmail.com | | |
| Becky Brewer | | |
| e-mail (optional) | | |
| EUGENE O'SULLIVAN | | |
| e-mail (optional) osullivcpa@aol.com | | |

7

**We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| [signature] | X. O'REILLY | 736 SOUTHAMPTON DR. |
| [signature] | CYNTHIA HAVEN | 431 OXFORD AVE. |
| [signature] | HERMAN GYR | 930 NOBLE RIDGE |
| [signature] | JULIE JEROME | 726 GREER RD |
| [signature] | Yoriko Kishimoto | 251 Embarcadero Rd |
| [signature] | NANCY McGARAGHAN | 200 COLERIDGE |
| [signature] | Janine M. HODGSON | 170 parkside DR. |
| [signature] | Shirley M. Fireman | 850 Webster |
| [signature] | Darel Hodgson | 170 Parkside |
| [signature] | LEIKA KEJRIWAL | 832 SOUTHAMPTON DR. |
| [signature] | Peter Herreshoff | 4180 Oak Hill Ave |
| [signature] | Nathaniel Sterling | 4180 Oak Hill |
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12

**We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| Marsha Alper | MARSHA ALPER | 2518 South CT. |
| Bonnie Pollard | BONNIE Pollard | 2450 South Ct. |
| Isabel Walker | ISABEL WALKER | 2460 South Court |
| Delney Waller | Delney Waller | 2500 South Ct. |
| Carole Hessler | Carole Hessler | 480 Anton Ct. |
| [illegible] | Joyce DAVIDSON | 807 RORKE |
| Ted Alper | TED Alper | 2518 S. Court |
| Megan Miller | Megan Miller | 2530 South Ct. |
| [illegible] | Mary Lynn | 2144 Louis Rd |
| [illegible] | Richard Dundas | 2144 Louis |
| [illegible] | ANNA Saitz | 2442 South Court |
| Bob Spears | BOB SPEARS | 959 MATADERO |
| Karen McNay | KAREN McNAY | 1520 Mariposa, PA |
| Henry Lum | Henry Lum | 4202 Suzanne Dr, PA |
| [illegible] | SUSAN BLOOM | 3151 Cowper St PA |
| Estelle Chalfin | ESTELLE CHALFIN | 432 High St. #302 PA |

16

**We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto <u>hold a public hearing</u> on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| [signature] | JUDITH STEINER | 1515 COWPER ST. |
| [signature] | DAVID PETRONE | 2301 WEBSTER ST. |
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**We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| Richard V. Heermance | RICHARD V. HEERMANCE | 208 N. CALIFORNIA PALO ALTO |
| Carol S. Heermance | CAROL S HEERMANCE | 208 N CALIFORNIA AVE PALO ALTO |
| Aimee Wallbrink | Aimee Wallbrink | 2643 Cowper St. |

3

2225 Webster

**We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto <u>hold a public hearing</u> on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| [signature] | DEANNA WONG | 2131 BYRON ST, Palo Alto 94301 |

1

**We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on new permits for the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto <u>hold a public hearing</u> on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| Kay Bushnel | Kay Bushnel | 775 Northampton Dr. Palo Alto |
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We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.

We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
| --- | --- | --- |
| Marla Rathbun | Marla Rathbun | 740 Garland Dr. |
| [signature] | Ken Broder | 2060 Louis Rd. |

2

**We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto <u>hold a public hearing</u> on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| BILL NEIDIG | [signature] | 2126 WEBSTER STREET |
| Christy Neidig | Christy Neidig | 2126 Webster St, |
| Linda Ziegler | Linda Ziegler | 2144 Webster ST. |
| Joe Ziegler | Joe Ziegler | 2144 Webster ST. |
| Stephanie Neidig | Stephanie Neidig | 2126 Webster St. |
| Mary Carusi | Mary Carusi | 2112 Webster St |
| M. Carusi | MICHAEL CARUSI | 2112 WEBSTER ST. |

7

**We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on new permits for the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto <u>hold a public hearing</u> on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
| --- | --- | --- |
| [signature] | CARL CIMILLUCA | 2176 Webster St. Palo Alto |
| [signature] | hurMA COOPER | 7 561 N. California Ave. |
| Therese Sze | THERESE W. SZE | 602 N. California Ave |
| [signature] | SIMON M SZE | 602 N. California " |
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**We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto <u>hold a</u> <u>public hearing</u> on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| [signature] | Esther Nigenda | 728 Garland Drive |
| Subhash Narang | SUBHASH NARANG | 728 Garland Drive |
| Mrs Jane R Meyers | Jane R. Meyers | 732 Garland Drive |
| Sonia Kantor | Sonia J. Kantor | 720 Garland DR |
| Robert H. Kantor | Robert H. Kantor | 720 Garland Dr. |
| Rita Westgaard | Rita Westgaard | 724 Garland Dr |
| [signature] | MENAD CAKLOVIC | 731 GARLAND DR. |
| [signature] | Mark Meyers | 732 Garland Dr. |
| [signature] | Naomi Meyers | 732 Garland Dr. |

**We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto <u>hold a public hearing</u> on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| Sharleen Fiddaman | Sharleen Fiddaman | 2255 Webster #22 |
| Patricia B. Sturrett | Patricia B. Sturrett | 765 San Antonio |
| Jean S. Robertson | Jean S. Robertson | 2280 Byron St. |
| Nancy A. Sicotte | NANCY A. SICOTTE | 2047 BYRON ST. |
| Harriet Lehrbaum | Harriet Lehrbaum | 596 N. California Ave |
| Richard B. Lehrbaum | Richard B. Lehrbaum | 596 N. California |
| Joyce Bryson | Joyce Bryson | 2266 Webster St. |
| Qiang Zheng | Qiang Zheng | 2250 Webster Street |
| Allen Zheng | Allen Zheng | 2250 Webster |
| Austin Zheng | Austin Zheng | 2250 Webster St |
| Yinzi Qi | Yinzi Qi | 2250 Webster St. |
| [illegible] | Petr Nino | 2302 Webster St |
| [illegible] | Amelia Wigton | 2255 Webster Street. |
| Elisa de Martel | Elisa de Martel | 2230 Webster St |
| [illegible] | Vincent de MARTEL | 2230 Webster St |

**We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| [signature] | Alyssa Levitan | 2326 Webster |
| [signature] | Grokyung Kim | 2320 Byron. |
| [signature] | Mallory Graffeo | 2275 Webster |
| [signature] | Brandon Graffeo | 2275 Webster |
| [signature] | Oliver Hechmann | 2323 Webster |
| [signature] | Bibiana Heckmann | 2323 Webster |

6

**We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto <u>hold a public hearing</u> on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| [signature] | Franklin Schellenberg | 4023 Villa Vista Palo Alto, CA |
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**We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
| --- | --- | --- |
| Marilyn Messer | Marilyn Messer | 1050 Guinda PA 94301 |
| Ken Dwiggins | KEN DWIGGINS | 1030 GUINDA ST., PA 94301 |
| Fran Rominger | FRAN ROMINGER | 1057 GUINDA ST. PA 94301 |
| Stephanie Dwiggins | STEPHANIE DWIGGINS | 1030 GUINDA ST, PA |

4

**We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| Shirley A Finfrock | Shirley A. FINFROCK | 841 ILima Ct. |
| Carla Bliss | Carla Bliss | 588 Barron Ave |
| Barbara Bowers | BARBARA BOWERS | 765 NORTHAMPTON Dr. |
| Joanne Koltnow | Joanne Koltnow | 317 Leland Ave |
| Nancy S. Drapkin | Nancy Drapkin | 1215 Forest Ave. |
| Kathleen Luchini | Kathleen Luchini | 220 Dana Ave |
| Gary L Dunker | Gary L. Dunker | 1403 Dana Ave. |

**We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto <u>hold a public hearing</u> on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| Sandra Browman | SANDRA BROWMAN | 2397 Webster st. |
| Mary R. Gretz | MARY R GRETZ | 2310 WEBSTER |
| Wm B. Gretz | William B. GRETZ | 2310 WEBSTER |
| Janice L Banks | Janice L. Banks | 2280 Webster St. |
| Leslie Armistead | Leslie Armistead | 555 Oregon Ave |
| Ron Morita | Ron Morita | 2361 Tasso St |
| Kathy Harrington | Kathy Harrington | 609 Oregon Ave |
| Julie Fukuhara | JULIE FUKUHARA | 2344 WEBSTER ST. |
| [signature] | Pete Fukuhara | 2344 Webster St. |
| [signature] | Phil Shpilberg | 2353 Webster |
| [signature] | William H. Benz | 2360 Webster |
| [signature] | Sandra Shpilberg | 2353 Webster. |
| Gertrude Reagan | GERTRUDE REAGAN | 967 Moreno |
| Jack Morton | JOHN D MORTON | 2243 WEBSTER ST. |
| Margaret O'Reilly | MARGARET O'REILLY | 736 SOUTHAMPTON DR |
| [signature] | JACK O'REILLY | 736 SOUTHAMPTON DR |
| Mahlon Hubenthal | MAHLON HUBENTHAL | 1228 Byron St |
| Carol Hubenthal | CAROL HUBENTHAL | 1228 Byron St. |

## Residents for Responsible Use of Groundwater,

## a Community Resource

**We hereby request that the City of Palo Alto impose an immediate moratorium on new permits for the pumping of our groundwater (dewatering) for the construction of residential basements. This moratorium is to continue until further study of dewatering and its effects is completed and city groundwater returns to its normal pre-drought levels.**

**We also request that the City of Palo Alto hold a public hearing on the practice of dewatering so City Council members can hear directly from concerned and affected citizens, and review information not available when the issue was last studied in 2008.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| Neilson S Buchanan | Neilson Buchanan | 155 Bryant |
| E-mail (optional) cnsbuchanan@yahoo.com | | |
| Doria Summa | DORIA SUMMA | 2290 YALE |
| e-mail (optional) doriasumma@gmail.com | | |
| Paul Machado | PAUL MACHADO | 363 Stanford Ave |
| E-mail (optional) plmachado@gmail.com | | |
| Rebecca B Sanders | | |
| E-mail (optional) rebsanders@gmail.com | | |
| Lisa Landers | Lisa Landers | 630 Barron |
| E-mail (optional) | | |
| Phyllis Thé | Phyllis Thé | 711 San Antonio #83 |
| E-mail (optional) pl.thee comcast.net | | |
| Jerry Holzemer | | |
| holz@sonic.net | | |
| [signature] | Richard Willits | 3396 Greer Road rwillits@gmail |

8

**Residents for Responsible Use of Groundwater,**

**a Community Resource**

**We hereby request that the City of Palo Alto impose an immediate moratorium on new permits for the pumping of our groundwater (dewatering) for the construction of residential basements. This moratorium is to continue until further study of dewatering and its effects is completed and city groundwater returns to its normal pre-drought levels.**

**We also request that the City of Palo Alto hold a public hearing on the practice of dewatering so City Council members can hear directly from concerned and affected citizens, and review information not available when the issue was last studied in 2008.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
| --- | --- | --- |
| Peter Taskovich | Peter Taskovich | 751 Gailen Ave Palo Alto |

E-mail (optional) ptaskovich@yahoo.com

e-mail (optional)

E-mail (optional)

E-mail (optional)

E-mail (optional)

E-mail (optional)

**We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto <u>hold a public hearing</u> on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
| --- | --- | --- |
| H.R. Davidson | H.R. Davidson | 2527 Webster Street<br>Palo Alto 94301 |

We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.

We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| [signature] | PETER O'RIORDAN | 1032 HARKER AVE |
| | DIANA DARCY | 1032 HARKER AVE |
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**We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| [signature] | DAN MAHONEY | 2267 TASSO ST, PALO ALTO 94301 |
| Leslie Mahoney | LESLIE MAHONEY | 2267 TASSO ST, PA 94301 |

**We hereby request that the City of Palo Alto impose an immediate moratorium on the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

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| Sylvia J Gartner | Sylvia Gartner | 824 Moreno Palo Alto 94303 |
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**We hereby request that the City of Palo Alto impose an immediate moratorium on new permits for the pumping out of our groundwater for the construction of basements for residential homes in Palo Alto to further study its effects and until the groundwater returns to its normal pre-drought level.**

**We also request that the City of Palo Alto hold a public hearing on this matter so that the City Council members can hear directly from concerned and affected citizens.**

| SIGNATURE: | PRINTED NAME: | ADDRESS: |
|---|---|---|
| | Anette Glankopf | |
| e-mail (optional) | ANNette_G@Att.net | |
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| e-mail (optional) | | |
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# CHANGE.ORG SIGNERS

| Name | City | Postal Code | Signed On |
|---|---|---|---|
| Deborah Baldwin | Menlo Park | 94025 | 8/6/2015 |
| Henry Heller | Palo Alto | 94303 | 8/7/2015 |
| M Smith | Palo Alto | 94301 | 8/7/2015 |

City of Palo Alto

# GROUNDWATER SUPPLY FEASIBILITY STUDY

FINAL
April 2003

2700 YGNACIO VALLEY ROAD, SUITE 300 • WALNUT CREEK, CALIFORNIA 94598 • (925) 932-1710 • FAX (925) 930-0208

**CITY OF PALO ALTO**

**GROUNDWATER SUPPLY FEASIBILITY STUDY**

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# 1.0 INTRODUCTION

The Palo Alto Utilities Department (Utilities) is presently examining the issues relating to the use of groundwater. Examining all water supply options, including local sources such as groundwater supply, is a part of good planning practices for the water utility. Utilities has engaged Carollo Engineers, P.C. (Carollo) to prepare a "Groundwater Supply Feasibility Study" (Study) to:

> "Evaluate whether operating one or two of the City's water wells as active supplies would cause a significant decrease in groundwater levels or deterioration in groundwater quality."

This Study estimates the groundwater basin capacity in Palo Alto vicinity, identifies a possible well supply system given the basin capacity constraints, and examines whether there is a safe way to use groundwater as a supply source either in drought periods or on an ongoing basis. We have examined the capability of Palo Alto's groundwater supply and some of the more significant potential impacts of pumping. The three potential impacts that this Study specifically addresses are:

- The risk of land surface subsidence;
- The risk of groundwater contamination through saltwater intrusion; and
- The risk of groundwater contamination through the travel of pollution plumes to the drinking water aquifer.

Palo Alto Utilities staff and Carollo have worked closely with staff of the Santa Clara Valley Water District (SCVWD) to ensure that SCVWD staff are fully informed of the analysis methods and findings. **At the present time, the City of Palo Alto is NOT planning to use any of the wells for long-term supply. Any change from the planned emergency-only use of the wells would happen only after further detailed analysis, environmental review, extensive discussion with the public, and approvals by both the Utilities Advisory Commission and the City Council. Staff is merely examining the issues related to the groundwater basin and the possible use of the wells in severe droughts or as a supplemental supply in the future.**

## 1.1 Background

The City of Palo Alto obtained its well system in 1896. The entire water supply for the City was derived from groundwater until 1938 when it began receiving supplemental supplies from the City and County of San Francisco. In 1962, the wells ceased operating on a continuous basis and San Francisco water became the City's primary source of supply with the wells maintained as an emergency water supply. The wells were last used in 1988 and 1991 to provide supplemental supplies during a serious drought. At this time, the City maintains five wells as emergency (standby) water sources, but they are in need of rehabilitation.

## 1.2 Well System Rehabilitation and Construction Plans

The City is presently implementing plans to rehabilitate the five existing wells and build three new wells. These improvements are part of a larger Water System Capital Improvement Plan, which was developed as a result of extensive study completed in 1999 (1999 Study). The primary purpose of the well rehabilitation and construction plans is to provide necessary emergency water supplies in the event of a complete cutoff from the SFPUC water supplies.

The overall water CIP has been reviewed and approved by both the Utilities Advisory Commission and the Palo Alto City Council. Funds for the improvements are included in the five-year Water Capital Improvement Program Budget.

# 2.0 POTENTIAL GROUNDWATER USE IN PALO ALTO

The imported water purchased from the SFPUC has been a reliable supply for 40 years. There is growing concern, however, that this supply may be jeopardized either partially or completely by a number of factors. For example, the SFPUC supply was rendered unavailable once in 1995 and again in 1998 due to water quality concerns.[1] In addition, recent studies conducted by the SFPUC have identified a number of system vulnerabilities that could cut off the water supply for up to 60 days in the event of a serious emergency.[2] In regards to long-term reliability, the SFPUC supply is insufficient to meet the current and forecasted needs of the users of the regional system it operates. Droughts in 1976-77 and 1987-1992 that resulted in the rationing of supplies clearly illustrates this fact. The SFPUC's Water Supply Master Plan (WSMP) recognized that on a long-term basis, its supplies are inadequate. The WSMP identified the system's yield as 239 mgd while current demand is greater than 260 mgd and the demand estimate for 2030 is 303 mgd, or a shortfall in supplies of 64 mgd. Thus, it is prudent for the City to evaluate its options for improving the reliability of its water supply.

The location of the City's wells is shown in Figure 1. These wells may have potential uses beyond supplying water during SFPUC outages. If the City Council decided, the wells could also help supplement water supplies during drought periods and perhaps even as active

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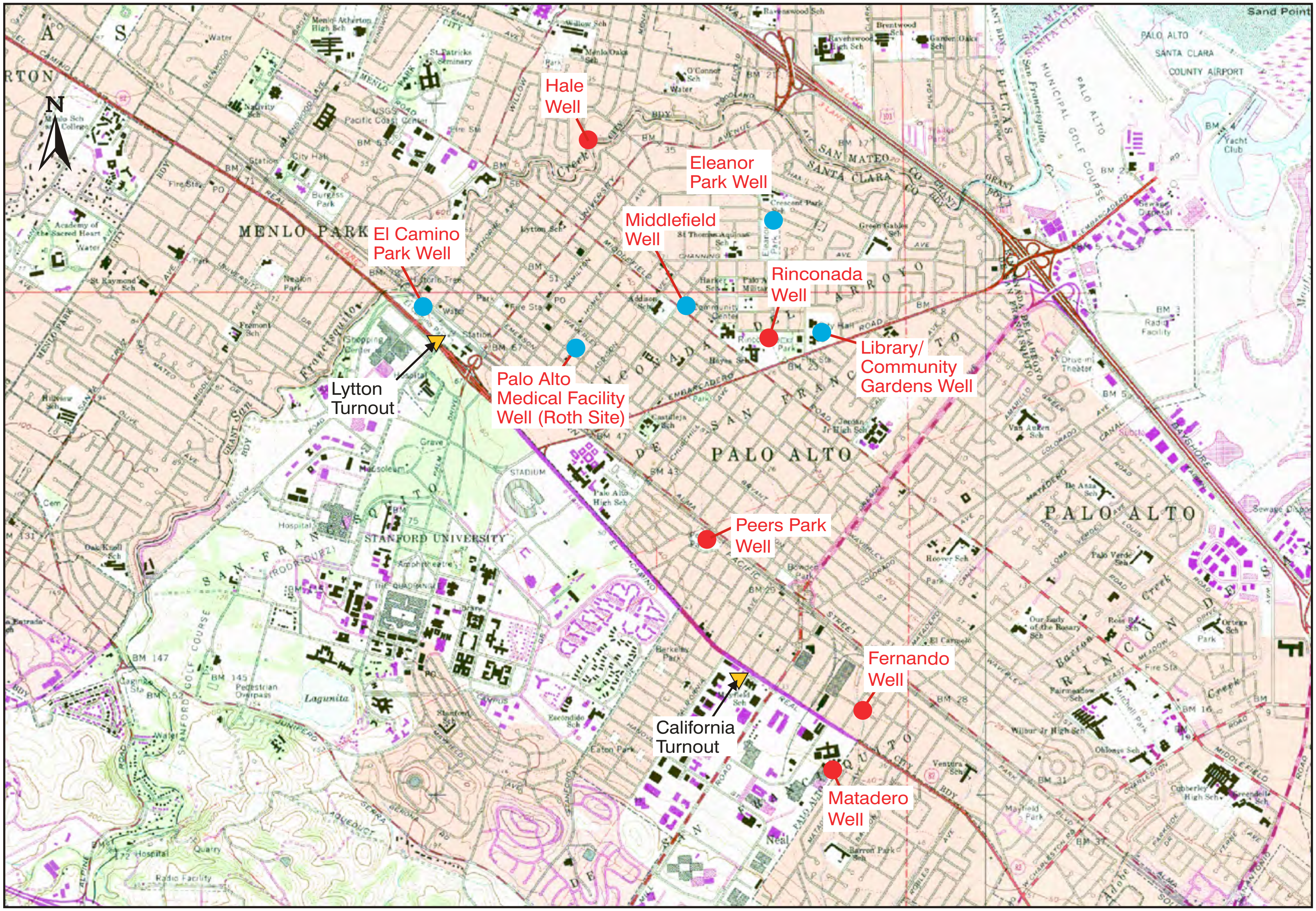
[1] "Water Wells, Regional Storage, and Distribution System Study," page 4-1, prepared for the City of Palo Alto by Carollo Engineers, P.C. dated December 1999.
[2] SFPUC fact sheet dated August 5, 2002.




LEGEND
- SFPUC Turnout
- Existing Well Sites
- Proposed Well Sites

No Scale

**Figure 1**
**EXISTING AND PROPOSED CITY WELLS**
**GROUNDWATER SUPPLY FEASIBILITY STUDY**
CITY OF PALO ALTO

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sources to be regularly used in conjunction with the SFPUC supply. These uses, however, raise significant concerns related to lowering of the groundwater levels. Significantly, depressed groundwater levels can potentially lead to environmental consequences such as subsidence, saltwater intrusion, and contaminant migration. Though there may be other as yet unidentified impacts, these impacts are discussed in this Study as they are considered to be the most significant potential impacts.

Currently, the wells are designated standby sources meaning that they can only be used 15 days a year and no more than 5 days consecutively.[3] The "standby" designation is made with the California Department of Health Services (DHS) in part because the well water quality exceeds some secondary (aesthetic) drinking water standards. According to the 1999 study, the well water quality exceeds secondary standards for TDS, iron, and manganese.

For the purposes of this Study, it is assumed that the water would be used for potable uses. As such, changing the well status with the DHS from "standby" to "active" would require the well water to be treated such that it met all drinking water regulations. Alternatively, the regulations allow the City to distribute water that meets primary drinking water quality standards but exceeds some secondary drinking water quality standards. Proceeding in this manner would require the City to first complete a study acceptable to the California Department of Health Services (DHS) showing consumer acceptance of water not meeting secondary drinking water standards (see California Code of Regulations Title 22, Division 4, Chapter 15, Article 16, Section 64449 for specific details).

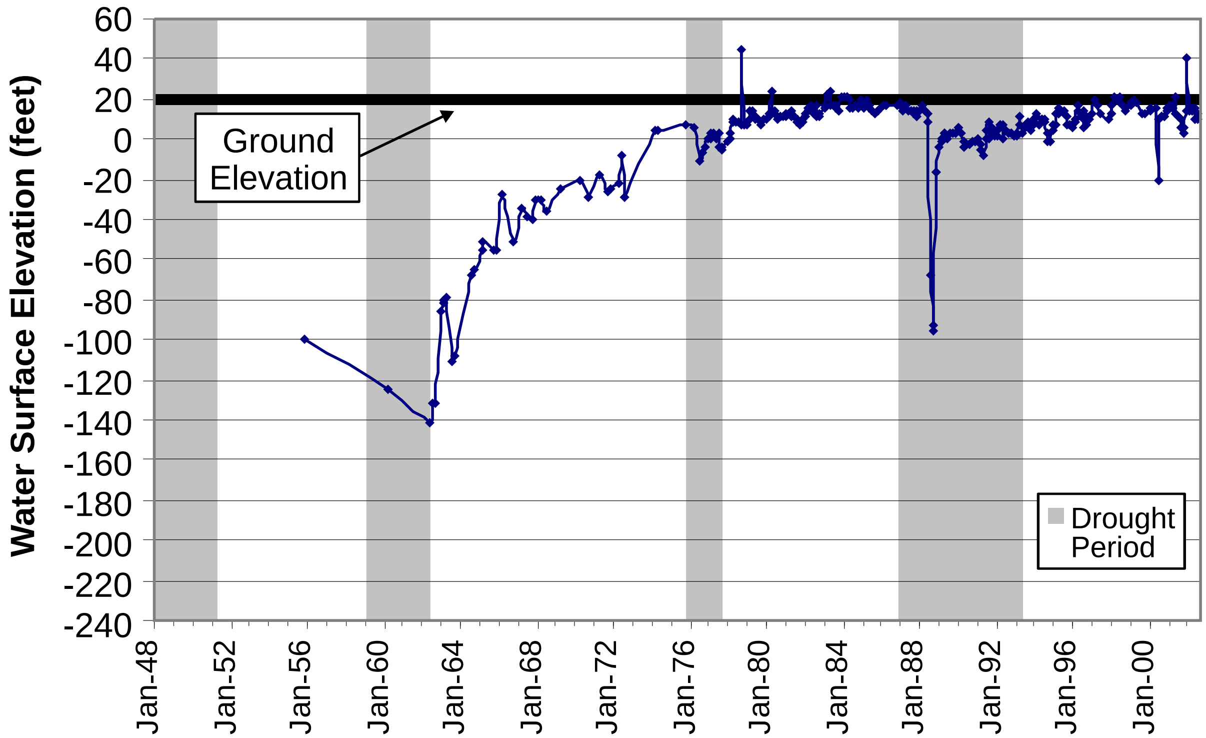
Customer acceptability, however, may require the City to install sufficient treatment at the wells to be used for drought or active supply such that the water quality is increased significantly or made comparable to the SFPUC water. This issue was covered in the City's "Long-Term Water Supply Study" dated May 2000 (May 2000 Study).

## 3.0 HISTORICAL GROUNDWATER LEVELS AND USE

The best way to evaluate the effect that pumping has on groundwater levels is to review historical data that show the basin's response to pumping. Groundwater pumping and water level data from 1950 through 2000 are presented in Figures 2 through 7. All of the water level graphs show a characteristic rise following the switch to SFPUC water in the early 1960s.

In general, the graphs show smooth trends in response to recharge, pumping, and drought conditions. There are occasional spikes in the graphs that appear to be outlying, erroneous

[3] According to the California Code of Regulations, Title 22, Section 64449, (e) (I), standby wells may be used as active sources without additional water treatment if the City were to conduct a study establishing the customers' willingness to accept water that doesn't meet secondary water quality standards.



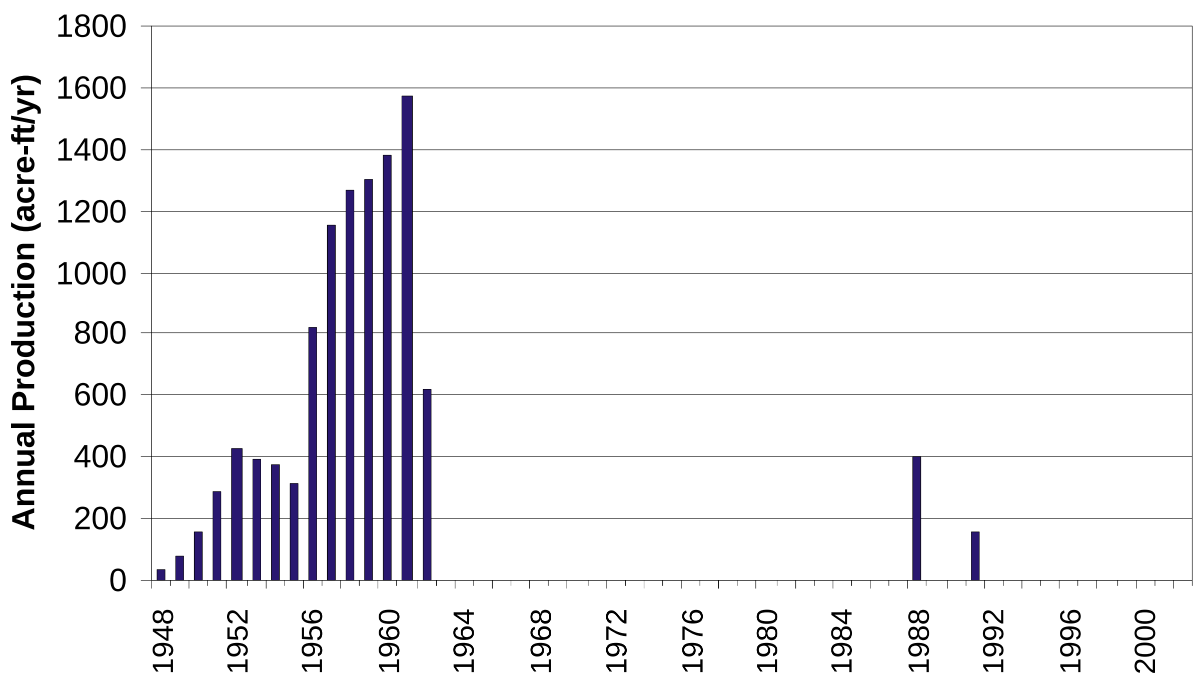




**Figure 2**
**HALE WELL**
**GROUNDWATER SUPPLY FEASIBILITY STUDY**
CITY OF PALO ALTO

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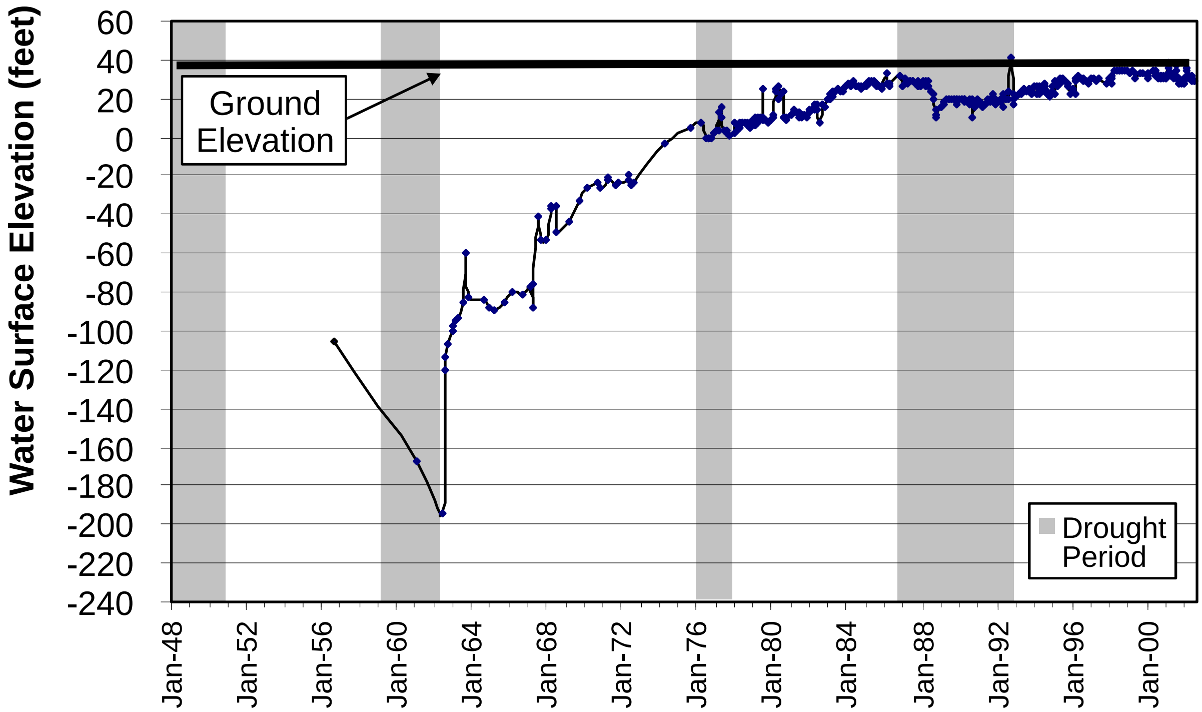


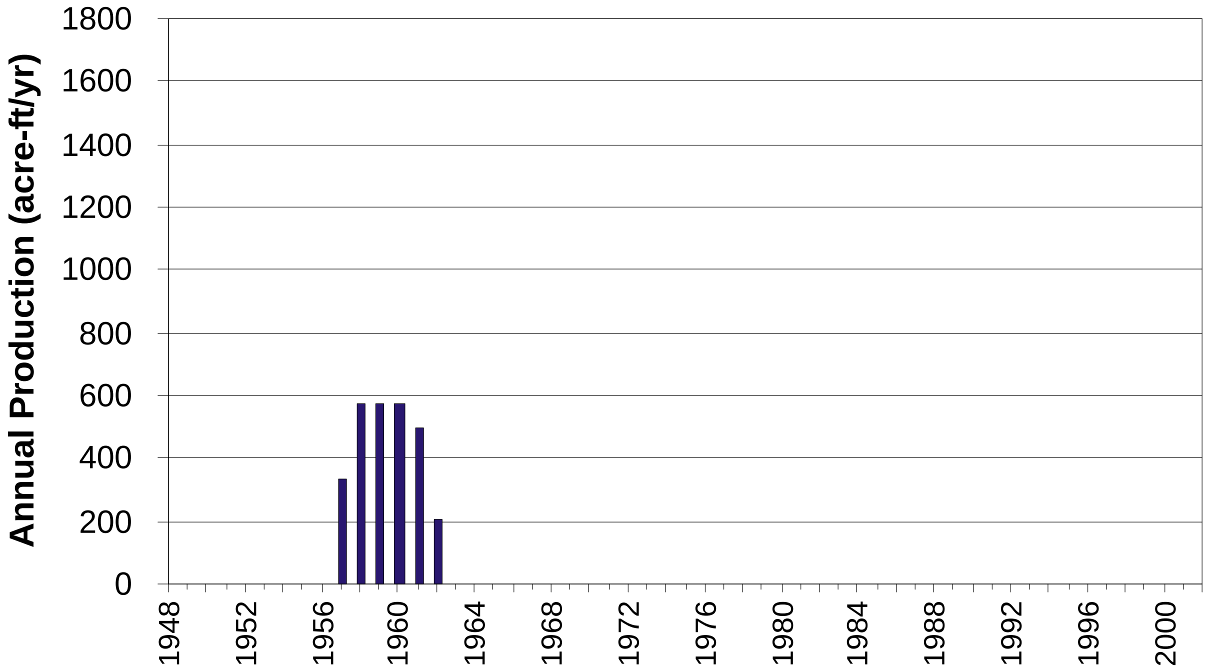


**Figure 3**
**MATADERO WELL**
**GROUNDWATER SUPPLY FEASIBILITY STUDY**
CITY OF PALO ALTO

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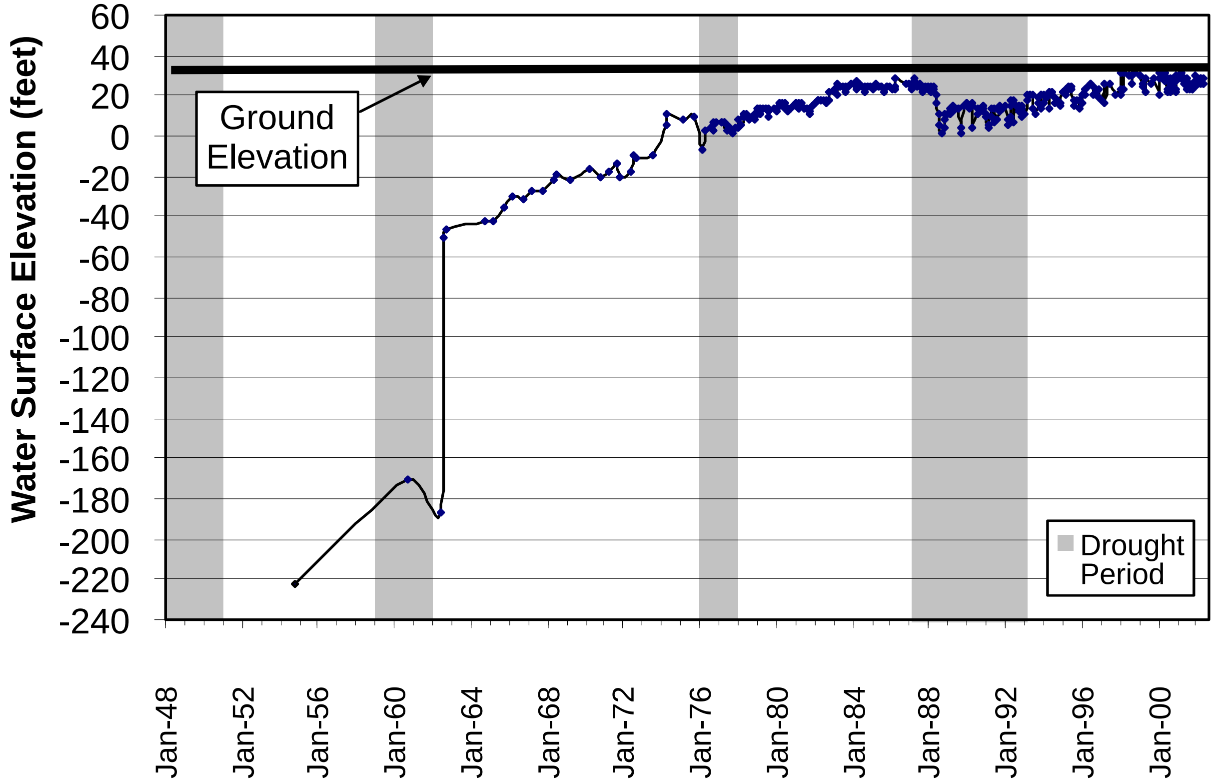


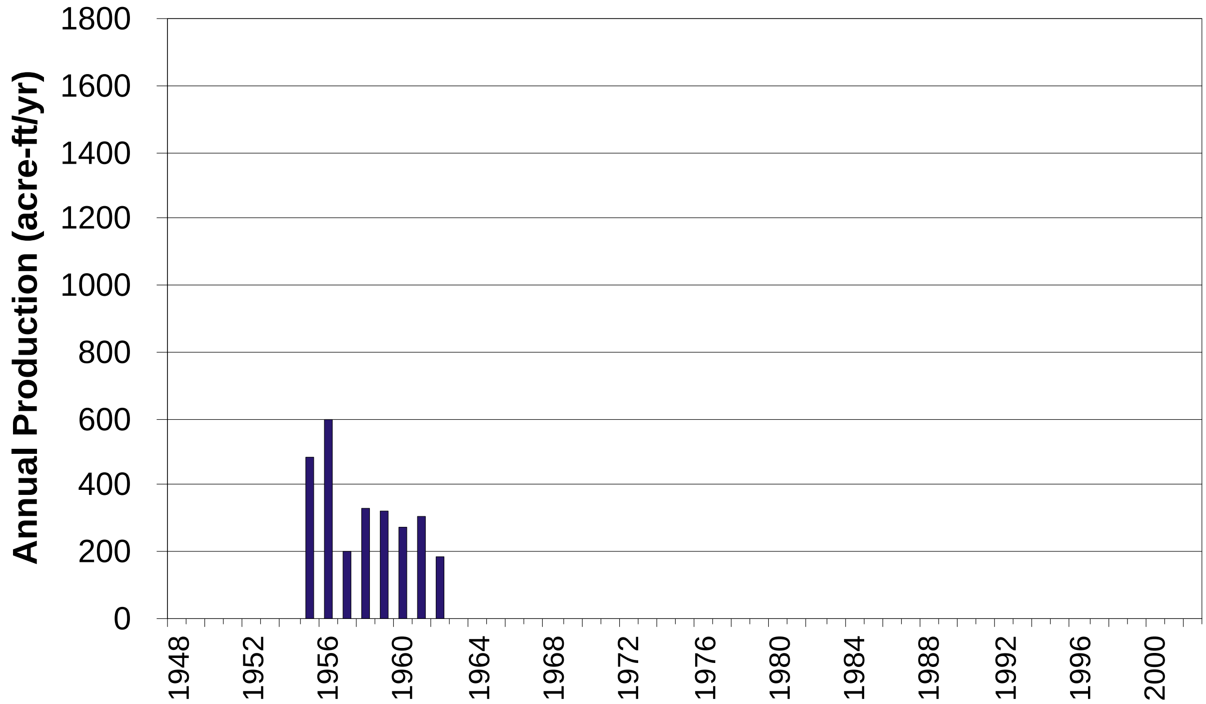


**Figure 4**
**FERNANDO WELL**
**GROUNDWATER SUPPLY FEASIBILITY STUDY**
CITY OF PALO ALTO

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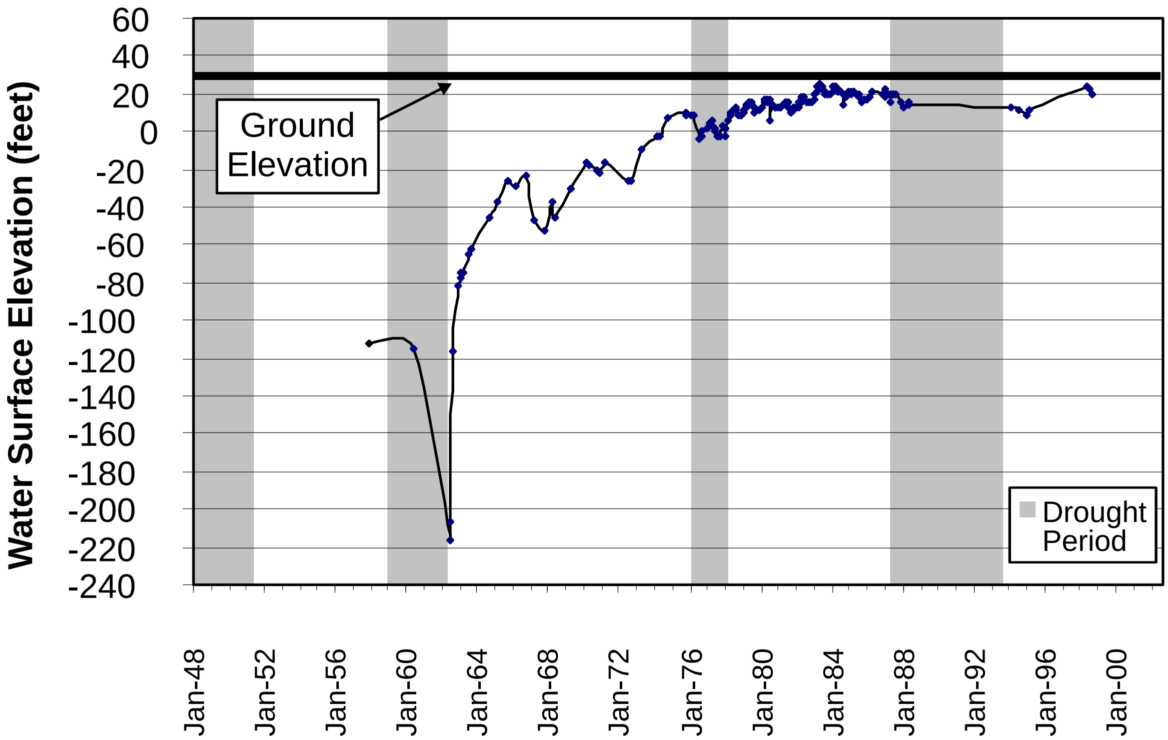


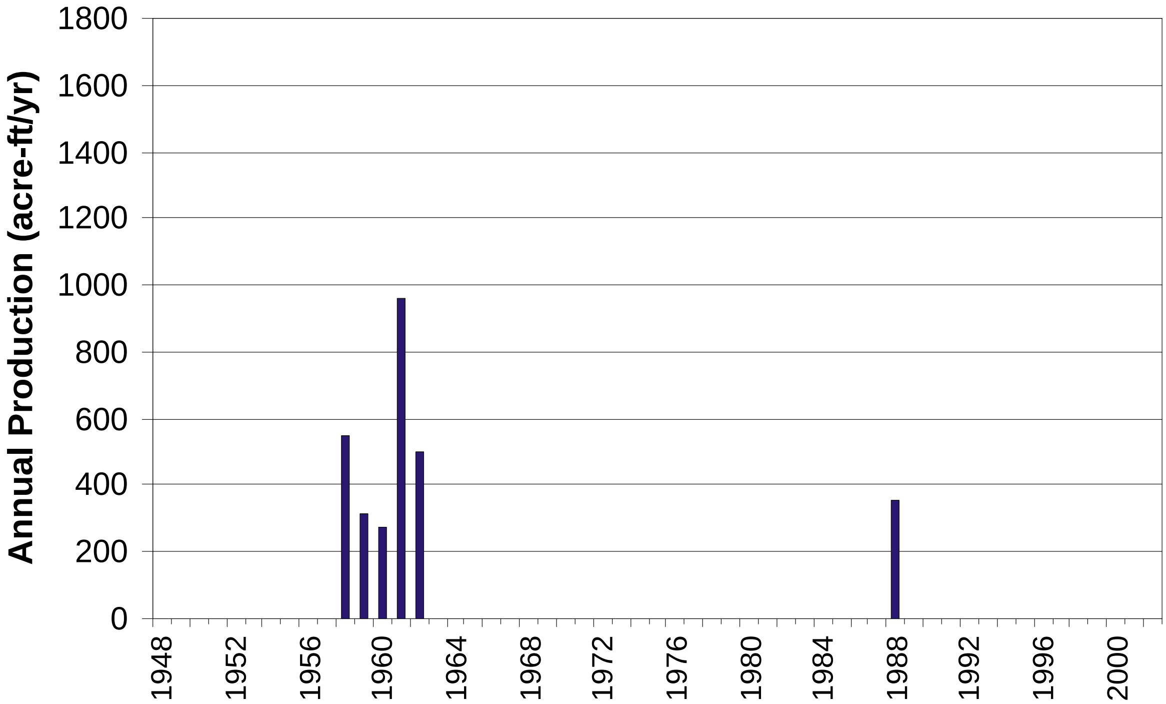


**Figure 5**
**PEERS PARK WELL**
**GROUNDWATER SUPPLY FEASIBILITY STUDY**
CITY OF PALO ALTO

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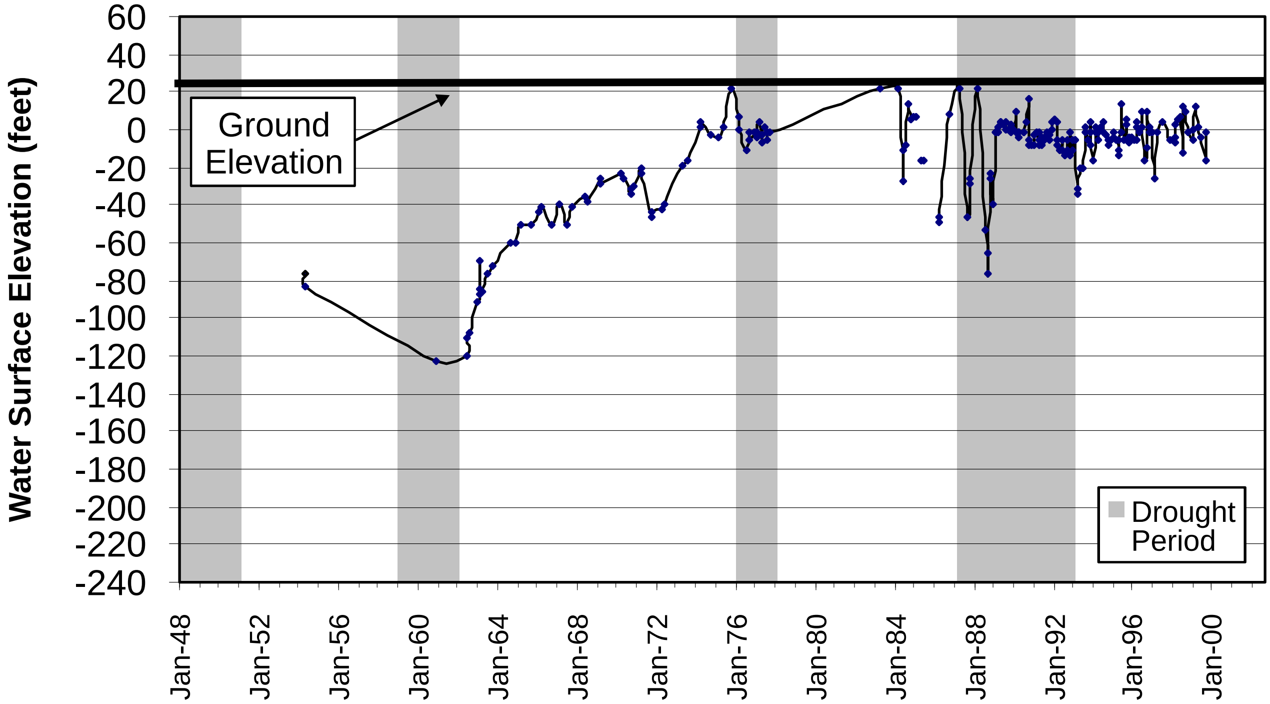


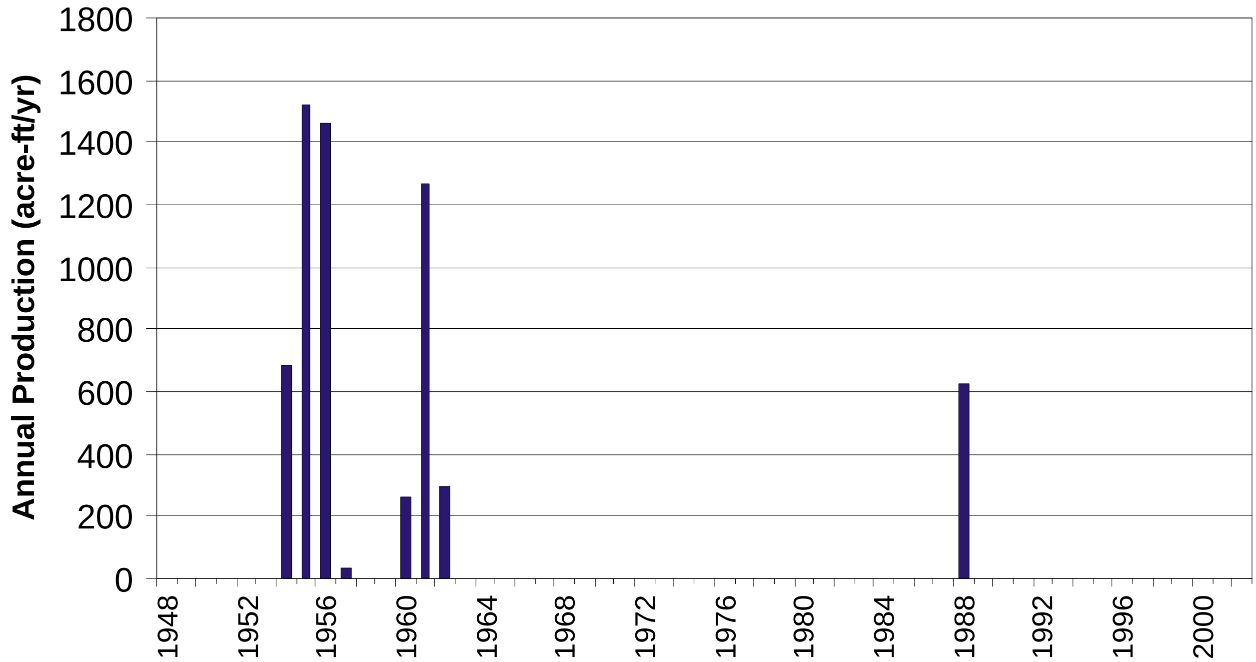
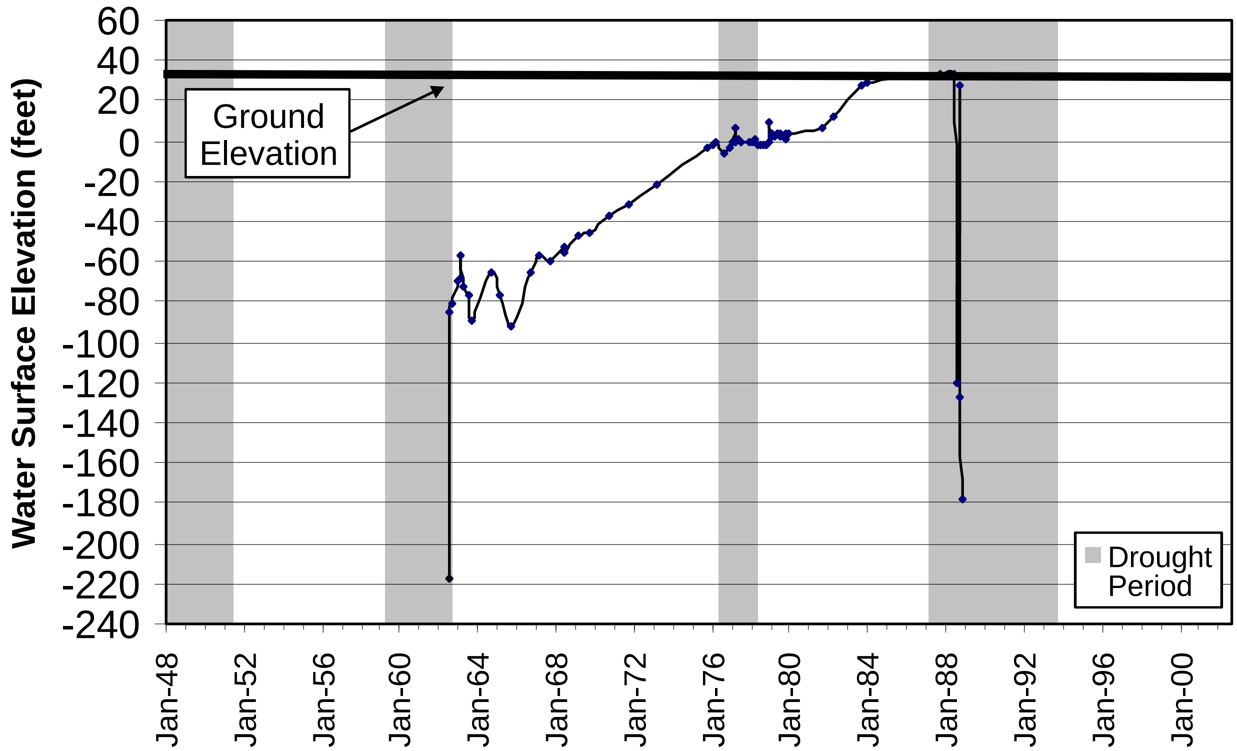




**Figure 6**
**RINCONADA WELL**
**GROUNDWATER SUPPLY FEASIBILITY STUDY**
CITY OF PALO ALTO



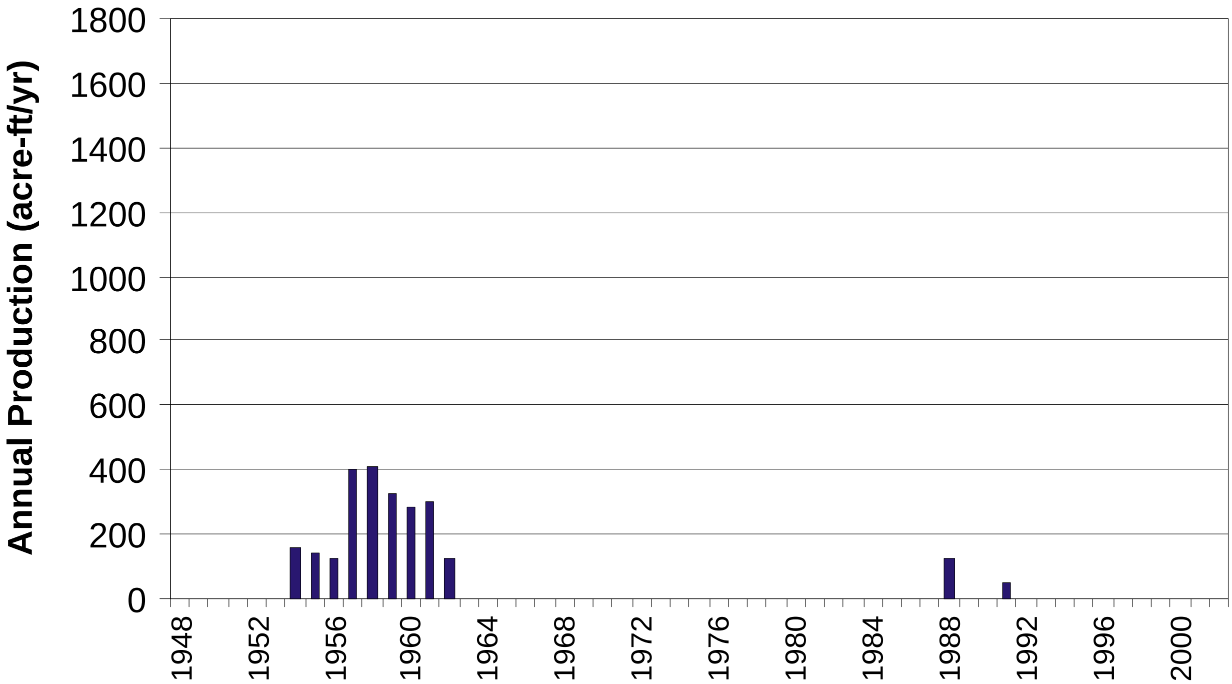




**Figure 7**
**MEADOW WELL**
**GROUNDWATER SUPPLY FEASIBILITY STUDY**
CITY OF PALO ALTO

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data. We believe that the occasional spikes in the data are more likely due to equipment error than due to the actual water level. The information presented in the graphs is used in the following section to estimate the groundwater basin capacity in the Palo Alto area.

## 4.0 ESTIMATION OF BASIN CAPACITY

Groundwater resources of the Palo Alto area occur within a much larger aquifer system - the Santa Clara Valley Groundwater Basin. This basin extends as far south as Coyote Narrows and extends north of Palo Alto far into San Mateo County. The system is bounded by uplifted bedrock to the west. To the east, the shallow portion of the aquifer system is bounded by San Francisco Bay. At depth, the aquifer systems of the west side of the valley interfinger under the bay with those of the east.

In a large groundwater basin, estimation of the capacity of a smaller area within a basin is difficult because the smaller area is, by definition, unbounded. Groundwater moves freely between basin areas in response to hydraulic head. Therefore, pumping or recharge in one area of the basin has effects on the basin as a whole. Indeed, the impacts of seasonal variations in recharge and in extractions by one or more of Palo Alto’s neighbors are evident in the seasonal rise and fall of the water levels at the Hale Well.

Estimating the capacity of the Santa Clara Valley Groundwater Basin in the Palo Alto area requires the definition of an arbitrary area for purposes of evaluating changes in groundwater storage that have occurred. For the purpose of estimating the storage capacity of the groundwater basin in the Palo Alto area, an arbitrary area was defined. This area is bounded on the west by the Hanover Fault zone that is approximately 2,000 feet west of El Camino Real with a similar trend. The Bay was adopted as the eastern boundary. The Hanover Fault zone separates the alluvium of the basin from the bedrock to the west and is a hydrogeologic boundary. For the upper portion of the aquifer system that is in hydraulic communication with the Bay, the Bay is a hydrogeologic boundary. For the deeper portions of the aquifer system, the Bay is not a hydrogeologic boundary but for purposes of definition in this Study, it was adopted as a boundary. The adopted north and south bounds are San Francisquito Creek and San Antonio Road, respectively. The area described by these boundaries is approximately 9,500 acres.

Given this defined area, there are several approaches to understanding the capacity or yield. Three methods were evaluated in a previous report to the City entitled “Estimation of Groundwater Basin Capacity” dated December 2002 (December 2002 Report). Those three methods are: 1) Use of the SCVWD calibrated groundwater model; 2) Analysis of basin recovery to cessation of pumpage; and 3) Analysis of basin response to 1988 drought pumping.

Once the December 2002 report was completed, the City and Carollo met with representatives of the SCVWD to discuss their questions and concerns regarding the report. One of the outcomes of that meeting was that the first two methods of calculating the groundwater basin capacity were controversial for the following reasons:

- The SCVWD groundwater model does not accurately reflect the hydrogeologic conditions at Palo Alto. One of the most important deviations is that the model does not account for any recharge from San Francisquito Creek. In fact, the model has a boundary condition that sets the contribution at zero. As such, using the model to calculate the Palo Alto groundwater basin capacity would likely result in a volume that is erroneously low unless the contribution from San Francisquito Creek is accounted for. Since this data is not available and obtaining it would not only require an extensive hydrogeologic study but would also raise concerns regarding the amount of water that must be left in the creek versus that which can be considered useful for groundwater recharge and later extraction, this method will not be further developed.
- Using the groundwater level recovery history to calculate the basin storage capacity yielded values that ranged over two orders of magnitude. SCVWD representatives recommended that the City should perform multiple aquifer tests to improve the accuracy of this data. However, the existing condition of the City's wells is not readily conducive to performing this type of test. In addition, an aquifer test could readily be performed once the City has completed upgrading its wells. For the present time, this method of estimating the basin capacity will not be pursued.

The third method presented in the December 2002 Report for estimating the groundwater basin capacity (i.e. analyzing the water level data gathered during and after pumping in 1988) will be used for the remainder of this Study.

## 4.1 1988 Drought Pumping Analysis

The pumping performed by the City of Palo Alto during the drought provides data to directly estimate the response of the basin to extractions. When the 1987-1992 drought occurred, the City's wells had been essentially idle since 1962. During this period, water levels in the basin had risen, on average, more than 150 feet. Approximately 90 percent of that recovery took place in the first 10 years following cessation of pumping. The City operated the wells for an approximately 5-month period in 1988 and extracted approximately 1,505 acre-feet. The water level response is shown on Figures 1 through 6. The extraction volume and the observed water level response are summarized in Table 1.

Averaging the observed water level declines results in an average decline of approximately 24 feet. This water level decline reflects Palo Alto's pumpage while also reflecting the simultaneous pumpage from neighboring utilities. Utilizing the observed 24 feet of decline across the assumed 9,500-acre area results in an observed coefficient of storage of approximately 0.007 (dimensionless). This value is quite appropriate for a semi-confined aquifer system, such as the Palo Alto area.

| **Table 1 Water Level Response<br>Groundwater Supply Feasibility Study<br>City of Palo Alto** | | |
|---|---|---|
| **Well** | **1988 Extractions (acre-feet)** | **Observed Water Level Decline During the 1988 Pumping Period (feet)** |
| Matadero | 0 | 18 |
| Hale | 398 | 15 |
| Fernando | 0 | 25 |
| Rinconda | 627 | 25 |
| Middlefield(1) | 0 | 37 |
| Meadows(2) | 123 | Data Not Available |
| Peers Park(3) | 357 | Data Not Available |
| **Total** | **1,505** | **Average = 24** |

Notes:
(1) Middlefield well water level decline likely reflects proximity (about 0.5 mile) to the operating Rinconda well. Similar effects are revealed for the Matadero and Fernando wells indicating that they are in the same basin as the operating wells.
(2) The Meadows well was not highly productive and was destroyed following its use in 1988. No water level data was collected after 1988.
(3) Water level data for the Peers Park well were not collected between the years 1988 and 1994. Subsequent data shows water level variation similar to the Hale well.

Though some groundwater was pumped in 1991, the City ceased significant extractions in December 1988. Of interest is the rapid recovery of the basin after drought conditions, with water levels recovering to pre-pumping levels within 18 months of the extraction period.

This also is reflective of the semi-confined nature of the basin and the active recharge efforts of SCVWD.

## 4.2 Summary of Basin Capacity Estimation

From the drought pumping analysis presented above, the following conclusions are drawn regarding the groundwater basin capacity:

- Water levels in the Palo Alto area have returned to almost predevelopment levels. Essentially, the groundwater basin in the Palo Alto area is full.
- Data from 1988 pumping provides a good example from which to appraise groundwater extraction concepts. 1,500 acre-feet were extracted with limited impact. Water level impacts were short-lived and water levels returned to pre-pumping levels within 18 months. If pumping were performed during a non-drought period, the drawdown would likely be less. Initial drawdown may also be affected by the condition of the existing casings that may cause otherwise productive portions of the aquifer to

contribute to the supply. An aquifer test should be conducted following the City's well construction and rehabilitation efforts to verify the basin's response to pumping.

- Utilizing the data from the 1988 pumping, the extraction of 1,000 acre-feet from the Palo Alto area will result in basin-wide water level declines on the order of 15 feet. Historical experience suggests that the basin will recover to pre-pumping levels within a couple years. It is expected that the water level would decline approximately 25 feet if the City were to extract 1,500 acre-feet in one year.
- Occasional depletion of storage resulting from extractions in excess of annual average recharge appears to have minimal adverse impacts.
- Seasonal fluctuations in water level record from Hale and Rinconada wells shows that Palo Alto's pumpage does not occur autonomously. Palo Alto's water level appears to be impacted by pumpers outside of SCVWD jurisdiction.

From the above analysis, it appears that the following groundwater pumping scenario may be safely supported by the groundwater basin:

- During drought conditions, 1,500 acre-feet may be withdrawn in one year as long as the aquifer is allowed to recover to pre-pumping levels before pumping is reinitiated.
- 500 acre-feet per year may be withdrawn on a year-to-year basis. This practice, however, should be discontinued if the groundwater levels continued to drop to levels that may induce negative environmental impacts (see discussion below on subsidence, saltwater intrusion, and contaminant plume migration).

The balance of this study is presented assuming the wells are used to supply 1,500 acre-feet per year (AFA) during droughts, or 500 AFA on a year-to-year or active basis.

## 5.0 POSSIBLE PALO ALTO GROUNDWATER SUPPLY SYSTEM

A well system that could provide this level of service would need a capacity of about 1,000 gallons per minute (gpm) assuming the well is operated continuously for the year during the drought operation (1,500 AFA) or 2,000 gpm if the well is operated for only half the year. In addition, the well site must be able to accommodate the treatment equipment that may be required for this operation (as discussed above), and the environmental and public involvement efforts must conclude that installing treatment is feasible at the site. The May 2000 Study evaluated the existing and proposed well sites in terms of their relative ability to be used as drought or active supplies. That study provided the following ranking of the existing wells:

- Hale and Peers Park are the best sites since they are existing wells that are high-capacity and have adequate adjacent space for treatment equipment.

- Rinconada is another existing high-capacity well but it lacks the space needed for treatment equipment (unless the equipment is constructed at the location of the existing tennis courts).
- Fernando and Matadero do not have adequate capacity or space to be considered feasible active or drought supply sources.

At the time the May 2000 Study was written, the City had not yet begun to implement the proposed new well projects. As such, these wells were generally ranked lower than the existing wells. The proposed well sites were ranked as follows:

- The El Camino Park site was ranked among the highest because of the size of the site and its proximity to the SFPUC turnouts and the proposed reservoir, which would facilitate blending the well water with SFPUC water before it is delivered to the distribution system.
- The Eleanor Pardee Park, the Library/Community Gardens, and the Roth sites (Old Palo Alto Medical Facility) were ranked high because of the size of each of these sites.
- The Middlefield Road well site was ranked lowest because it is the most constrained site.

It should be emphasized that none of the previous studies included performing either the environmental, public involvement, or other studies that are needed before any of the above sites can be considered truly feasible for well or water treatment facility construction. The City's current on-going efforts (the Phase I and Phase II Water Supply Capital Improvement Projects) include performing these needed studies.

If treatment or blending are not required, any of the City's wells could be used for drought or active use assuming the required approvals (discussed above) are obtained. If, however, water treatment facilities must be constructed, it would be best to focus on a single site since only one well is needed to be within the identified capacity limits. In addition, focusing the permitting and engineering requirements on a single site is the most cost-effective approach for the City. For a drought supply with treatment, the best existing well sites are Hale and Peers Park. The best proposed well site for a drought supply source with treatment is El Camino, though the Roth site, the Library/Community Gardens, and Eleanor Pardee Park all appear to be feasible sites at this time.

# 6.0 POTENTIAL IMPACTS OF GROUNDWATER EXTRACTIONS

The potential impacts from groundwater extractions derive from changes in groundwater flow directions that result from changes in water levels caused by extractions (pumping). As a preface to the following sections, a brief summary of the history of groundwater levels in the Palo Alto area and the Santa Clara Valley is presented.

Groundwater development in the Santa Clara Valley began around 1900. At that time most groundwater wells in the lower elevations of the Santa Clara Valley were artesian – that is, flowing at ground surface. As aggregate extractions increased, water levels fell progressively, subject to climatic variations, reaching depths of as much as 200 feet below ground surface by the early 1960s. With the importation of water to the Santa Clara Valley water levels began to recover. In Palo Alto, water levels are currently at elevations comparable to the 1910s. In wet winters, wells in the Palo Alto area now, if not controlled, flow at ground surface.

## 6.1 Subsidence

One of the potential impacts of groundwater extractions is a decrease in the elevation of the ground surface known as land subsidence. Some of the negative effects of the subsidence are an increased risk of flooding, and damage to infrastructure. Subsidence has been associated to areas with significant groundwater pumping, natural gas production, or oil production. Groundwater is pumped from porous layers with higher hydraulic capacities, i.e., sand and gravel aquifers. As the pumping occurs, water from the confining layers of the aquifers is drawn into the porous aquifer. The aquifers consisting of sand and gravel tend to be incompressible, however, the confining layers may be compressible materials, such as clay. When the groundwater is pumped from these compressible layers the soils compress and the surface elevation starts to drop. This decline in elevation is the result of the physical properties of clay. Clay is comprised of platy minerals that are commonly oriented randomly within the clay deposit. With the removal of fluid and overburden pressure, the clay particles rotate such that they orient parallel with the ground surface. This rotation results in a decrease in vertical thickness of the deposit. The thickness loss is irreversible and the resulting elevation loss is permanent. However, land subsidence can be arrested with increased groundwater levels.

In Santa Clara Valley, extractions since the turn of the century resulted in lowering of groundwater levels as much as 200 feet (-160 below sea-level). This lowering of water level resulted in as much as up to 12 feet of subsidence in some locations of the Santa Clara Valley. Subsidence in the Palo Alto area was between 2 and 4 feet. The amount of subsidence in a given area was a function of the amount of water level decline and the local geologic conditions. Areas with shallow bedrock experienced less subsidence than those areas underlain by sediments of substantial thickness.

The relationship between water levels, pumpage, imported water supply, and subsidence (as measured in San Jose, CA) is shown on Figure 8. As can be seen in this figure, subsidence generally correlates with periods of falling water levels. Currently, land subsidence has essentially stopped in the Santa Clara Valley as a result of the increased groundwater levels resulting from the use of alternative water supplies and basin management.

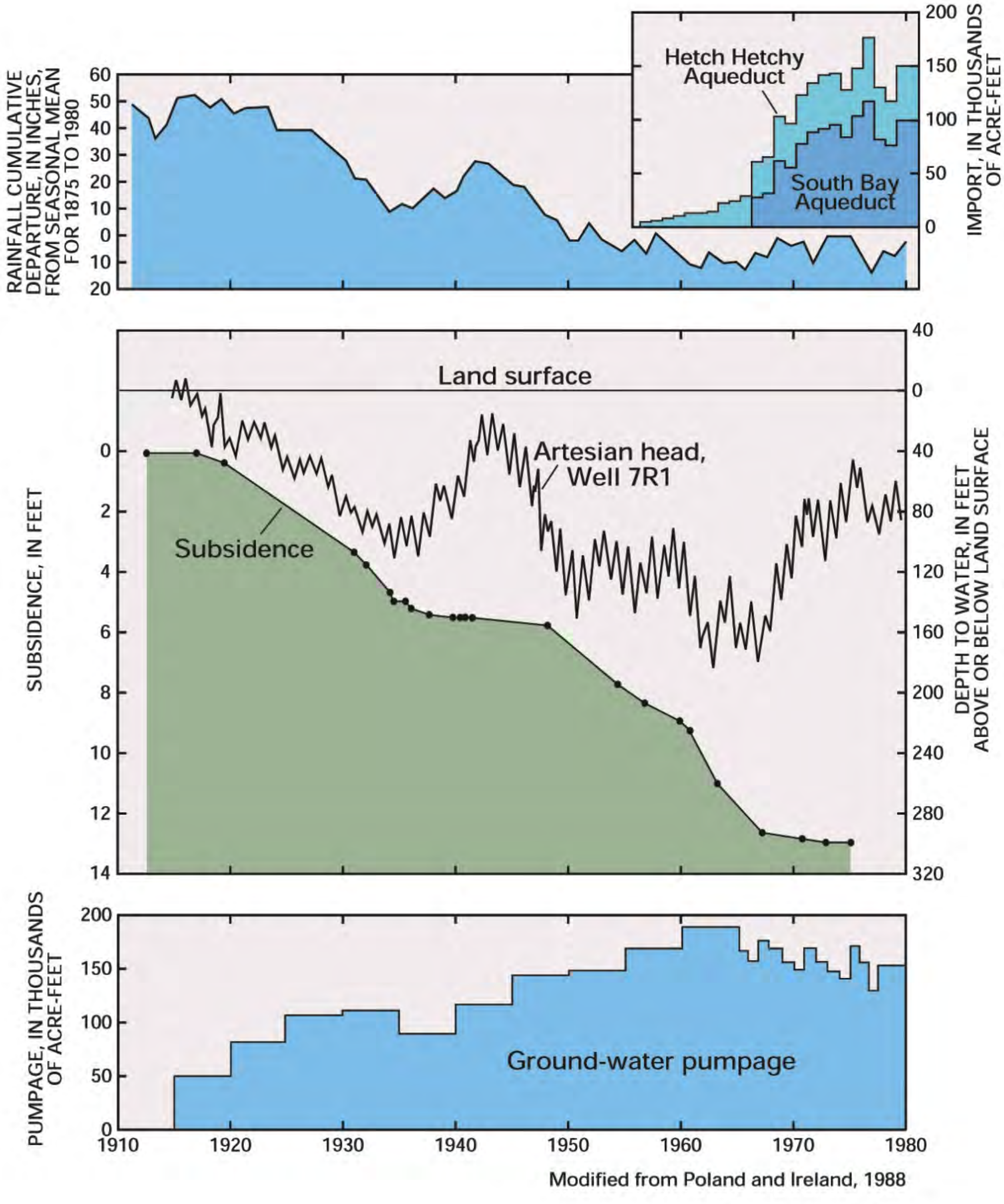


**Figure 8**
**HISTORICAL DATA ON WATER USE, SUPPLY, AND SUBSIDENCE IN SAN JOSE, CA**
**GROUNDWATER SUPPLY FEASIBILITY STUDY**
CITY OF PALO ALTO

Pa303f8-6589.cdr

As discussed above, the loss of elevation associated with subsidence is the result of the reorientation of clay minerals within clay deposits. The compaction of these deposits is essentially irreversible in that when water levels subsequently rise, the clay minerals do not return to their original orientation. However, since these materials are now compacted, the lowering of water levels does not result in significant further compaction. If the City's wells were used at the capacity limits considered herein, the result would be a transient lowering of water levels to levels less than 25 percent of the historical lows. As such, use of the wells should not result in renewed subsidence.

There was no data collection focused on subsidence in the Palo Alto area during the last use of the wells (in 1988 and in 1991). The closest subsidence measurement station maintained by the SCVWD is approximately 10 miles to the south of Palo Alto. However, there are no known anecdotal reports of property damage from renewed subsidence in the Palo Alto area during this period of well use.

## 6.2 Saltwater Intrusion

The movement of saltwater into freshwater aquifers is called saltwater intrusion. Under natural conditions, groundwater flows from areas of recharge on the land to areas of discharge; in coastal areas these are commonly the ocean or the bay. If groundwater extractions result in on-land water level elevations below sea-level, groundwater flow directions reverse and seawater moves from the ocean into coastal aquifers. Although the most common mechanism of seawater intrusion is the lateral movement of seawater through the offshore exposure of the aquifer, seawater intrusion can also occur vertically where depressed water levels in underlying aquifers induce flow from overlying water bodies into the aquifer. If the overlying water body is saline this also results in a type of seawater intrusion. This vertical movement of seawater is often distinguished from lateral movement of seawater by the designation of seawater infiltration.

The coastal portion of the Santa Clara Valley aquifer system has historically been impacted by both seawater intrusion and seawater infiltration. Groundwater extractions in the Santa Clara Valley from the turn of the last century until the 1970s resulted in the maintenance of groundwater elevations that were chronically and increasingly below sea-level. As previously mentioned water surface elevations in the Palo Alto dropped at as much as 140 feet below sea-level. This resulted in the on-land movement of seawater from the Bay and in many areas the vertical movement of seawater from Bayland ponds used for salt harvesting and aquaculture. The rate of intrusion/infiltration is governed by the magnitude of the gradient: the steeper the gradient, the more rapid the movement of water through the aquifer. Seawater intrusion and infiltration has been arrested as the result of reduced groundwater extractions, water importation and basin management efforts.

While currently arrested, seawater intrusion could be reactivated if water levels were again chronically below sea-level. However, because groundwater moves very slowly, the short-term occurrence of below sea-level water levels, while briefly reversing the flow direction, results in little actual transport of saline groundwater. What transfer does occur, is reversed when flow directions return to normal. This would be the case for either the emergency supply operation for which the wells are currently permitted, or the possible drought supply that is discussed herein.

## 6.3 Contaminant Plume Migration

Groundwater extraction modifies its natural flow direction. In the vicinity of an extraction well, groundwater flow directions are altered both vertically and horizontally resulting in the production of water from the well. Water produced from the well derives from a recharge area surrounding the well, the size and shape of this recharge area being a function of the hydrogeology and well design. This recharge area is commonly referred to as a capture zone of the well.

If there are sources of contamination within the capture zone of a well, the well can become contaminated. Within an urbanized setting, the potential sources of groundwater contamination are limited to contamination associated with industrial and commercial land uses. Predominantly this is in the form of leaky underground storage tanks. This would include gas stations, industrial solvents from manufacturing or research, and dry cleaners.

As part of the 1999 Study, all sources of contamination known by regulatory agencies were reviewed to determine the risk to City's existing wells and proposed new well sites. This review revealed very few contamination sites in the areas surrounding the existing and proposed well sites. Most of the existing contamination is in the more industrial portions of the City – those portions west and south of the downtown area. Fortuitously, these areas are not the areas of the City with the most favorable hydrogeologic characteristics for water supply wells.

The only identified contaminated sources in the area near the existing or proposed wells were the Shell gas station on Alma Street and the City of Palo Alto Fire Station. These locations are proximate to the proposed El Camino Well, and they both had leaky underground gasoline storage tanks. Both sites have been cleaned up and closed by the Regional Water Quality Control Board.

The use of the wells at the capacity limits considered herein will temporarily modify groundwater flow patterns in the vicinity of the wells creating the potential for capture of contaminate plumes. However, based on available records there are no known contaminate plumes within the capture zones of the City's existing or proposed wells.

## 7.0 SUMMARY

Once refurbished, the City's five existing wells and the three proposed new wells will provide an excellent standby water source to be used during water supply emergencies such as a shutdown of the SFPUC system. If the Palo Alto City Council decided to use the wells during droughts or as supplemental sources to be used in conjunction with the SFPUC supply, the wells could also provide added benefits in terms of enhancing the reliability and redundancy of the City's water supply. Any regular use considered in the future, however, should not exceed the reliable capacity of the groundwater basin to avoid such negative environmental consequences such as subsidence, saltwater intrusion, and contaminant migration.

Groundwater pumping and water level data for the last 50 years were analyzed to help evaluate the basin's response to pumping. It should be noted that the data collection and analysis is too limited to draw firm conclusions regarding the reliable basin capacity or sustainable yield that the City may be able to pump on an active basis. In addition, these values could only be derived after analyzing and accounting for natural recharge patterns and the pumping plans of the City's neighboring utilities. To provide an initial analysis on issues related to other-than-emergency use of the wells, however, the following may be inferred from the data analysis presented herein:

- Water levels in the Palo Alto area have returned to almost predevelopment levels. Essentially, the groundwater basin in the Palo Alto area is full.
- Depending on the method, estimates of average annual recharge to the basin are between 38 and 3,800 acre-feet. A conservative year-to-year value is likely on the order of 500 AFA.
- Data from 1988 pumping provides an example from which to appraise groundwater extraction concepts. 1,500 acre-feet were extracted with limited impact. Water level impacts were short-lived and water levels returned to pre-pumping levels within 18 months. If pumping were performed during a non-drought period, the drawdown would likely be less. These values should be revisited through an aquifer test performed following the City's well construction and rehabilitation efforts.
- Utilizing the data from the 1988 pumping, the extraction of 1,000 acre-feet from the Palo Alto area will result in basin-wide water level declines on the order of 15 feet. Historical experience suggests that depending on climatic conditions, the basin will recover to pre-pumping levels within a year or so. It is expected that the water level would decline approximately 25 feet if the City were to extract 1,500 acre-feet in one year. This decline, however, is not likely to induce significant detrimental environmental impacts since it is much less than the historical drawdown levels and is transient in duration.

- Occasional depletion of storage resulting from extractions in excess of annual average recharge appears to have minimal adverse impacts.
- Seasonal fluctuations in water level record from Hale and Rinconada wells show that Palo Alto's pumpage does not occur autonomously. Palo Alto's water level appears to be impacted by pumpers outside of SCVWD jurisdiction, possibly Menlo Park and East Palo Alto. Under drought conditions, impacts of all local pumpers will be superimposed on water level conditions.

The limited analysis suggests that sustained year-to-year extractions of approximately 500 AFA may be possible with negligible water level decline. The actual extraction value would be dependent on the location and depth of the well, how many wells were being operated, and the extent at which neighboring utilities were operating their wells and climatic conditions. If extractions were periodic, as in response to drought or delivery reductions, extractions of 1,500 AFA are possible provided this use is short-lived (one year every three or so years) and the basin is allowed to recover after this use.

These estimates were based on the best available data and on general knowledge of groundwater basin behavior. However, the data was limited, as the basin has not been actively pumped since 1963. When more information becomes available both from developing the City's wells for emergency use and from data collected from the SCVWD's monitoring well, these estimates will be re-examined.

The level of well use described above is not expected to result in reinitiation of subsidence or seawater intrusion or the movement of contaminate plumes for the following reasons:

- Reinitiation of significant subsidence would require the dewatering of sediments not dewatered as part of the water level declines of the last century. This would require water level declines of more than 140 feet. As proposed the operation of the wells would result in short term water level declines of between 20 and 30 feet, and dewatering of previously dewatered and compacted sediments.
- The year-to-year 500 AFA extraction is intended to not lower groundwater levels substantially, which would preserve the natural groundwater flow direction and prevent saltwater intrusion. The periodic 1,500 AFA well use described above would result in transient occurrence of water levels below sea-level. While water level below sea-level will reverse the seaward gradient, the slow travel time of groundwater provides a buffer from seawater intrusion for transient use.
- Operation of the wells would result in temporary disruption of natural flow directions and could effect movement of contaminate plumes. However, no known contaminate plumes exist proximate to the existing or proposed wells sites.