City of Palo Alto (ID # 7633)

City Council Staff Report

Report Type: Action Items **Meeting Date: 3/7/2017**

Summary Title: Direct Staff to Take Further Action to Minimize Basement Construction Pumping of Groundwater

Title: Adoption of an Ordinance Amending Chapter 16.28 of the Municipal Code to Require Testing, Monitoring and Protective Measures for Temporary Construction-Related Dewatering and Consideration of Recommendations From Policy and Services Committee to Direct Staff to Analyze Additional Measures to Minimize Construction-Related Groundwater Pumping

From: City Manager

Lead Department: Public Works

Recommendation

At their December 14, 2016 meeting, the Policy and Services Committee recommended that Council:

1. Adopt seven new components for the City's Construction Dewatering Guidelines. Staff is further recommending that Council adopt an ordinance codifying the Dewatering Guidelines, with the updates recommended by Policy and Services, in the Municipal Code at Chapter 16.28 (Attachment A).

2. Direct staff to consider four additional requirements and return to Council for adoption, with a goal of making the new requirements applicable for the 2018 construction season (Attachment B).

Executive Summary

Policy and Services Committee endorsed staff recommendations being forwarded to Council regarding the Construction Dewatering Program approved by Council in February 2016 including enhancements occurring in two phases; the first applied to the 2017 construction season and the second to 2018.

The 2017 enhancements would include improving fill station performance, ensuring watering of adjacent neighboring vegetation, monitoring actual groundwater elevation changes, clarifying reporting, and enhancing the Hydrogeological Study, while adding an exemption to the Study if cut-off wall technology is used to limit groundwater pumping. Staff recommends the current program with proposed 2017 additions be implemented, and that the attached ordinance (Attachment A) be adopted.

The second phase would potentially contain additional enhancements, subject to further analysis. Staff will return to Council to authorize these enhancements, with a goal of making them applicable for the 2018 construction season (Attachment B).

Staff recommended two additional requirements for 2018 that the Policy and Services Committee did not recommend that Council pursue. These are development of an additional pumping fee and a requirement to analyze the impacts of multiple pumping sites operating at once.

Of the four new requirements being recommended to Council for further evaluation, the most impactful is cut-off walls (or similar advanced technologies) be considered as a requirement in 2018 and a maximum of 30 gallons per minute (gpm) as a performance standard.

Background

Council approved construction groundwater pumping requirements in February 2016 for the 2016 construction season (Attachment A: CMR 6478). The requirements apply to sites not having either their Conditions of Approval from the Planning Department, or their building permit from Development Services by February 16, 2016. These requirements were incorporated into the planning and building permit process on a pilot basis for the 2016 construction season. Staff was to evaluate the results of the pilot and return to Council with a proposed ordinance codifying specific requirements.

At the same time, Council directed staff to continue working with Santa Clara Valley Water District to further understand the North County groundwater systems and provide an update. That update was provided in April 2016 (Attachment C: CMR 6700).

Discussion
In reviewing the results and experiences of the 2016 pilot, staff found:

1. There were eight residential basement construction sites which required pumping to the storm drain system. The total water pumped from all sites was 140 million gallons (MG). As a point of comparison, the City of Palo Alto uses about 8 MG per day. The City required that pumping be completed in 10 weeks and not extend beyond October 31. The average duration of pumping was 10.8 weeks. Based on this data and discussions with stakeholders, it appears the 10-week time frame is more generally achievable if a two week start-up period is added ahead of the 10-week period.

2. Three of the sites were required to submit a Geotechnical Study and draw conclusions about potential impacts. The other sites received their Conditions of Approval or building permits before February 16, 2016, and did not have to perform this study. Generally, the studies that were done predicted lower flow rates than occurred. The calculations were not well supported and readily verifiable. Community members submitted comments and observations suggesting the very low groundwater drawdown levels predicted may have been substantially exceeded.

3. Some neighbors and truckers complained water flow rates from the fill stations were inadequate. This can be remedied by requiring performance tests prior to full start-up and storage tanks being configured so they are always at least one-half full.

4. Recorded flow monitoring was spotty and prone to error. The City's reporting requirements need to be strengthened and include accuracy checks for meters.

5. Some of the flow meters were placed without sufficient attention to safety, and safety measures need improvement.

Based on analysis of the pilot results, input from stakeholders and previous direction from Council, staff is recommending modifications to the dewatering requirements in two phases. The first phase is making relatively minor changes to the requirements adopted by Council for the 2016 construction season. Proposed changes 1 through 3 below (and the pre-existing requirements) would apply to all sites in the 2017 construction season. Proposed changes 4 through 7 would apply to those sites not having a building permit or Planning Conditions of Approval before the effective date of the attached ordinance. The second phase would be implemented after further analysis and return to Council, with a goal of being effective the 2018 construction season. The two phases are described below:

First Phase: Proposed changes for the 2017 Construction Season

1. Fill Stations: Demonstrate a maximum 10-minute truck fill time and 2 simultaneous, 100’ hose, 10 gallons per minute (gpm) deliveries (for each hose) during the two week start up period defined below. Design the tank system so that the storage tank is always at least one-half full. Ongoing metering of instantaneous and total flow of fill stations is currently required.

2. Pump for no more than 10 weeks for residential sites. A two week start-up period ahead of the 10 weeks is allowed. At the end of the two week start-up period, compliance with all performance standards and water quality standards shall be demonstrated.

3. Report on all measurements and requirements (reports due at the end of the two-week start-up period, then bi-weekly, and then a final report at the end of pumping).

4. At the basement slab center, pump the groundwater down no deeper than 3 feet below the depth of the slab, following the two week start-up period. Once the slab is poured, the depth to the center of the slab shall be 1 foot.

5. Offer to water trees/plants on adjacent properties and do so if requested.

6. The City will add supplemental city contract resources to manage information, review submittals, verify compliance and prepare public reports; and add those costs to city permit fees (this will average to approximately $10,000 per site).

7. Geotechnical Study Enhancements
   a) Currently a Geotechnical Study is required to determine groundwater drawdown levels and any associated impacts. The key change for CY 2017 is to require verification of the anticipated drawdown curve with a pump test using actual wells, by the end of the two week start-up period. Cone Penetrometer Tests (CPT) is also encouraged to verify soils data. The actual pumping rates, following the two week start-up period, shall be limited to the rates used in in the verification. The maximum amount of water pumped over the 10-week period, (excluding the 2 week start- up period) shall be limited to that calculated during verification. This activity will add on the order of $10,000 to the construction cost of a basement (separate from the additional $10,000 permit fee described in #6 above).
   b) To support the work in (a) above, measure the ground water level at a distance representative of the distance to the nearest structure on an adjacent parcel, or farthest feasible point on the subject site. This monitoring shall be daily for the first week (including the two week start-up period), then weekly thereafter. If drawdown results are greater than anticipated by the Geotechnical Study, at the end of the 2 week start-up period or thereafter, submit a revised Geotechnical Study and any revised conclusions on impacts of the groundwater drawdown. The cost of this activity is largely covered by the cost of (a) above, but some additional cost will be incurred.
   c) Survey and mark land elevations on structures on adjacent parcels (assuming permission is obtained) prior to any pumping. This activity will not add significantly to construction costs, as survey measurements are routinely taken.
   d) The Geotechnical Study and verification shall not be required if the storm drain pumping is continuously limited to 30 gallons per minute (gpm) following the two week start-up period. This could be accomplished through installation of groundwater cut-off walls (such as secant walls) or similar construction techniques. (These optional activities would, if implemented, add significantly to the cost of constructing basements.) Similarly, the 10 week pumping period can be extended if the 30 gpm flow rate is continuously achieved following the two-week start-up period. The fee described in item 6, would also be lowered dramatically or eliminated. Additionally, the contractor need

only provide off-site hauling of water sufficient to meet the needs of adjacent neighbors, as opposed to the one-day per week requirement for 2016.

Second Phase: Potential Calendar Year (CY) 2018 Construction Season Changes, for further analysis by staff and return to Council:

1. Determine whether existing wells from other sites/purposes can be used to satisfy the groundwater monitoring requirements; utilize such existing wells if practical.
2. Limit the groundwater level drawdown at the closest off-site adjacent structure to 3'.
3. Determine whether existing wells can be used to satisfy the requirement in (b) above; if not, install a new monitoring well.
4. Potentially, require the use of groundwater cut-off walls, or other construction methods, which will limit the pumping (following a two week start-up period) to 30 gallons per minute (gpm).

Resource Impact

The City's review, monitoring, and approvals associated with program implementation of the suggested measures will require approximately $100,000 in contract services. If this approach is approved, Council will be asked to approve a budget amendment in the General Fund as well as an amendment to the Municipal Fee schedule to allow cost- recovery. If the 2017 changes are approved, staff estimates the cost of basement construction would increase by approximately $20,000 per site.

Environmental Review

The 2017 recommended program enhancements are minor modifications to an existing regulatory program designed to be protective of the environment. These modifications are not subject to the California Environmental Quality Act (CEQA) as there is no possibility the modifications may have a significant effect on the environment (CEQA Guidelines Section 15061(b)(3)).

The potential 2018 requirements will be evaluated and the appropriate environmental review prepared as specific proposals are developed.

Attachment A: 2017 Ordinance amending the Municipal Code by adding Amending Chapter 16.28
Attachment B: List of Additional Potential Requirements to be considered by Staff for 2018
Attachment C: February 1, 2016 CMR 6478
Attachment D: 2016 Pumping Requirements
Attachment E: April 11, 2016 CMR 6700

Attachments:

- Attachment A: Dewatering ORD Chapter 16.28 v2
- Attachment B: Second Phase Potential Calendar CY2018
- Attachment C: SR 6478 Approval of 2016 Basement Construction Dewatering Program Changes
- Attachment D: Guidelines for Dewatering During Below Ground Construction
- Attachment E: SR 6700 Update on Recycled Water Planning Efforts and Groundwater Studies
- Attachment F - Council letter 03-07-17 - Dewatering1
- Attachment G - Council letter 03-07-17 - Dewatering2

Ordinance No. ____

Ordinance of the Council of the City of Palo Alto Amending Chapter 16.28 of the Municipal Code to Require Testing, Monitoring and Protective Measures for Temporary Construction-Related Groundwater Pumping (Dewatering)

The Council of the City of Palo Alto does ORDAIN as follows:

SECTION 1. Findings and Declarations. The City Council finds and declares as follows:

A. Temporary pumping and discharge of groundwater during construction of below-ground basements and garages removes tens of millions of gallons of groundwater in Palo Alto each year, and discharges this water to the storm drain system.

B. For many years, Palo Alto has prohibited pumping of groundwater after the completion of basement construction.

C. In recent years, concerns have arisen regarding dewatering and its impacts, including significant waste of a community resource, potential damage to neighboring structures, trees and vegetation, and possible impacts on the groundwater system.

D. To begin to address these concerns and gather additional information for potential future action, the Palo Alto City Council adopts this ordinance requiring testing, monitoring and protective measures where temporary construction-related groundwater pumping (dewatering) will occur.

SECTION 2. Section 16.28.030 of Chapter 16.28 (Grading and Erosion and Sediment Control) of the Palo Alto Municipal Code is hereby amended to read as follows:

16.28.030 Definitions.

When used in this chapter, the following words shall have the meanings ascribed to them in this section.

(a) "Applicant" means any person, corporation, partnership, association of any type, public agency, or any other legal entity who submits an application to the building official for a permit pursuant to this chapter.

(b) "As-graded" means the surface conditions extant on completion of grading.

(c) "Bedrock" means in-place solid rock.

(d) "Bench" means a relatively level step excavated into earth material on which fill is to be placed.

(e) "Best management practices" means a technique or series of techniques which, when used in an erosion control plan, is proven to be effective in controlling construction-related runoff, erosion, and sedimentation.

(f) "Borrow" means earth material acquired from an off-site location for use in grading on a site.

(g) "Building official" means the chief building official of the city of Palo Alto and his/her duly authorized designees.

(h) "City engineer" means the city engineer of the city of Palo Alto and his/her duly authorized designees.

(i) "Civil engineer" means a professional engineer registered in the state of California to practice in the field of civil works.

(j) "Civil engineering" means the application of the knowledge of the forces of nature, principles of mechanics, and the properties of materials to the evaluation, design, and construction of civil works for the beneficial uses of mankind.

(k) "Compaction" means the densification of a fill by mechanical means.

(l) "Drainageway" means a natural or manmade channel which collects and intermittently or continuously conveys storm water runoff.

(m) "Earth material" means any rock, natural soil, or fill, and/or combination thereof.

(n) "Engineering geologist" means a geologist experienced and knowledgeable in engineering geology and certified by the state of California to practice engineering geology.

(o) "Engineering geology" means the application of geologic knowledge and principles in the investigation and evaluation of naturally occurring rock and soil for use in the design of civil works.

(p) "Erosion" means the wearing away of the ground surface as a result of the movement of wind, water, and/or ice.

(q) "Final erosion and sediment control and storm water pollution prevention plan ('final plan')" means a set of best management practices or equivalent measures designed to control surface runoff and erosion and to retain sediment on a particular site after all other planned final structures and permanent improvements have been erected or installed.

(r) "Grade" means the vertical location of the ground surface. "Existing grade" means the grade prior to grading. "Rough grade" means the stage at which the grade approximately conforms to the approved plan. "Finish grade" means the final grade of the site which conforms to the approved plan.

(s) "Grading" means any land disturbance or land fill, or combination thereof.

(t) "Interim erosion and sediment control and storm water pollution prevention plan ('interim plan')" means a set of best management practices or equivalent measures designed to control surface runoff and erosion and to retain sediment on a particular site during the period in which pre-construction and construction-related land disturbances, fills, and soil storage occur, and before final improvements are completed.

(u) "Key" means a designed compacted fill placed in a trench excavated in earth material beneath the toe of a proposed fill slope.

(v) "Land disturbance" or "land-disturbing activities" means any moving or removing by manual or mechanical means of the soil mantle or top six inches (6") of soil, whichever is shallower, including but not limited to excavations.

(w) "Land fill" means any human activity depositing soil or other earth materials.

(x) "Manual of standards" means a compilation of technical standards and design specifications published by the Association of Bay Area Governments.

(y) "Permittee" means the applicant in whose name a valid permit is duly issued pursuant to this chapter and his/her agents, employees, and others acting under his/her direction.

(z) "Sediment" means earth material deposited by water or wind.

(aa) "Site" means any lot or parcel of land, or contiguous combination under the same ownership where grading is performed or permitted.

(bb) "Slope" means an inclined ground surface, the inclination of which is expressed as a ratio of horizontal distance to vertical distance.

(cc) "Soil" means naturally occurring superficial deposits overlying bedrock.

(dd) "Soils engineer" means a professional civil engineer experienced and knowledgeable in the practice of soils engineering and licensed by the state of California for practice in that field.

(ee) "Soils engineering" means the application of the principles of soils mechanics in the investigation, evaluation, and design of civil works involving the use of earth materials and the inspection and/or testing of the construction thereof.

(ff) "Temporary construction-related dewatering" means temporary pumping of groundwater to facilitate construction of underground structures such as basements and garages.

(~~ff~~gg) "Wet season" means the period from October 1 to April 15.

SECTION 3. Section 16.28.060 of Chapter 16.28 (Grading and Erosion and Sediment Control) of the Palo Alto Municipal Code is hereby amended to read as follows:

16.28.060 Permit required.

No person may grade, fill, excavate, store, or dispose of soil and earth materials or perform any other land-disturbing or land-filling activity, or engage in temporary construction-related dewatering, without first obtaining a permit as set forth in this chapter, except when the activity is performed in accordance with one or more of the general or specific exemptions set forth in Sections 16.28.070 and 16.28.080. Exemption from the requirement to obtain a permit does not provide relief from the requirement to conduct all grading activities in conformance with the general grading requirements contained in Sections 16.28.270 through 16.28.340 of this chapter.

SECTION 4. Section 16.28.070 of Chapter 16.28 (Grading and Erosion and Sediment Control) of the Palo Alto Municipal Code is hereby amended to read as follows:

16.28.070 General exemptions.

All land-disturbing or land-filling activities or soil storage, and all temporary construction-related dewatering, shall be undertaken in a manner designed to minimize surface runoff, erosion, and sedimentation and to safeguard life, limb, property, and the public welfare. A person performing such activities need not apply for a permit pursuant to this chapter, if all the following criteria are met:

(a) The site upon which land area is to be disturbed or filled is 10,000 square feet or less, except where temporary construction-related dewatering will be required.

(b) Natural and finished slopes are flatter than 10:1.

(c) Volume of soil or earth materials stored is 100 cubic yards or less.

(d) Rainwater runoff is diverted, either during or after construction, from an area smaller than 5,000 square feet.

(e) An impervious surface, if any, of less than 5,000 square feet is created.

(f) No drainageway is blocked or has its storm water carrying capacities or characteristics modified.

(g) The activity does not take place within 100 feet by horizontal measurement from the top of the bank of a watercourse, the mean high watermark (line of vegetation) of a body of water or the boundary of the wetlands associated with a watercourse or water body, whichever distance is greater.

SECTION 5. Section 16.28.155 is hereby added to Chapter 16.28 (Grading and Erosion and Sediment Control) to read as follows:

16.28.155 Additional Requirements for Temporary Construction-Related Dewatering

(a) In addition to applicable requirements in this Chapter 16.28, where temporary construction-related dewatering will be required, applicants also shall:

(1) Submit a dewatering geotechnical study conforming to regulations issued by the City Engineer, adhere to its findings, and make modifications as directed by the City Engineer.

(2) Install and maintain at least one fill station meeting standards established by the City Engineer.

(3) With the consent of neighboring property owners, water trees and other vegetation on adjacent properties.

(4) Verify the anticipated drawdown curve in the dewatering geotechnical study with a pump test performed on monitoring wells installed on the project site, as specified by the City Engineer.

(5) Prior to pumping, survey and mark elevations on structures on adjacent parcels.

(6) Submit periodic measurements and reports as required by the City Engineer.

(7) Continuously comply with all permit conditions, performance measures, regulations and requirements established by the City Engineer. Promptly implement corrective actions identified by the City to address any compliance issues.

(b) Prior to pouring a basement slab, groundwater may be pumped no deeper than three feet below the depth of the slab, measured at the center. After the slab is poured, groundwater may be pumped no deeper than one foot below the center.

(c) Dewatering may not be conducted before April 1 or after October 31. Pumping permits for single family residential basements are limited to ten (10) weeks, with an additional two (2) week start-up period. At the end of the start-up period, the applicant must demonstrate compliance with all performance and water quality standards established by the City Engineer. The City Engineer may adopt a regulation specifying time limitations for commercial property pumping.

(d) The City Engineer is authorized to establish and from time to time revise regulations to implement this Section and advance the goals of minimizing temporary construction-related dewatering and reducing its impacts.

(e) Where pumping is continuously limited to no more than 30 gallons per minute, the City Engineer is authorized to waive requirements for a geotechnical study, verification procedures and pump time limitations.

SECTION 6. Severability. If any provision, clause, sentence or paragraph of this ordinance, or the application to any person or circumstances, shall be held invalid, such invalidity shall not affect the other provisions of this Ordinance which can be given effect without the invalid provision or application and, to this end, the provisions of this Ordinance are hereby declared to be severable.

SECTION 7. CEQA. The City Council finds and determines that this Ordinance is not a project within the meaning of section 15378 of the California Environmental Quality Act ("CEQA") because it has no potential for resulting in physical change in the environment, either directly or ultimately. In the event that this Ordinance is found to be a project under CEQA, it is subject to the CEQA exemption contained in CEQA Guidelines section 15061(b)(3) because it can be seen with certainty to have no possibility of a significant effect on the environment in that this Ordinance simply clarifies existing local regulations.

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SECTION 8. Effective Date. This ordinance shall be effective on the thirty-first date after the date of its adoption.

INTRODUCED:

PASSED:

AYES:

NOES:

ABSTENTIONS:

ABSENT:

ATTEST:	APPROVED:
______________________________	______________________________
City Clerk	Mayor
APPROVED AS TO FORM:	______________________________
	City Manager
______________________________	
City Attorney	______________________________
	Director of Public Works/ City Engineer

Attachment B

Construction Groundwater Pumping

Second Phase: Potential Calendar Year (CY) 2018 Construction Season Changes:

1. Determine whether existing wells from other sites/purposes can be used to satisfy the groundwater monitoring requirements; utilize such existing wells if practical.
2. Limit the groundwater level drawdown at the closest off-site adjacent structure to 3’.
3. Determine whether existing wells can be used to satisfy the requirement in (c) above; if not, install a new monitoring well.
4. Potentially, require the use of groundwater cut-off walls, or other construction methods, which will limit the pumping (following a two week start-up period) to 30 gallons per minute (gpm).

City of Palo Alto (ID # 6478)
City Council Staff Report

Report Type: Action Items **Meeting Date: 2/1/2016**

Summary Title: Approval of 2016 Basement Construction Dewatering Program Changes

Title: Approval of 2016 Basement Construction Dewatering Program Changes and Other Related Issues

From: City Manager

Lead Department: Public Works

Recommendation

Staff recommends that City Council approve the five "Group 1" basement construction dewatering program changes for the 2016 construction season listed below and provide staff direction for returning to the Policy and Services Committee with updates and discussion of other work items related to groundwater and basement construction dewatering issues. This is based on a unanimous recommendation from the Policy and Services Committee to forward the program changes to the full Council as an action item.

Executive Summary

The Policy and Services Committee discussed staff recommendations on investigating program enhancements for basement construction dewatering at its December 1 and 15, 2015 meetings (Attachment A: #6268 and #6450). The discussion items were organized into three groups: Group 1, a set of potential new requirements for the 2016 construction season which are being brought to the Council for approval with a goal of swift implementation; Group 2, ongoing and potential future work for gathering information about the groundwater basin; and Group 3, a list of additional (some big) ideas generated at the December 1, 2015 Policy and Services meeting. With respect to Group 3, staff will return to the Committee in the first half of 2016 with questions that should be considered part of a further discussion with the Committee about whether to recommend Council consideration and potential direction on any of these. The potential scope of the items could make this a major new initiative and will require careful assessment of the resources necessary to support them, in the context of other work priorities.

Staff has further refined the Group 1 items for approval. Staff is keeping new applicants advised of the concepts under consideration to avoid any surprises at the end of the permitting process. The Policy and Services Committee unanimously approved the Group 1 recommendations, but asked that they be an Action item for full Council, so that they could be discussed.

Background

Over the years, basement construction groundwater pumping has generated public concern in Palo Alto. The ongoing drought and mandated water restrictions this past summer escalated 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 effects on neighboring properties, such as subsidence and cracks, and effects on trees and other landscaping.

Basement construction is often required for non-residential, mixed use and multifamily residential buildings, particularly if underground parking is included in the proposal. 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). 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 City of Palo Alto has long regulated several aspects of basement groundwater pumping for both residential and commercial sites (see Attachment A for a detailed discussion). Additional correspondence received is attached (Attachment C).

Discussion

At the December 15, 2015 Policy and Services Committee meeting, Committee members voted unanimously to forward Group 1 items to Council for approval as soon as possible. Staff has further developed the Group 1 activities and is seeking approval of the following new requirements:

Group 1: New Basement Dewatering Submittal, Fill Station and Groundwater Use Requirements

1. Encourage greater fill station use through public outreach and enhanced signage. This is a contractor requirement and City activity and includes continuing to use door hangers, Neighborhood Preparedness Coordinators and the City's website.

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

3. Add additional requirements to Groundwater Use Plans that are already required for dewatering. These additional requirements include maximizing on-site water reuse (e.g. watering on-site and nearby vegetation), at least one day per week water truck hauling service for neighbor and City landscaping, and piping to nearby parks or major users where feasible.

4. Expand fill station specifications that must be implemented by contractors to address water pressure issues from multiple concurrent users, including separate pumps for neighbors where needed and sidewalk bridges for hoses to reduce tripping hazards. City inspectors will inspect fill stations to ensure compliance with specifications.

5. Require Grading Permit applicants anticipated to or encountering groundwater to submit a statement of the effects of the proposed groundwater pumping on nearby buildings, infrastructure, trees, or landscaping.

   Under Section 16.28 of the Palo Alto Municipal Code, the City Engineer is authorized to require augmentation of the Soils and Geotechnical Reports as part of the Grading Permit application. The statement of dewatering effects must be stamped by a California licensed Geotechnical Engineer and submitted to the City. This report will be made available for public review. The

Geotechnical Engineer is to be separate from and independent of the project's design engineer(s). The detailed requirements are described in Attachment B: Draft Basement Construction Dewatering Requirements, and in anticipation of the City Council's potential action, on January 14^{th} development project owners/applicants were notified of these pending requirements and advised to begin assembling the required information.

Staff recommends approval of these new requirements which will be incorporated into the planning and building permit process on a pilot basis for the 2016 construction season. Pending further experience with dewatering requirements and consultation with stakeholders, staff will evaluate returning to Council with a proposed ordinance codifying specific requirements and enforcement measures.

Group 2: Gathering of Groundwater Information and Plans by Palo Alto and its Partner Agencies

As discussed at the Policy and Services Committee, staff will continue working with the Santa Clara Valley Water District (Water District) in an already ongoing effort on developing a further understanding of the North County groundwater systems, impacts of groundwater pumping, and opportunities for enhanced groundwater recharge. A Water District key mission is to manage the County's groundwater; therefore, staff will collaborate closely with the Water District, and the new Council-level Recycled Water Committee. This collaboration may also include working with San Mateo County and its cities to ensure coordination with their development of a groundwater strategic plan. Council may also wish to refer review of this future work to the City's Utilities Advisory Commission.

Staff will provide an update on the work plan for this effort to the Policy and Services Committee in the first quarter of 2016.

Group 3: Further Ideas Brought Forward by Individual Policy & Services Committee Members

Individual Policy and Services Committee members articulated additional ideas and suggestions. Some of these ideas are multifaceted and complex, and will require sustained effort from staff and assistance from consultants over multiple years. The Committee and City Council will need to evaluate priorities and timelines, including the potential that significant new assignments may delay other projects currently underway. Staff will prepare a report for the Policy and Services Committee in the first half of 2016 to discuss these matters and the development of a *potential* recommendation to Council to direct additional work in one or more of these areas:

1. Charging for discharge of groundwater. The current fee for dewatering to the storm drain system is $80 per month. This effort would consider increased fees to charge for the use of the City's storm drain system and staff time to manage the dewatering requirements. Committee members suggested exploring whether the fee that the Santa Clara Valley Water District charges for groundwater pumping would be an appropriate baseline.

2. Developing dewatering requirements tailored to drought situation.

3. Developing approaches to ensure that multiple basement pumping is not happening in close proximity (distance and time), and instead is spaced out, essentially allowing only a limited number of basement construction dewatering in one area.

4. Addressing potential damage from dewatering through bonds or insurance.

5. Further study of all pumping activities in the City, including private wells, City Hall garage, Oregon Underpass and other underpasses.

6. Review of basement building and zoning code issues, including FAR adjustments for basements and not allowing two-story basements, or any basement, in areas with shallow groundwater. (Note: Staff's initial reaction is that utilizing zoning to implement these requirements may be quite difficult because groundwater depth can vary significantly from block to block)

7. Review of impacts of multiple basements on soil absorption and/or the creation of barriers to groundwater flow.

8. Investigation of costs of other construction methods that do not require

dewatering, or as much dewatering.

9. Investigate whether Palo Alto should assume a groundwater management leadership role for the North County area. (Including consideration of staff time and cost implications.)

10. In addition, Committee members were interested in how increased use of permeable surfaces may assist with groundwater recharge. (Note: City staff can provide an update on the new stormwater permit requirements for a Green Infrastructure Plan which will require more infiltration of stormwater into the ground rather than discharging it through storm drains via both public and private projects.)

Group 2 is part of an ongoing effort and the Committee and City Council will be updated periodically. Group 3 activities will be brought to the Committee /Council for discussion and direction to study them; staff is making no estimate on when they could be implemented.

Resource Impact

Testing and refining the suggested measures to improve the dewatering program or any other measures suggested by the Committee will require significant staff time that is currently allocated to other projects. For the homeowner, these measures may increase basement construction project costs.

As mentioned in earlier parts of this report, Group 1 recommendations have sent staff scurrying to develop final recommendations for action and are likely to require additional ordinance language to be created and brought back to the City Council for approval. Group 3 suggestions are varied and require thoughtful review and potentially large costs. In every case, consideration of our ability to fund and support or absorb the efforts will be required.

Environmental Review

The Group 1 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)). Group 3 requirements will be evaluated and appropriate environmental review prepared as specific proposals are developed.

Attachments:

- Attachment A - Policy and Services December Staff Reports(PDF)
- Attachment B - Construction Dewatering Study Requirements (DOCX)
- Attachment C - Correspondence (PDF)

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)

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
Steve Broadbent
David Stonestrom
John Northway
Bob Morris, Public Works

REVIEWED BY: Julie Caporgno, Chief Planning and Transportation Official

DEPARTMENT/DIVISION HEAD APPROVAL: Curtis Williams

Curtis Williams
Interim Director

Attachment A

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.

<u>Discharge Volume</u>

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

PREPARED BY: Bob Morris

BOB MORRIS
Senior Project Manager

DEPARTMENT HEAD: Gl S. Rbt

GLENN S. ROBERTS
Director of Public Works

CITY MANAGER APPROVAL:

STEVE EMSLIE/KELLY MORARIU
Deputy City Managers

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.

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

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

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.

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.

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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.

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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.

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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

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 $\geq$ \$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 $\geq$ 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 $\geq$ 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 $\geq$\$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;

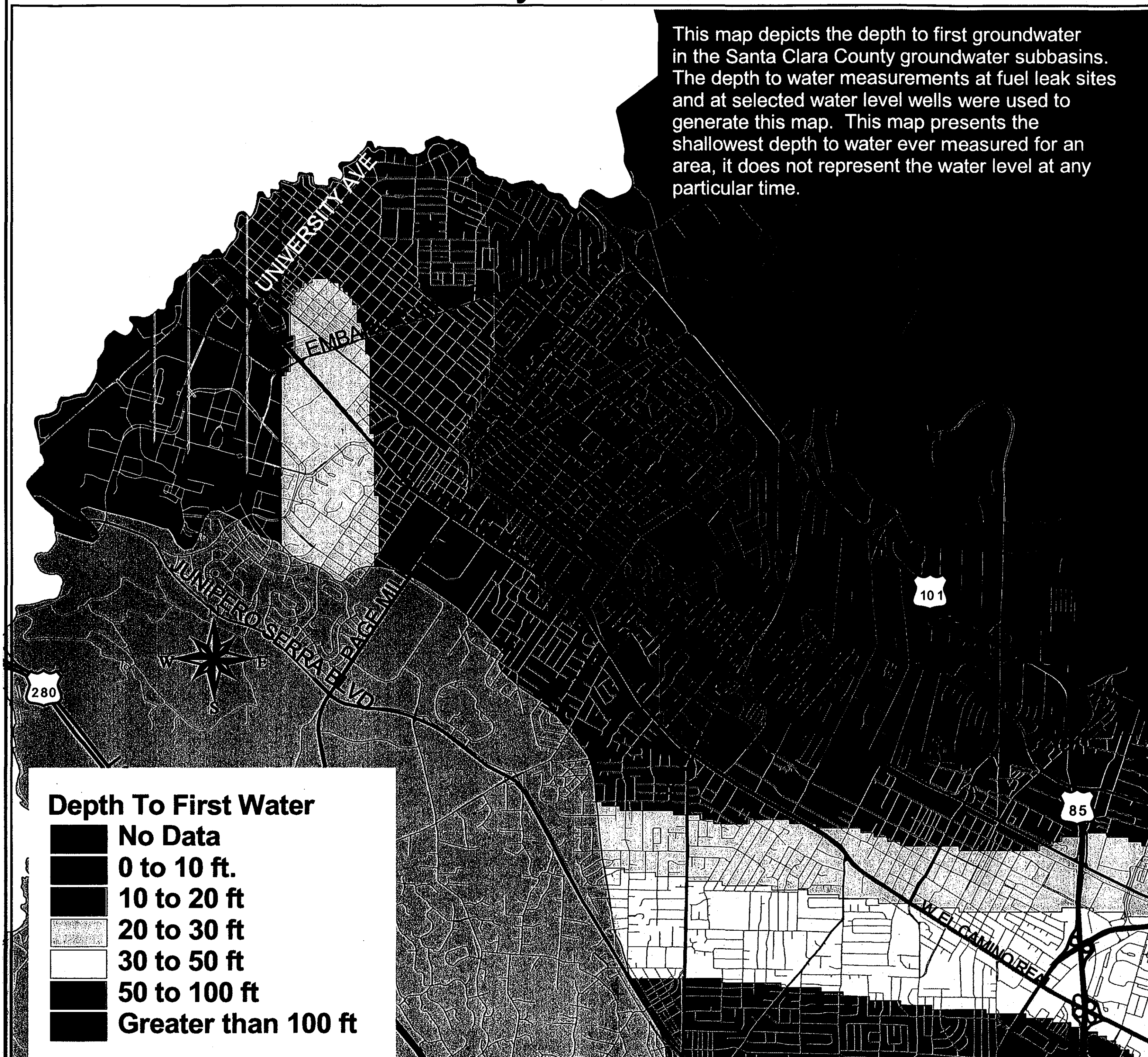
(B) all such areas combined do not exceed 2% of the area of the lot or 200 square feet, whichever is greater; that each such area does not exceed 200 square feet; and that each such area is separated from another by a distance of at least 10 feet. Area devoted to required stairway access shall not be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

ATTACHMENT J

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,

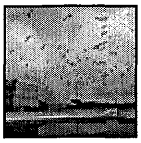
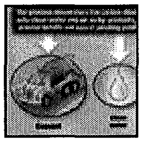
Jody Davidson

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

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

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

2015 MAY 26 AM 11:14
RECEIVED
MANAGER'S OFFICE

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

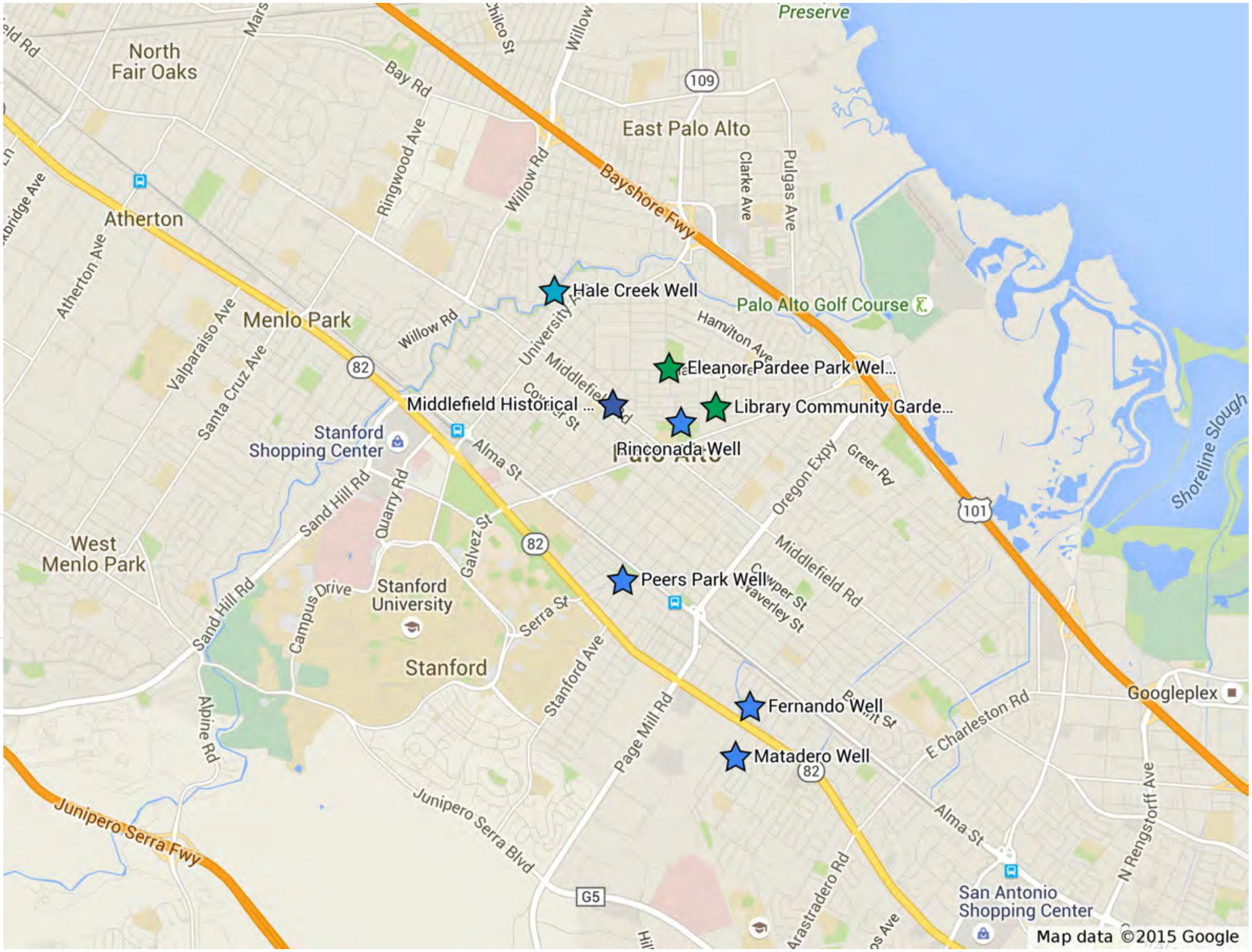
Basement dewatering sites

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.

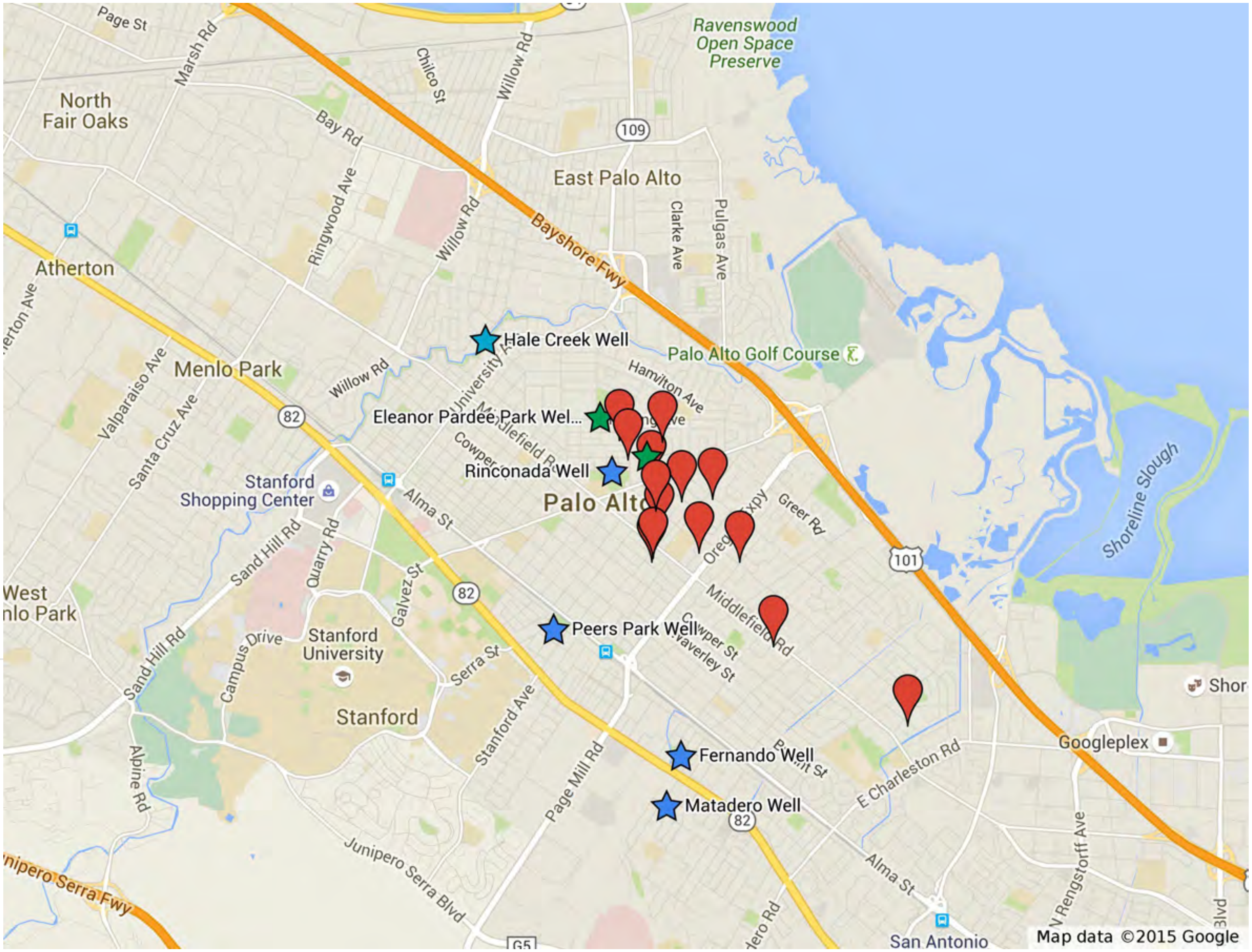
Map B: Dewatering_Map 2015

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

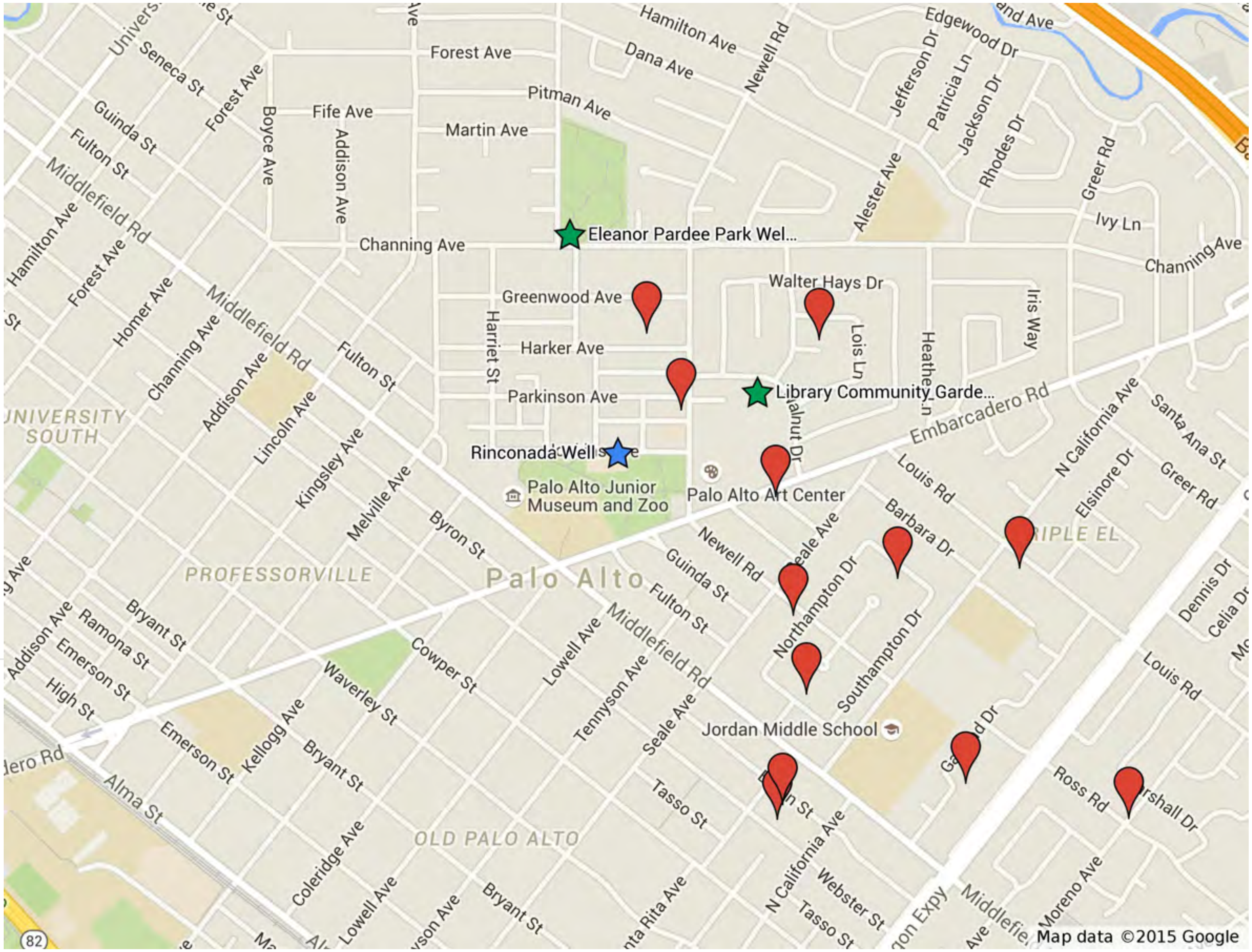
Map C: Dewatering_Map 2015 (Community center zoom)

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

COUNCIL MEETING
11/2/15
[ ] Placed Before Meeting
[ ] Received at Meeting

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 <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:
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 ERSTWILD 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 MINDELZUN	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 #

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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
Harry 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
Diana Lewiston	Diana Lewiston	1849 Newell Rd 94304

6

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.

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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 Stroheker		2076 Edgewood
e-mail (optional)		
SRIDHAR MANJUNATH EASWARAN		2088 EDGEWOOD
e-mail (optional)		
Louise Beattie		1445 Hamilton Ave 94301
e-mail (optional) LDBEATTIE@gmail.com		
Peter Ising		4010 Orme
e-mail (optional)		
[signature]		525 Homer Ave #1
e-mail (optional)		
LENORE CYMES		
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
	LINDA MENON	1972 Ivy Ln,
	ZAYOSKA	1465 Channing
	Hilary Jones	235 Walter Hays
	Nancy Yamada	1921 Edgewood Dr.
	SOPHIA ABRAMSON	1356 PITMAN AV
	Lucian Hugler	1930 Ivy Lane
	Stuart Beattie	1445 Hamilton
	YAFEI BI	1912 Edgewood Dr.
	James P. Marks	689 Wildwood Lane
	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 Southwo
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 <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.

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SIGNATURE:	PRINTED NAME:	ADDRESS:
[illegible]	X. O'REILLY	736 SOUTHAMPTON DR.
Cynthia Havn	CYNTHIA HAVSN	431 OXFORD AVE.
[illegible]	HERMAN GYR	930 KOBLE RIDGE
Julie Jerome	JULIE JEROME	726 GREER RD
[illegible]	Yoriko Kishimoto	251 Embarcadero Rd
Nancy McGaraghan	NANCY McGARAGHAN	200 COLERIDGE
[illegible]	Janine M. HODGSON	170 Parkside DR.
Shirley M. Finn	Shirley M. Finneran	850 Webster
Darel Hodgson	Darel Hodgson	170 Parkside
Leika Kejriwal	LEIKA KEJRIWAL	832 SOUTHAMPTON DR.
Peter Herrenhoff	Peter Herrenhoff	4180 Oak Hill Ave
[illegible]	Nathaniel Sterling	4180 Oak Hill

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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]	Marylynn	2194 Louis Rd
[illegible]	Richard Dundas	2194 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	482 HIGH St. #302 PA

16

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]	JUDITH STEINER	1515 COWPER ST.
[signature]	DAVID PETRUNE	2301 WEBSTER ST.

2

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.

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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.

2225 Webster

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.

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

1

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SIGNATURE:	PRINTED NAME:	ADDRESS:
Kay Bushnel	Kay Bushnel	775 Northampton Dr. Palo Alto

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.

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SIGNATURE:	PRINTED NAME:	ADDRESS:
Marla Rathbun	Marla Rathbun	740 Garland Dr.
K	Ken Broder	2060 Louis Rd.

2

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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 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:
Carl A Cimilluca	CARL CIMILLUCA	2176 Webster St. Palo Alto
[illegible]	Hanna Cooper	7561 N. California Ave.
Therese Sze	THERESE W. SZE	602 N. California Ave
S M Sze	SIMON M SZE	602 N. California "

4

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.

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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 J 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 Zh	Qiang Zheng	2250 Webster Street
Allen Zheng	Allen Zheng	2250 Webster
[illegible]	Austin Zheng	2250 Webster St
[illegible]	Linzi Qai	2250 Webster St.
[illegible]	Peter [illegible]	2302 Webster St
[illegible]	Amelia Wigton	2255 Webster Street.
Elise [illegible]	Elisa de Martel	2230 Webster St
[illegible]	Vincent de MARTEL	2230 Webster St

15

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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 Heckmann	2323 WEBSTER
[signature]	Bibiana Heckmann	2323 Webster

6

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.

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SIGNATURE:	PRINTED NAME:	ADDRESS:
[signature]	Franklin Schellenberg	4023 Villa Vista Palo Alto, CA

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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

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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.

7

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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.
[illegible]	Pete Fukuhara	2344 Webster St.
[illegible]	Phil Shpilberg	2353 Webster
W. H. Benz	William H. Benz	2360 Webster
[illegible]	Sandra Shpilberg	2353 Webster.
Gertrude Reagan	GERTRUDE REAGAN	967 Moreno
Jack Morton	JOHN D MORTON	2343 WEBSTER ST.
Margaret O'Reilly	MARGARET O'REILLY	736 SOUTHAMPTON DR
J. O'Reilly	JACK O'REILLY	736 SOUTHAMPTON DR
Mahlon Hubenthal	MAHLON HUBENTHAL	1228 Byron St
Carol Hubenthal	CAROL HUBENTHAL	1228 Byron St.

18

Residents for Responsible Use of Groundwater,

a Community Resource

We hereby request that the City of Palo Alto impose an <u>immediate moratorium</u> on <u>new permits</u> 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 <u>hold a public hearing</u> 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	777 San Antonio #83
E-mail (optional) pl-the@comcast.net		
Jerry Holzeman		
holz@sonic.net		
Richard Willits	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)

1

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:
H.R. Davidson	H.R. Davidson	2527 Webster Street Palo Alto 94301

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:
	PETER O'RIORDAN	1032 HARKER AVE
	DIANA DARCY	1032 HARKER AVE

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.

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SIGNATURE:	PRINTED NAME:	ADDRESS:
Dan Mahoney	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 <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.

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SIGNATURE:	PRINTED NAME:	ADDRESS:
Sylvia J Gartner	Sylvia Gartner	824 Moreno Palo Alto 94303

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	
e-mail (optional)		
e-mail (optional)		
e-mail (optional)		
e-mail (optional)		
e-mail (optional)		
e-mail (optional)		
e-mail (optional)		

1

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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Figure 8 Historical Data on Water Use, Supply, and Subsidence in San Jose, CA 17

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.

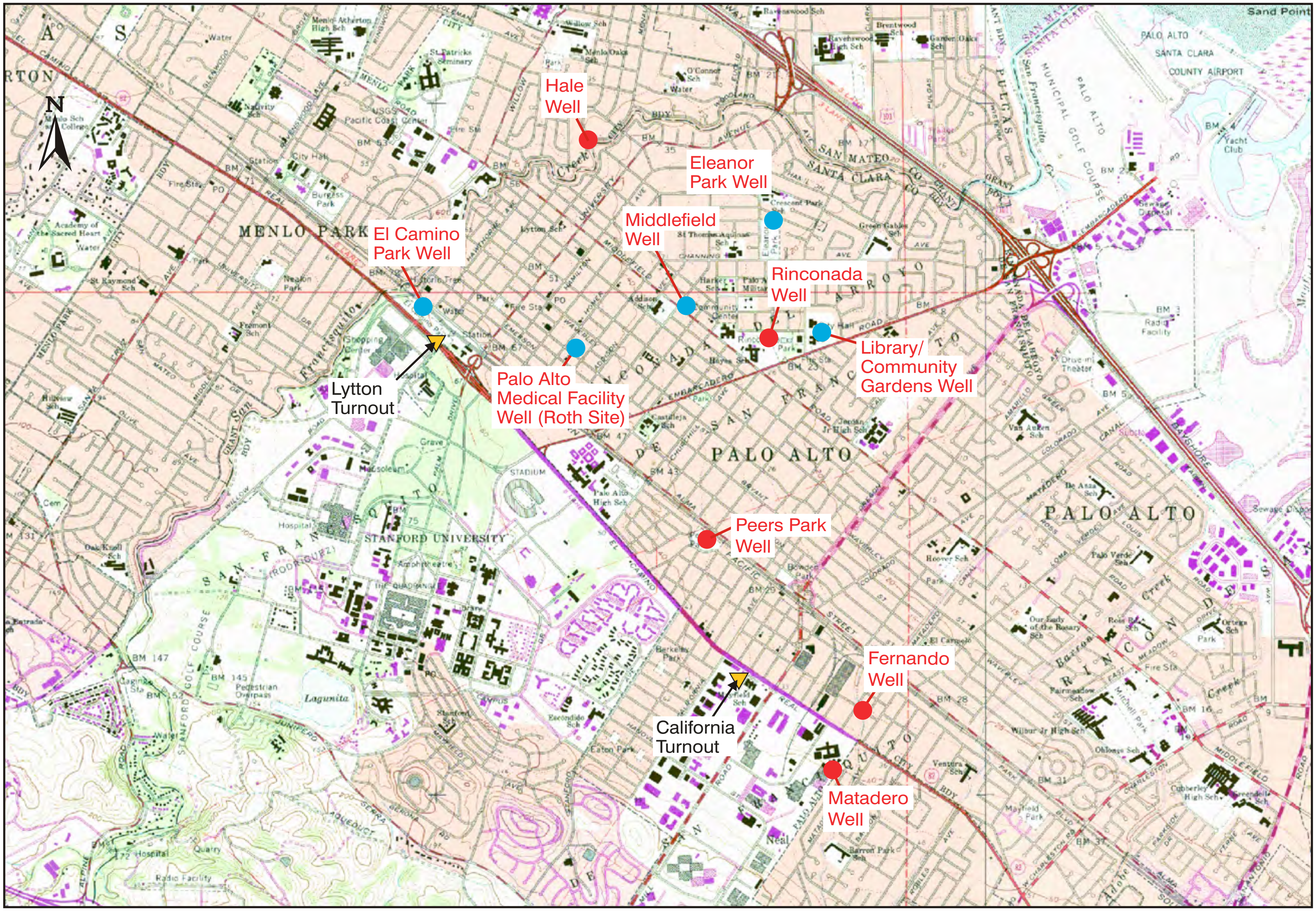
The overall water CIP has been reviewed and approved by both the Utilities Advisory Commission and the Palo Alto City Council. Funds for the improvements are included in the five-year Water Capital Improvement Program Budget.

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

[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).

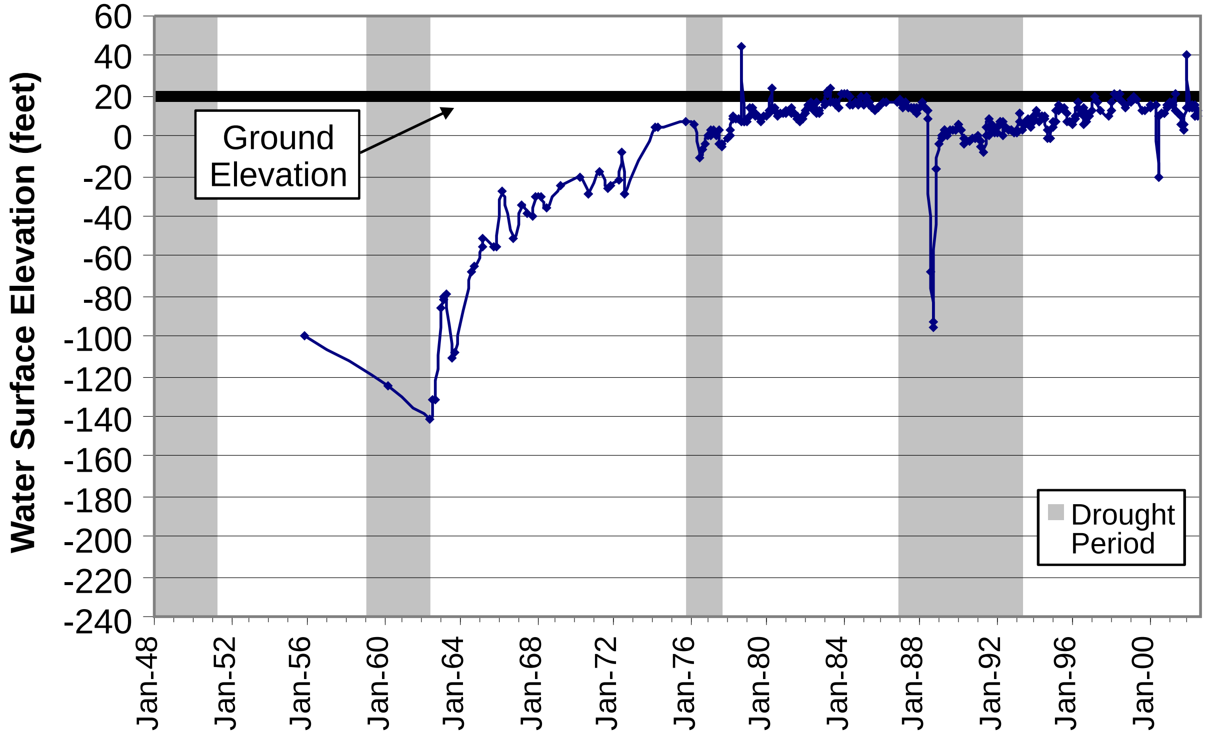
Customer acceptability, however, may require the City to install sufficient treatment at the wells to be used for drought or active supply such that the water quality is increased significantly or made comparable to the SFPUC water. This issue was covered in the City’s “Long-Term Water Supply Study”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



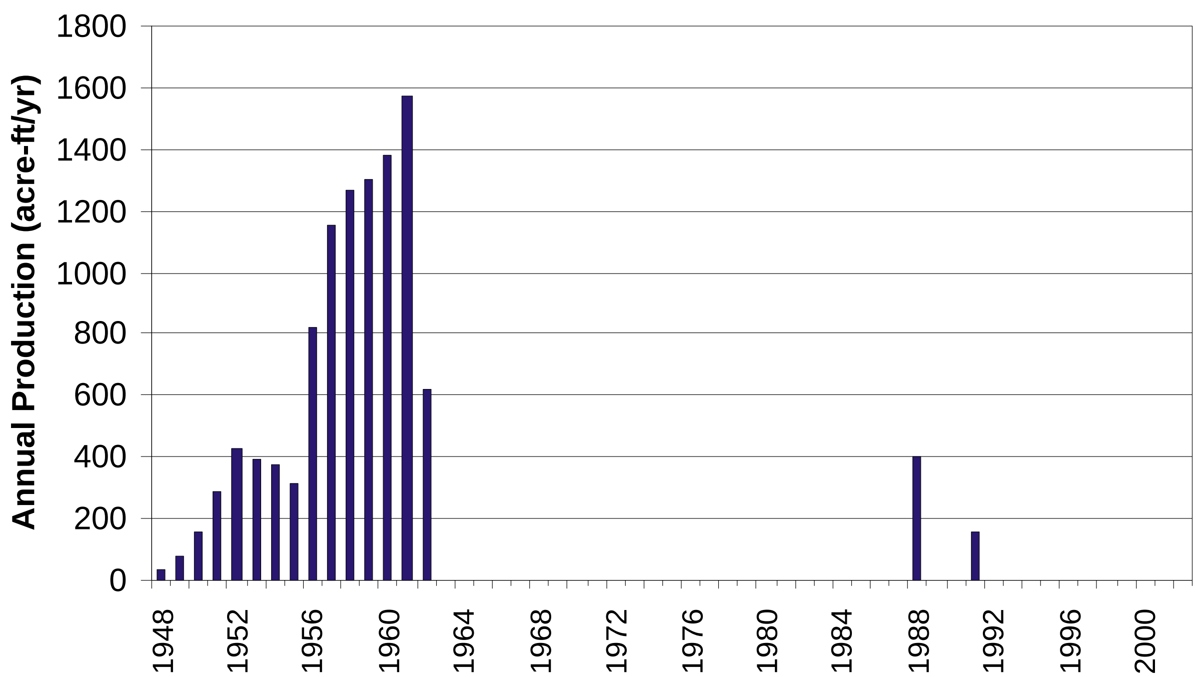


Figure 2
HALE WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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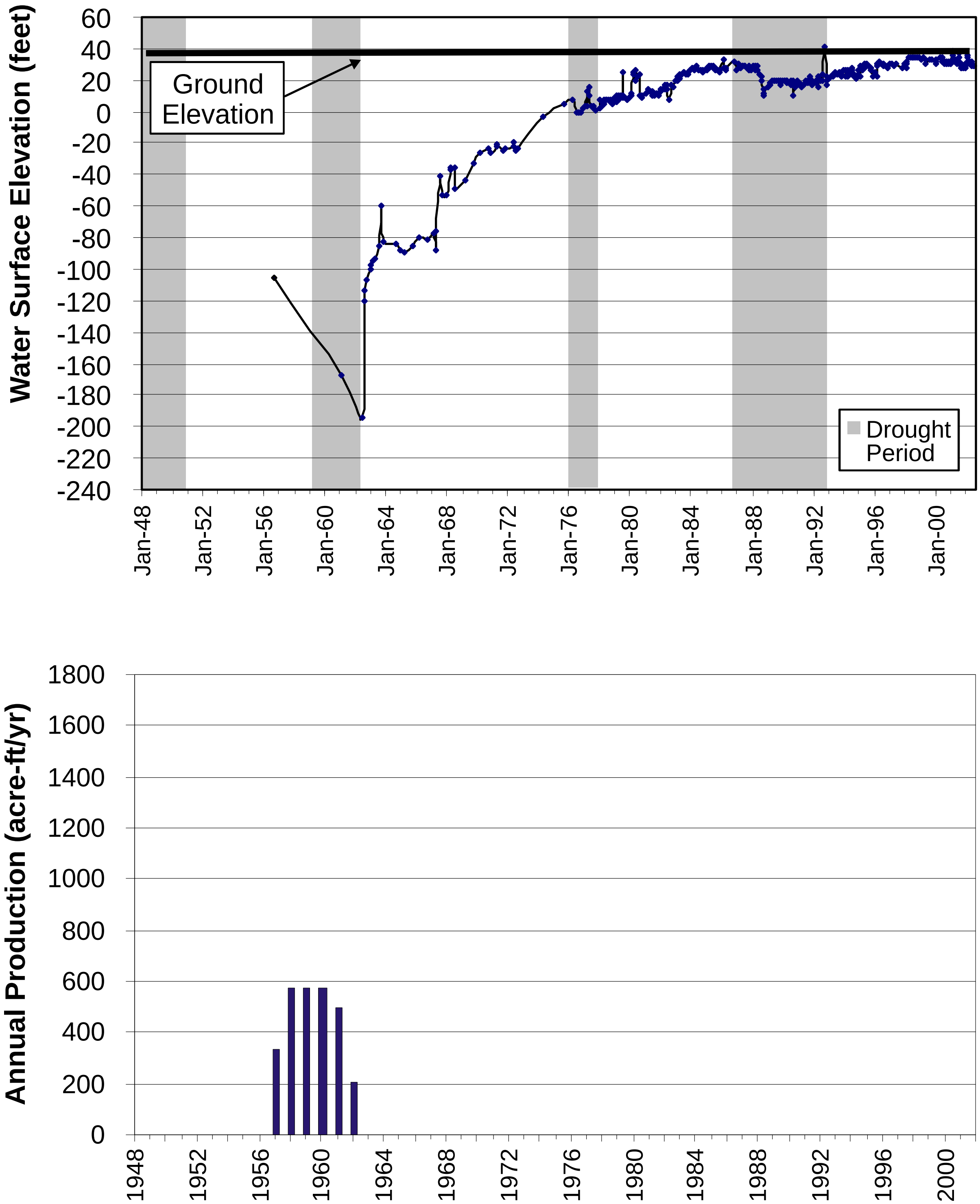
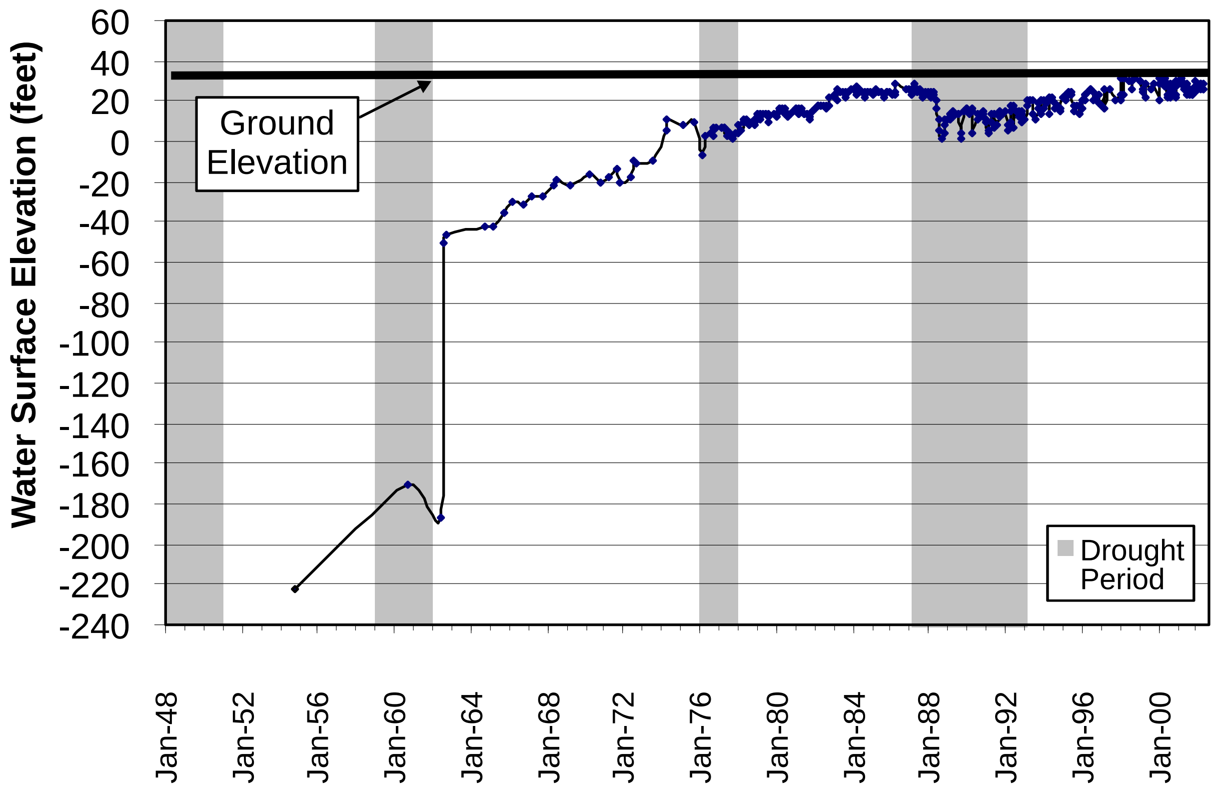


Figure 3
MATADERO WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO



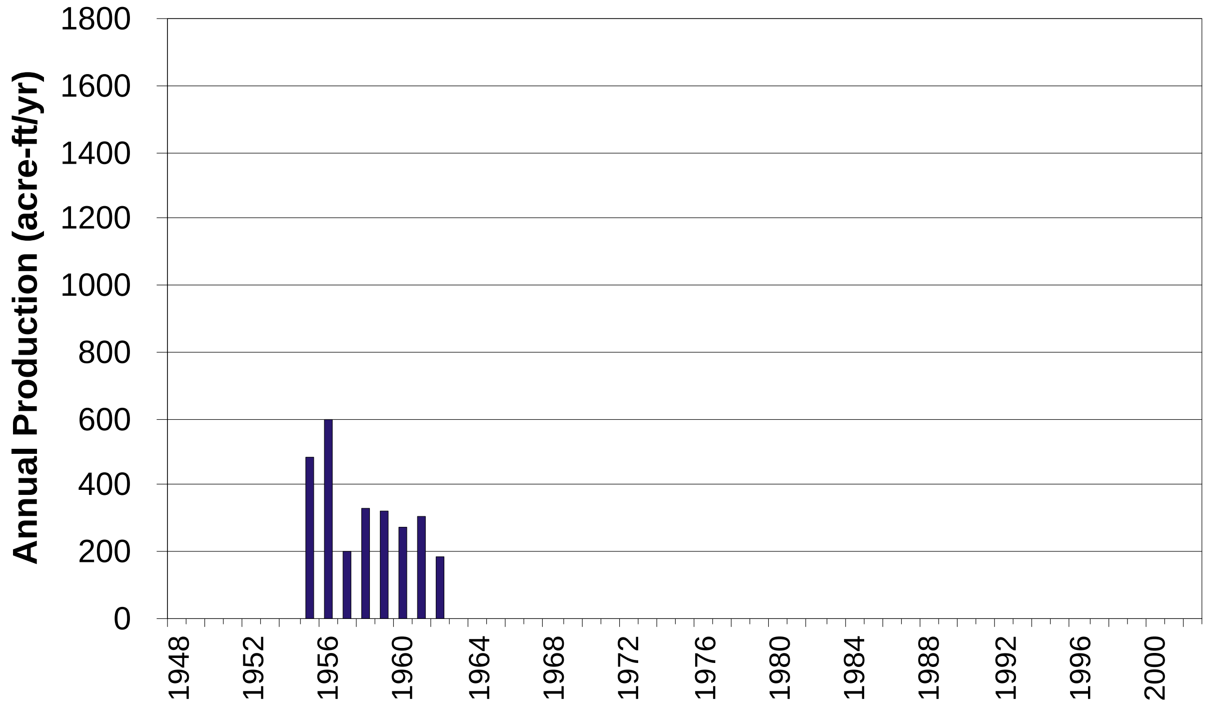
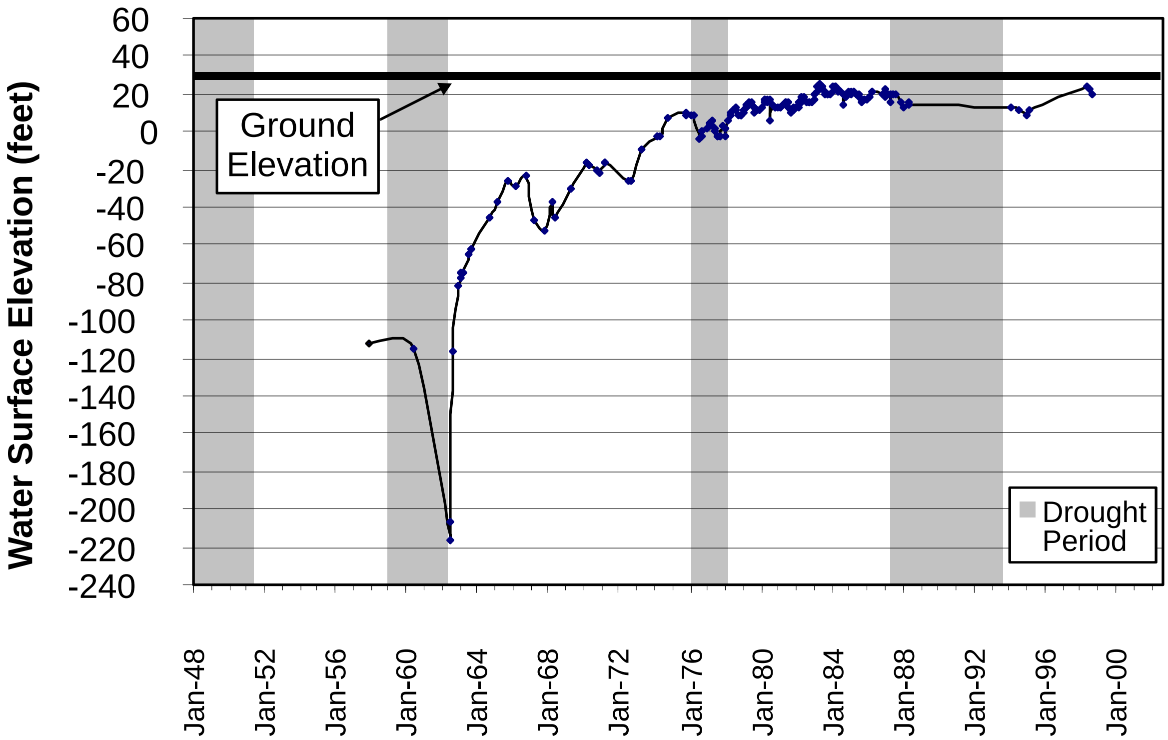


Figure 4
FERNANDO WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO



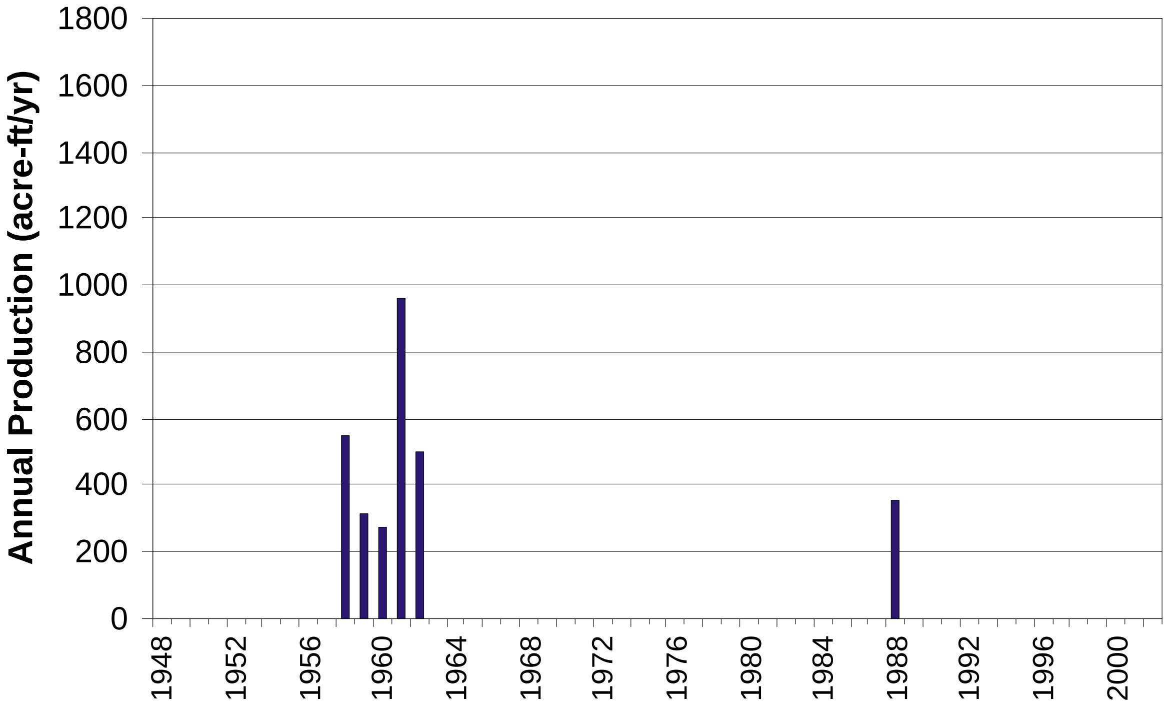


Figure 5
PEERS PARK WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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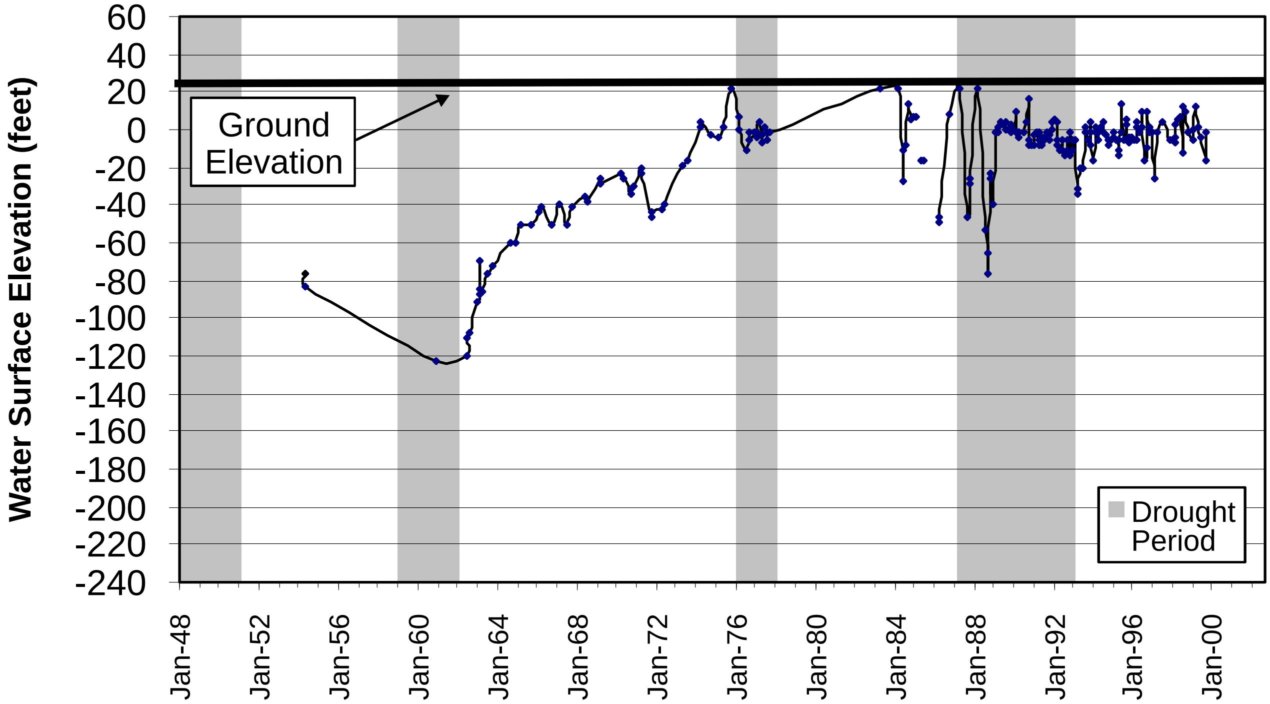

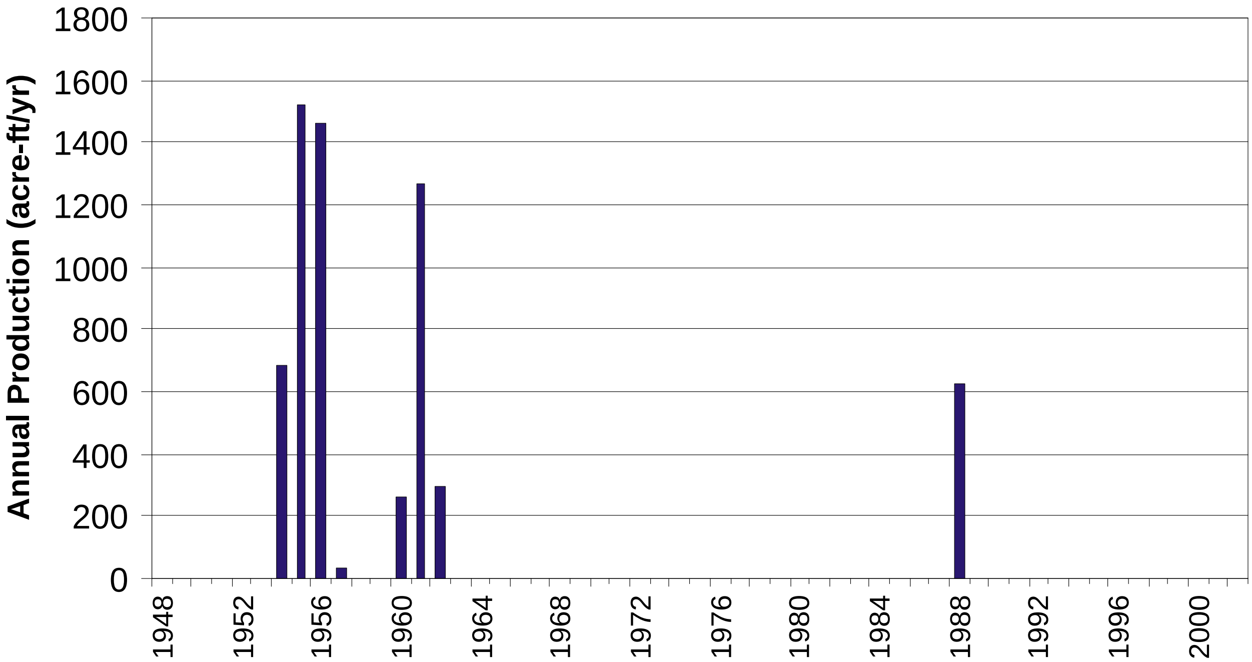

Figure 6
RINCONADA WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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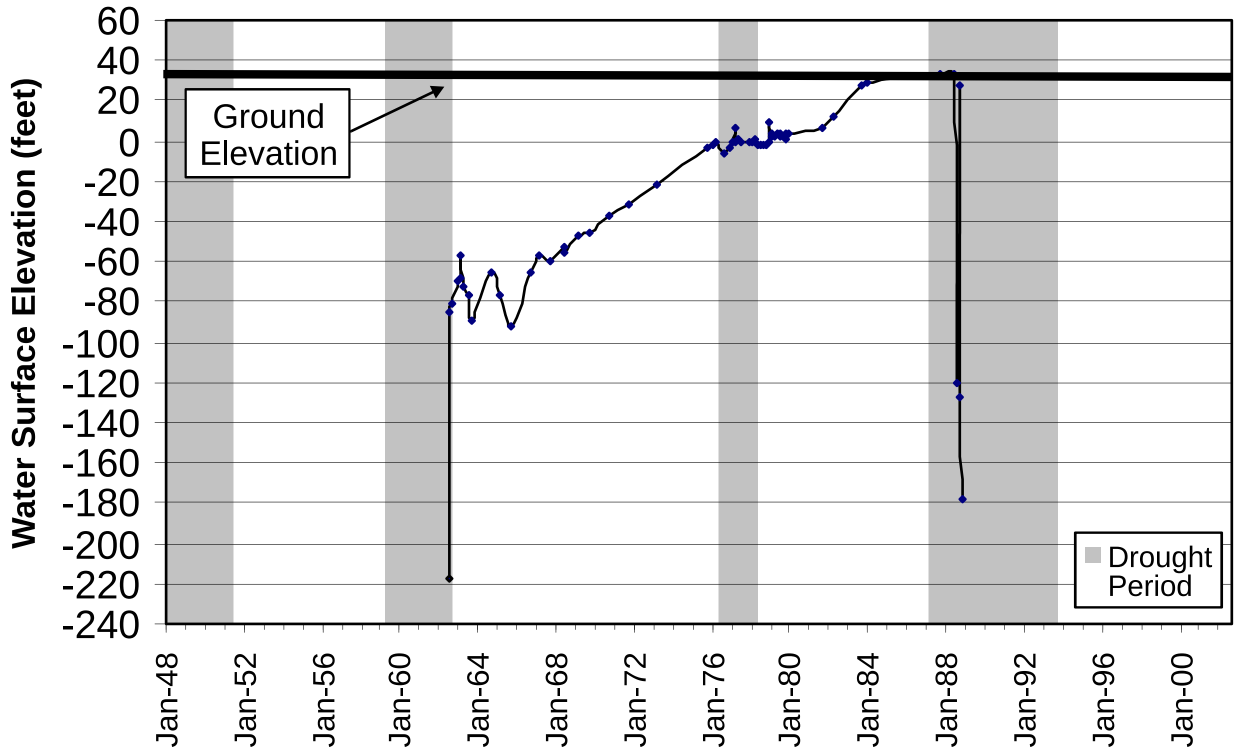

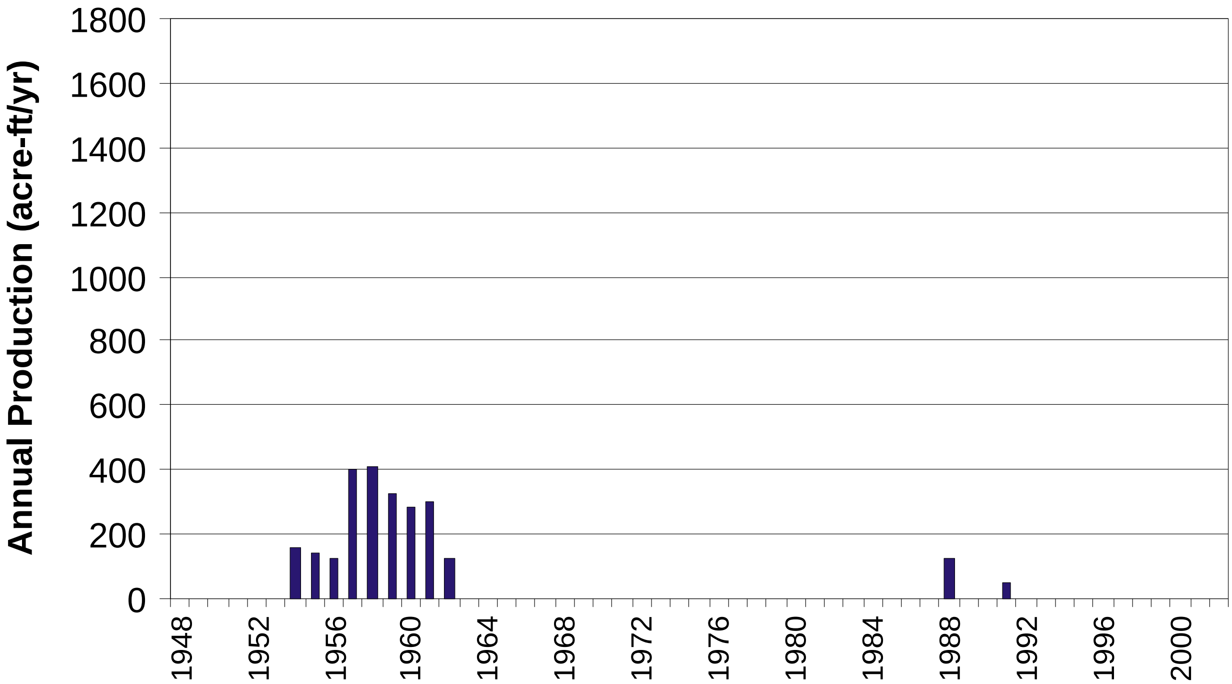

Figure 7
MEADOW WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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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
Groundwater Supply Feasibility Study
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.

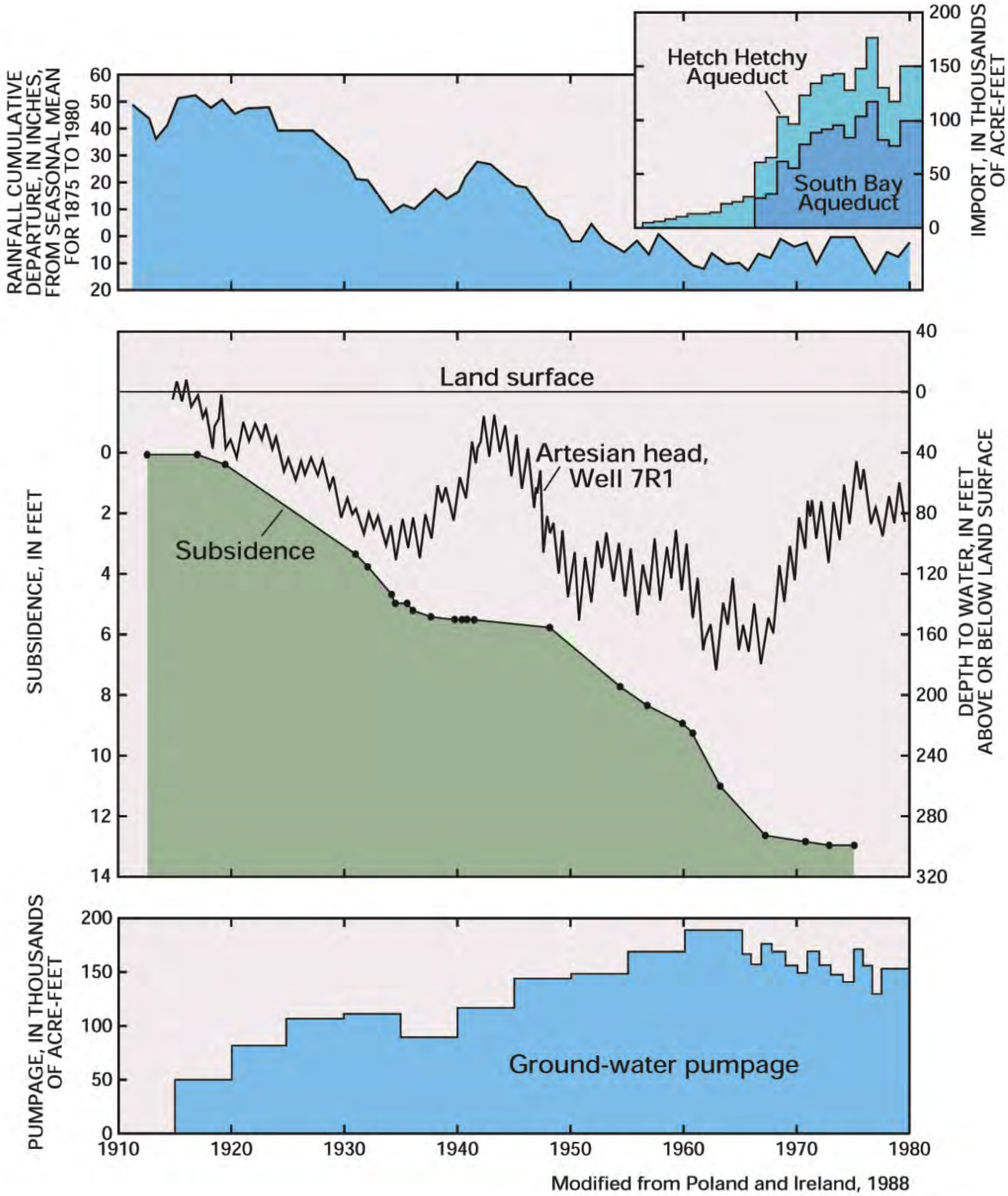

Figure 8
HISTORICAL DATA ON WATER USE, SUPPLY, AND SUBSIDENCE IN SAN JOSE, CA
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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.

City of Palo Alto (ID # 6450)

Policy and Services Committee Staff Report

Report Type: Agenda Items **Meeting Date: 12/15/2015**

Summary Title: Basement Construction Dewatering Update

Title: Update on 2016 Next Steps on Basement Construction Dewatering Program and Discussion and Potential Recommendation to Council Regarding Ideas From Committee Members for Additional Project Work

From: City Manager

Lead Department: Public Works

Recommendation

Staff recommends that the Policy and Services Committee review and discuss this Staff Report and provide direction. Staff recommends that Group 1 (most time-sensitive) items not return to Policy & Services but that staff develop those recommendations into actionable items for City Council approval, as needed. Our goal would be to return to Council as soon as possible in 2016. Group 2 and 3 items will be brought back to Policy and Services as indicated below.

Executive Summary

The Policy and Services Committee discussed staff recommendations on investigating program enhancements for basement construction dewatering at its December 1, 2015 meeting (Attachment A: #6268) and heard public testimony (Attachment B: correspondence). The Chair requested that staff summarize the wide range ideas suggested by individual Committee members for follow-up to ensure that all were captured to facilitate potential further discussion by the Committee. (see ID# 6438). The ideas are organized into three groups.

Group 1 is a set of potential new requirements for the 2016 construction season that staff recommended on December 1 and would continue to investigate with a goal of swift implementation; Group 2 is for ongoing and potential future work for gathering information about the groundwater basin; and Group 3 is a list of additional (some big) ideas generated at the meeting. With respect to Group 3, staff will return to the Committee in the first half of 2016 with questions that should be considered as part of a further discussion with the Committee about whether to recommend Council consideration and potential direction on any of these. The potential scope of the items could make this a major new initiative and will require careful assessment of the resources necessary to support them, in the context of other work priorities.

Assuming the committee accepts the staff recommendations, we will continue to share our

thinking with various stakeholders, as part of our deeper dive into implementation details of Group 1. This is important as new house construction applications are being submitted and it is important that we advise people of our potential planned changes, even before they could go into effect. We expect that some aspects of the recommendations in Group 1 could require specific Council action, so staff attention needs to be directed to work through the details of new requirements so that we can get to Council in early 2016.

Discussion

Below is a summary of the potential program changes identified by Staff and Committee members at the December 1, 2015 Policy and Services Committee meeting:

Group 1: New Basement Dewatering Submittal, Fill Station and Groundwater Use Requirements

Staff will continue to work (investigate feasibility and practicality) on the five program enhancements brought forward for consideration at the December 1, 2015 Committee meeting. Staff has added a bit more information to some of the Group 1 recommendations below.

1. Encourage greater fill station use through public outreach and enhanced signage.

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

3. Refine requirements for Groundwater Use Plans; including maximizing on-site water reuse, at least one day per week water truck hauling service for neighbor and City landscaping, and piping to nearby parks or major users where feasible.

4. Expand fill station specifications to address water pressure issues from multiple concurrent users, including separate pumps for neighbors where needed and sidewalk bridges for hoses.

5. *Broaden the City's Basement Pumping Guidelines to specifically require a determination of effects on adjacent buildings, infrastructure, trees, or landscaping. Applicants would determine the location of the temporary groundwater cone of depression caused by pumping. Avoidance measures would be required to be included in the determination if offsite effects are anticipated. City Urban Forestry staff may develop guidelines for avoidance measures such as soil enhancements and supplemental watering of neighboring landscaping by project applicants. Additional measures to avoid effects could include adjusting the location, depth or duration of pumping or altering construction methods to minimize or eliminate pumping.

Additional considerations raised at the Committee meeting include:
Ensuring that fill stations are compliant to specifications
Two committee members did not find outreach on the water cycle (2) to be a priority

Staff recommends continuing to investigate these Group 1 program enhancements and then finalize new requirements on basement dewatering for approval, as needed, by the full Council in early 2016.

Group 2: Gathering of Groundwater Information and Plans by Palo Alto and its Partner Agencies

Continue working with the Santa Clara Valley Water District (Water District) in an already ongoing effort on developing a further understanding of the North County groundwater systems, impacts of groundwater pumping, and opportunities for enhanced groundwater recharge. A Water District key mission is to manage the County's groundwater; therefore, staff will collaborate closely with the Water District, and the new Council-level Recycled Water Committee. This collaboration may also include working with San Mateo County and its cities to ensure coordination with their development of a groundwater strategic plan.

Staff will provide an update on the work plan for this effort to the Policy and Services Committee/(City Council?) in the first quarter of 2016.

Group 3: Further Ideas Brought Forward by Individual Policy & Services Committee Members

Individual Committee members articulated additional ideas and suggestions. Some of these ideas are multifaceted and complex, and will require sustained effort from staff and assistance from consultants over multiple years. The Committee and Council will need to evaluate priorities and timelines, including the potential that significant new assignments may delay other projects currently underway. Staff will prepare a report for the Policy and Services Committee in the first half of 2016 to discuss these matters and the development of a *potential* recommendation to Council to direct additional work in one or more of these areas:

1. Charging for discharge of groundwater. The current fee for dewatering to the storm drain system is $80 per month. This effort would consider increased fees to charge for the use of the City's storm drain system and staff time to manage the dewatering requirements. Committee members suggested exploring whether the fee that the Santa Clara Valley Water District charges for groundwater pumping would be an appropriate baseline.

2. Developing dewatering requirements tailored to drought situation.

3. Developing approaches to ensure that multiple basement pumping is not happening in close proximity (distance and time), and instead is spaced out, essentially allowing only a limited number of basement construction dewatering in one area.

4. Addressing potential damage from dewatering through bonds or insurance.

5. Further study of all pumping activities in the City, including private wells, City Hall garage, Oregon Underpass and other underpasses.

6. Review of basement building and zoning code issues, including FAR adjustments for basements and not allowing two-story basements, or any basement, in areas with shallow groundwater. (Note: Staff's initial reaction is that utilizing zoning to implement these requirements may be quite difficult because groundwater depth can vary significantly from block to block)

7. Review of impacts of multiple basements on soil absorption and/or the creation of barriers to groundwater flow.

8. Investigation of costs of other construction methods that do not require dewatering, or as much dewatering.

9. Investigate whether Palo Alto should assume a groundwater management leadership role for the North County area. (Including consideration of staff time and cost implications.)

10. In addition, Committee members were interested in how increased use of permeable surfaces may assist with groundwater recharge. (Note: City staff can provide an update on the new stormwater permit requirements for a Green Infrastructure Plan which will require more infiltration of stormwater into the ground rather than discharging it through storm drains via both public and private projects.)

In summary, staff will finalize its investigation of Group 1 activities for implementation of potential new requirements starting in 2016. Group 2 is part of an ongoing effort and the Committee and Council will be updated periodically. The Group 3 activities will be brought to the Committee /Council for discussion and direction to study them; Staff is making no estimate on when they could be implemented.

Resource Impact

Testing and refining the suggested measures to improve the dewatering program or any other measures suggested by the Committee will require significant staff time that is currently allocated to other projects. For the homeowner, these measures may increase basement construction project costs.

As mentioned in earlier parts to this report, the Group 1 recommendations have sent staff scurrying to develop final recommendations for action. The Group 3 suggestions are varied and require thoughtful review and potentially large costs. In every case, consideration of our ability to fund and support or absorb the efforts will be required.

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: 120115 6268 Basement Construction Dewatering (PDF)
- -: Attachment B: Correspondence (PDF)

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

1

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
Steve Broadbent
David Stonestrom
John Northway
Bob Morris, Public Works

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.

<u>Discharge Volume</u>

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

PREPARED BY: Bob Morris
BOB MORRIS
Senior Project Manager

DEPARTMENT HEAD:
GLENN S. ROBERTS
Director of Public Works

CITY MANAGER APPROVAL:
STEVE EMSLIE/KELLY MORARIU
Deputy City Managers

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.

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.

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. 30APR06
STATE OF CALIFORNIA

George J. Burwasser,
EIP Associates

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.

Attachment C

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

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.

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- 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 96
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;

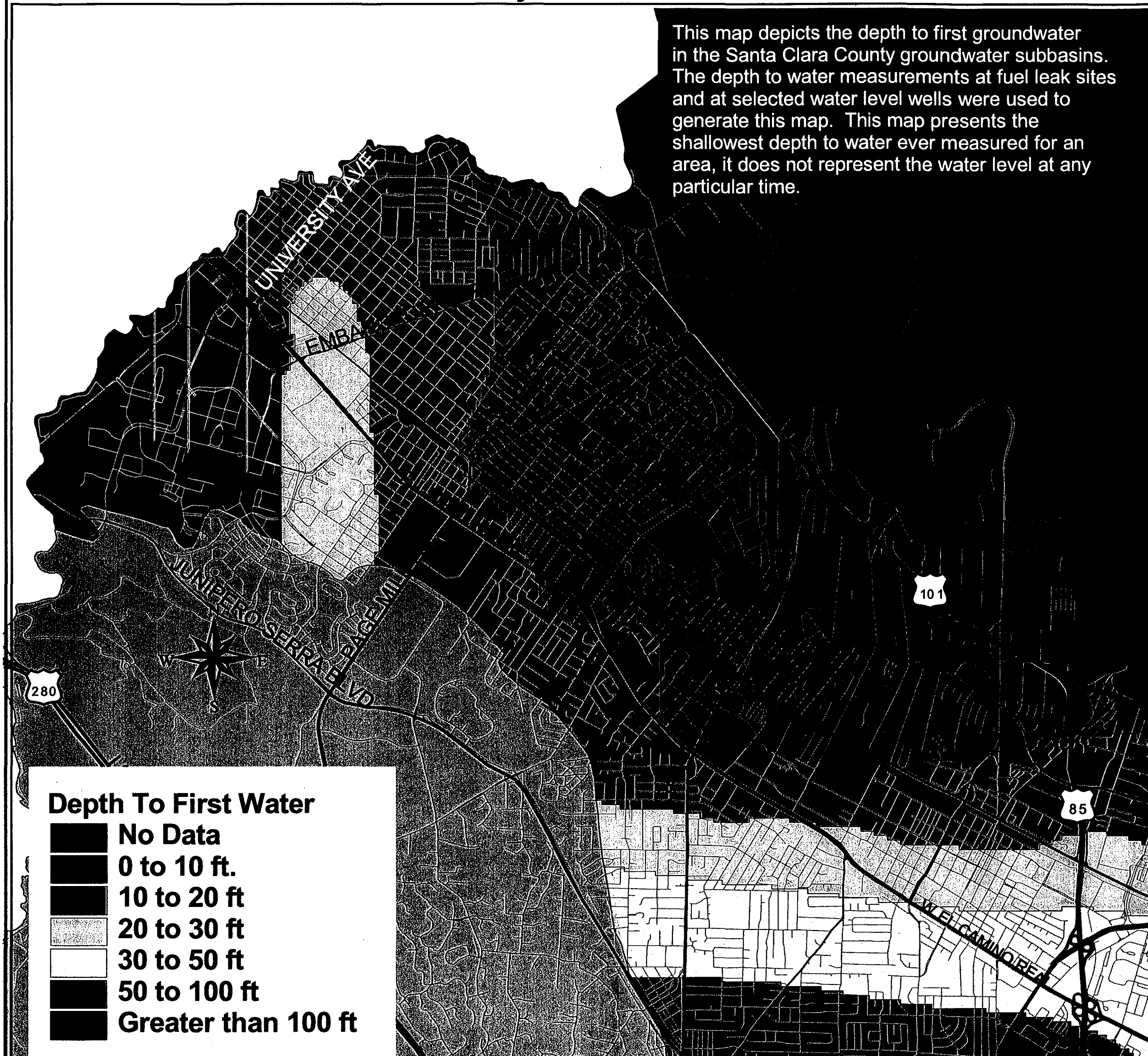
(B) all such areas combined do not exceed 2% of the area of the lot or 200 square feet, whichever is greater; that each such area does not exceed 200 square feet; and that each such area is separated from another by a distance of at least 10 feet. Area devoted to required stairway access shall not be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



groundwater management

Santa Clara Valley Water District

Map Version: October 15, 2003

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,

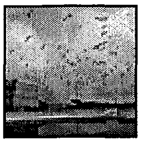
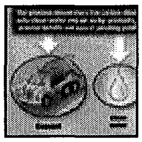
Jody Davidson

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

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

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 1/10th 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.

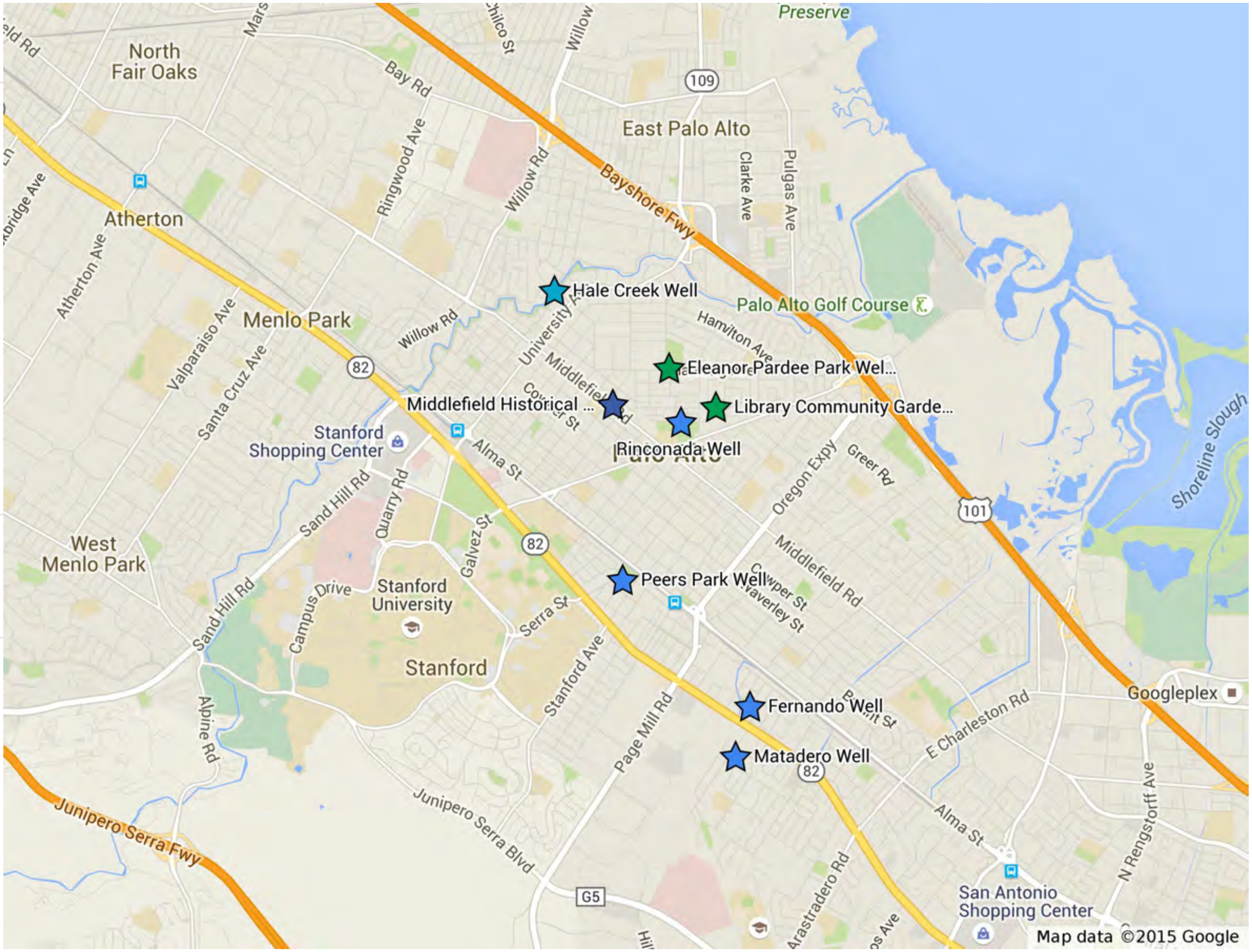
Map A: Palo Alto Emergency Water Supply Well Map

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.



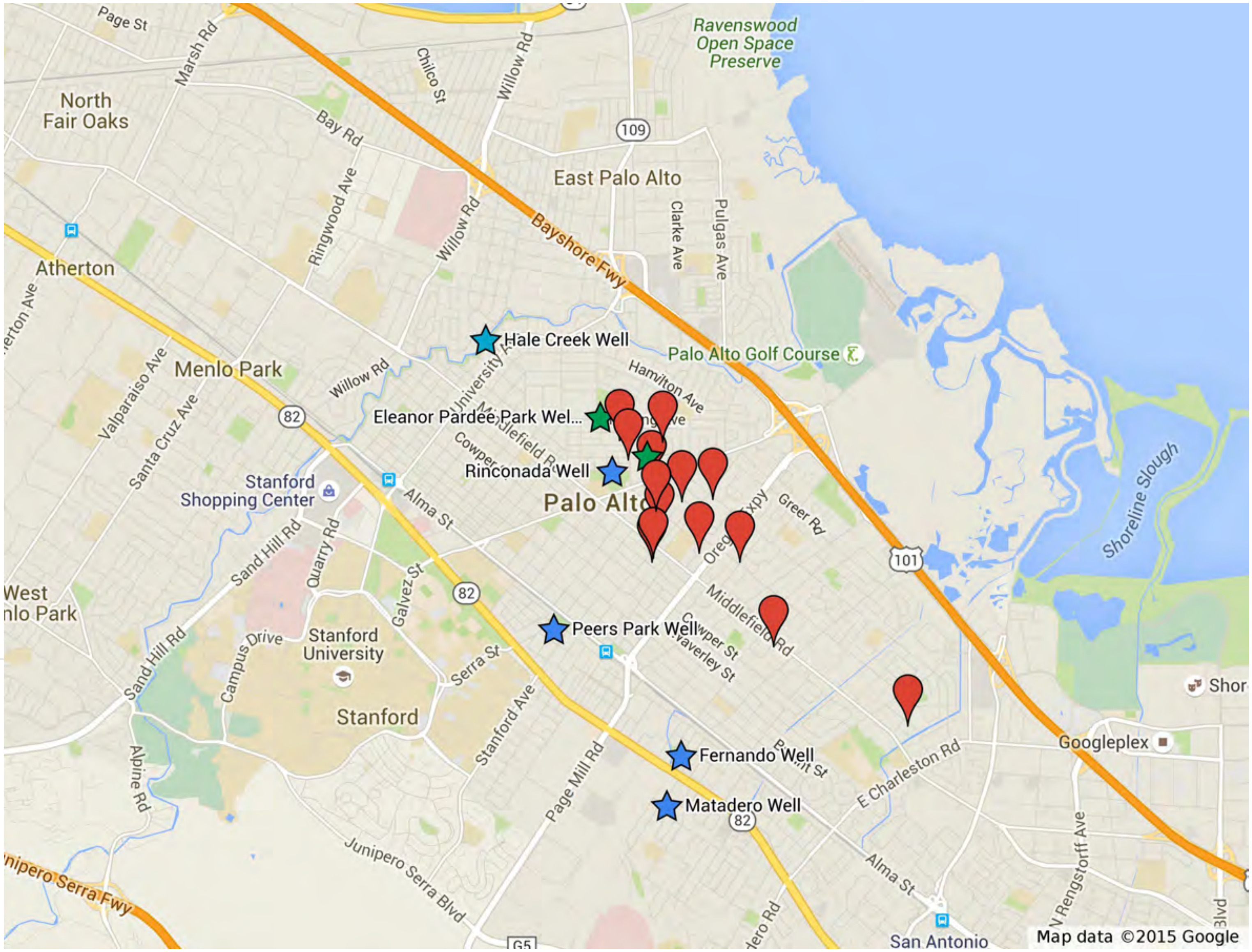
Map B: Dewatering_Map 2015

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

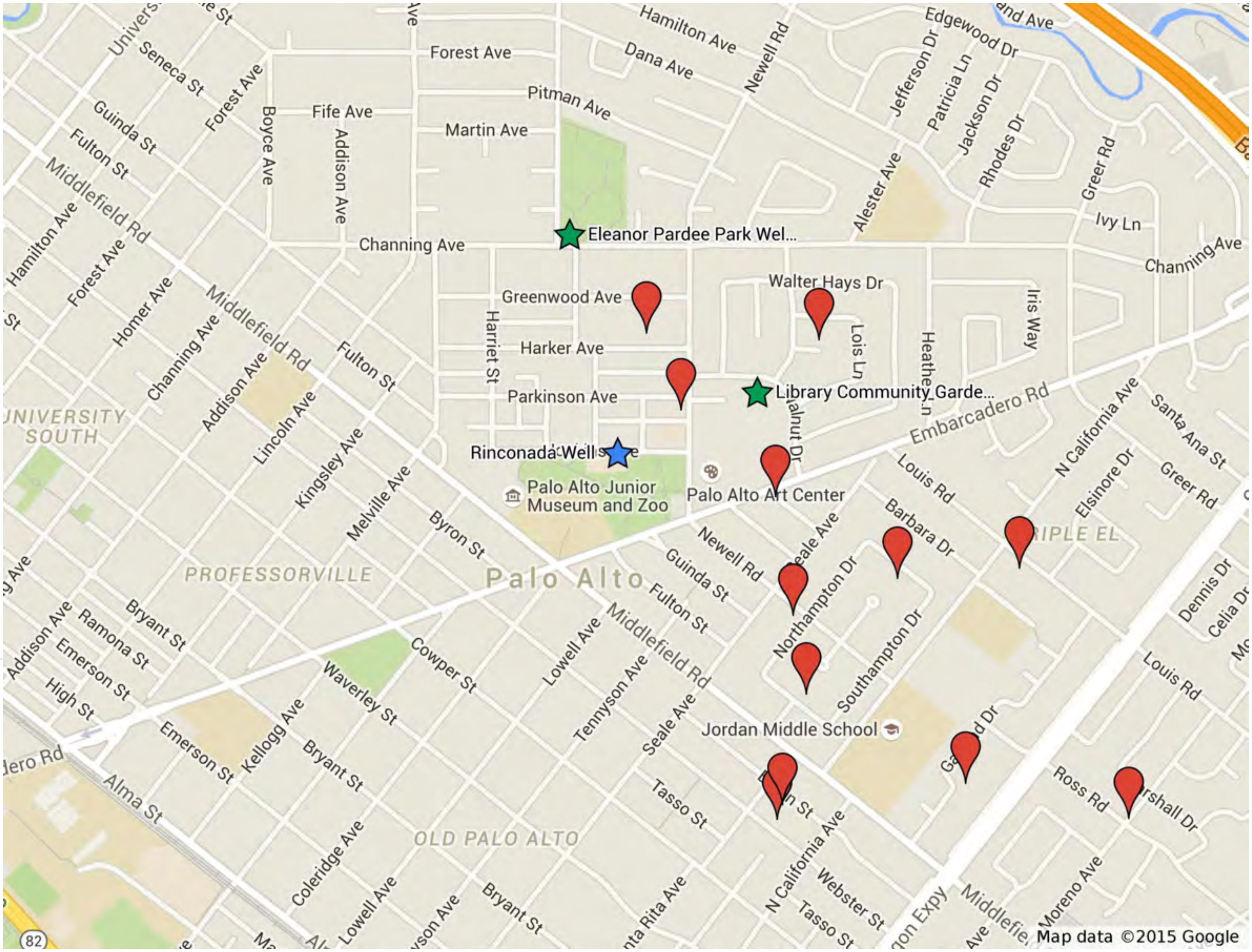
Map C: Dewatering_Map 2015 (Community center zoom)

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

COUNCIL MEETING
11/2/15
[ ] Placed Before Meeting
[ ] Received at Meeting

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 <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:
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. Kalbhenner	Nancy Kalbrenner	2031 Byron St.
Mary J. Cardelli	MARY J. CARDELLI	85 ERSTWILD 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 MINDELZUN	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
Harry 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
Diana Lewiston	Diana Lewiston	1849 Newell Rd 94304

6

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]	Richard J Tinge	71 Tulip Lane
e-mail (optional) dtingey@aol.com		
Phyllis Sherlock	Phyllis Sherlock	1275 Dana PA
e-mail (optional)		
Michal Strikeber		2076 Edgewood
e-mail (optional)		
	SRIDHAR MANJUNATHESWARAN	2088 EDGEWOOD
e-mail (optional)		
	Louise Beattie	1445 Hamilton Ave 94301
e-mail (optional) LDBEATTIE@gmail.com		
Peter Tingey		4010 Dana
e-mail (optional)		
[signature]		525 Homer Ave #1
e-mail (optional)		
	LENORE CAMES	
e-mail (optional) LENRAVEN1@GMAIL.COM		

8

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</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:
[illegible]	SUSIE SCHOLPP	961 Lincoln
[illegible]	Judith Field	2581 Park #103
[illegible]	UNDA MENON	1972 Ivy Ln,
[illegible]	ZAYOSKA	1465 Channing
Hilary Jones	Hilary Jones	235 Walter Hays
Nancy Yamada	Nancy Yamada	1921 Edgewood Dr.
Sophia Abramson	SOPHIA ABRAMSON	1356 PITMAN AV
[illegible]	Lucan Hugler	1930 Ivy Lane
Stuart Beattie	Stuart Beattie	1445 Hamilton
[illegible]	YAFEI BI	1912 Edgewood Dr.
J Marks	James P. Marks	689 Wildwood Lane
Sara Peck	SARA PECK	650 WILDWOOD LANE
[illegible]	Carla Carvalho	1924 Edgewood Dr.
[illegible]	JOHN RATLIFF	1924 EDGEWOOD
[illegible]	Deborah Baldwin	635 Wildwood Ln

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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 <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]	X. O'REILLY	736 SOUTHAMPTON DR.
[signature]	CYNTHIA NAVYN	431 OXFORD AVE.
[signature]	HERMAN GYR	930 KOBLE 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. Fineman	850 Webster
[signature]	Darel Hodgson	170 Parkside
[signature]	LEIKA KEJRIWAL	832 SOUTHAMPTON DR.
[signature]	Peter Herrenhoff	4180 OakHill Ave
[signature]	Nathaniel Sterling	4180 Oak Hill

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SIGNATURE:	PRINTED NAME:	ADDRESS:
[illegible]	MARSHA ALPER	2518 South CT.
Bonnie Pollad	BONNIE Pollard	2450 South Ct.
[illegible]	ISABEL WALKER	2460 South Court
Delney Waller	Delney Waller	2500 South Ct.
[illegible]	Carole Hessler	480 Anton Ct.
[illegible]	JOYCE DAVIDSON	807 RORKE
[illegible]	TED ALPER	2518 S. Court
[illegible]	Megan Miller	2530 South Ct.
[illegible]	Mary Lynn	2194 Louis Rd
[illegible]	Richard Dundas	2194 Louis
[illegible]	anna saitz	2442 south court
[illegible]	BOB SPEARS	959 MATADERO
Karen McWay	KAREN MCWAY	1520 Mariposa, PA
[illegible]	Henry Lum	4202 Suzanne Dr, PA
[illegible]	SUSAN BLOOM	3151 Cooper St PA
Estelle Chalfin	ESTELLE CHALFIN	432 High St. #302 PA

16

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SIGNATURE:	PRINTED NAME:	ADDRESS:
Judith Steiner	JUDITH STEINER	1515 COWPER ST.
David Petrone	DAVID PETRONE	2301 WEBSTER ST.

2

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.

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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.

2225 Webster

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]	DEANNA WONG	2131 BYRON ST, Palo Alto 94301

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:
Kay Bushnell	Kay Bushnell	775 Northampton Dr. Palo Alto

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.

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SIGNATURE:	PRINTED NAME:	ADDRESS:
Marla Rathbun	Marla Rathbun	740 Garland Dr.
K	Ken Broder	2060 Louis Rd.

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	[illegible]	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. C. Carusi	MICHAEL CARUSI	2112 WEBSTER ST.

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:
Carl A Cimilluca	CARL CIMILLUCA	2176 Webster St. Palo Alto
[illegible]	[illegible]	7561 N. California Ave.
Therese Sze	THERESE W. SZE	602 N. California Ave
S M Sze	SIMON M SZE	602 N. California "

4

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SIGNATURE:	PRINTED NAME:	ADDRESS:
[illegible]	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
[illegible]	MENAD CAKLOVIC	731 GARLAND DR.
[illegible]	Mark Meyers	732 Garland Dr.
[illegible]	Naomi Meyers	732 Garland Dr.

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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 Zh	Qiang Zheng	2250 Webster Street
[illegible]	Allen Zheng	2250 Webster
[illegible]	Austin Zheng	2250 Webster St
[illegible]	Yinzi Qi	2250 Webster St.
[illegible]	Peter Nino	2302 Webster St
[illegible]	Amelia Wigton	2255 webster Street.
[illegible]	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:
	Alyssa Levitan	2326 Webster
	Gookyung Kim	2320 Byron.
	Mallory Graffeo	2275 Webster
	Brandon Graffeo	2275 Webster
	Oliver Heckmann	2323 WEBSTER
	Bibiana Heckmann	2323 Webster

6

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SIGNATURE:	PRINTED NAME:	ADDRESS:
[signature]	Franklin Schellenberg	4023 Villa Vista Palo Alto, CA

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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

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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.

7

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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.
Pete Fukuhara	Pete Fukuhara	2344 Webster St.
[illegible]	Phil Shpilberg	2353 Webster
W H Benz	William H. BENZ	2360 WEBSTER
[illegible]	Sandra Shpilberg	2353 Webster.
Gertrude Reagan	GERTRUDE REAGAN	967 Moreno
Jack Morton	JOHN D MORTON	2343 WEBSTER ST.
Margaret O'Reilly	MARGARET O'REILLY	736 SOUTHAMPTON DR
J O'Reilly	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 The	Phyllis The	777 San Antonio #83
E-mail (optional) pl-the@comcast.net		
Jerry Holzeman		
holz@sonic.net		
Richard Willits	Richard Willits	3396 Greer Road rwillits@gmail

8

Residents for Responsible Use of Groundwater,

a Community Resource

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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)

1

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

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SIGNATURE:	PRINTED NAME:	ADDRESS:
Sylvia J Gartner	Sylvia Gartner	824 Moreno Palo Alto 94303

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SIGNATURE:	PRINTED NAME:	ADDRESS:
	Anette Glankopf	
e-mail (optional)	ANNette-G@Att.net	
e-mail (optional)		
e-mail (optional)		
e-mail (optional)		
e-mail (optional)		
e-mail (optional)		
e-mail (optional)		
e-mail (optional)		

1

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

carollo engineers

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.

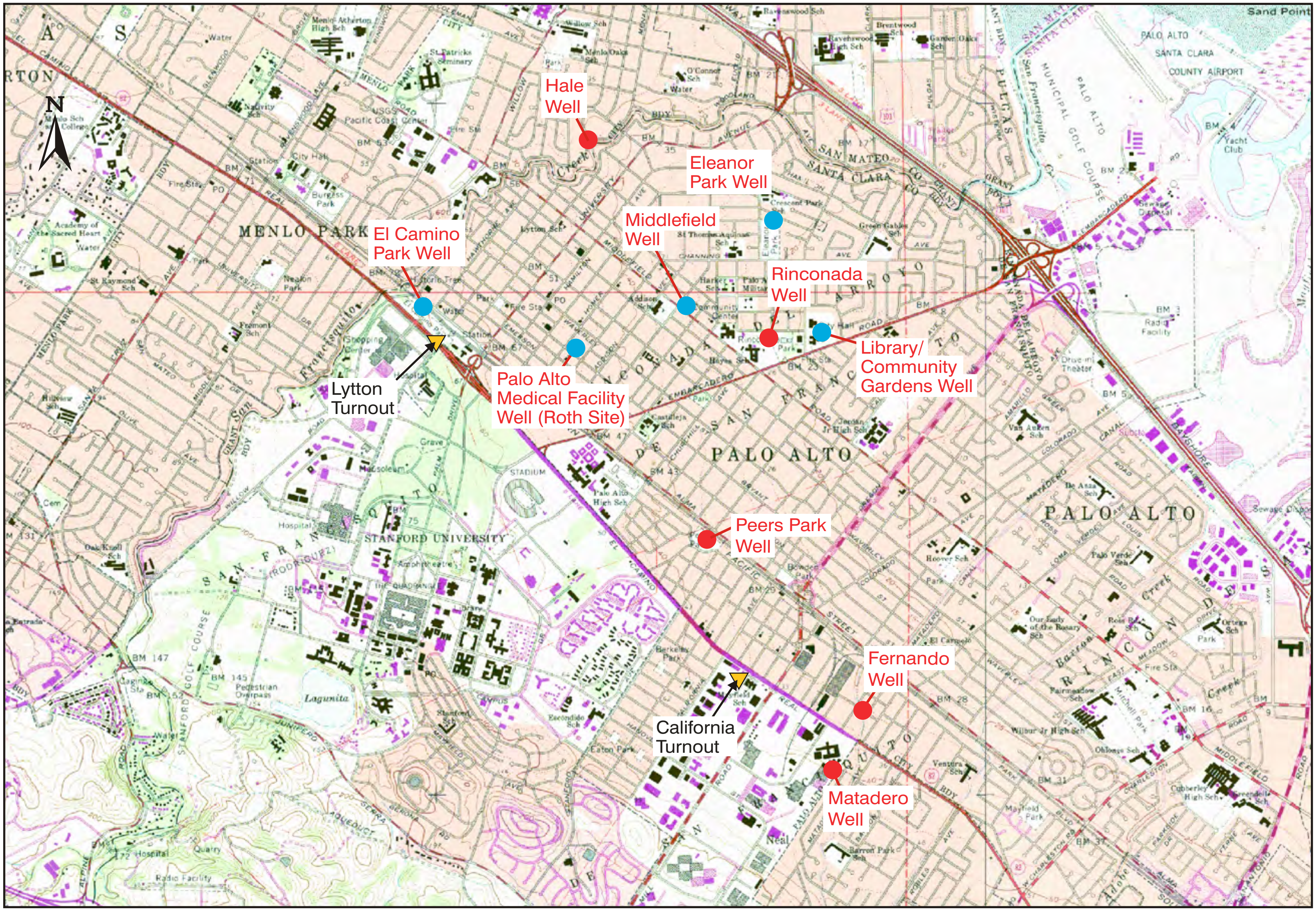
2.0 POTENTIAL GROUNDWATER USE IN PALO ALTO

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

---

[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).

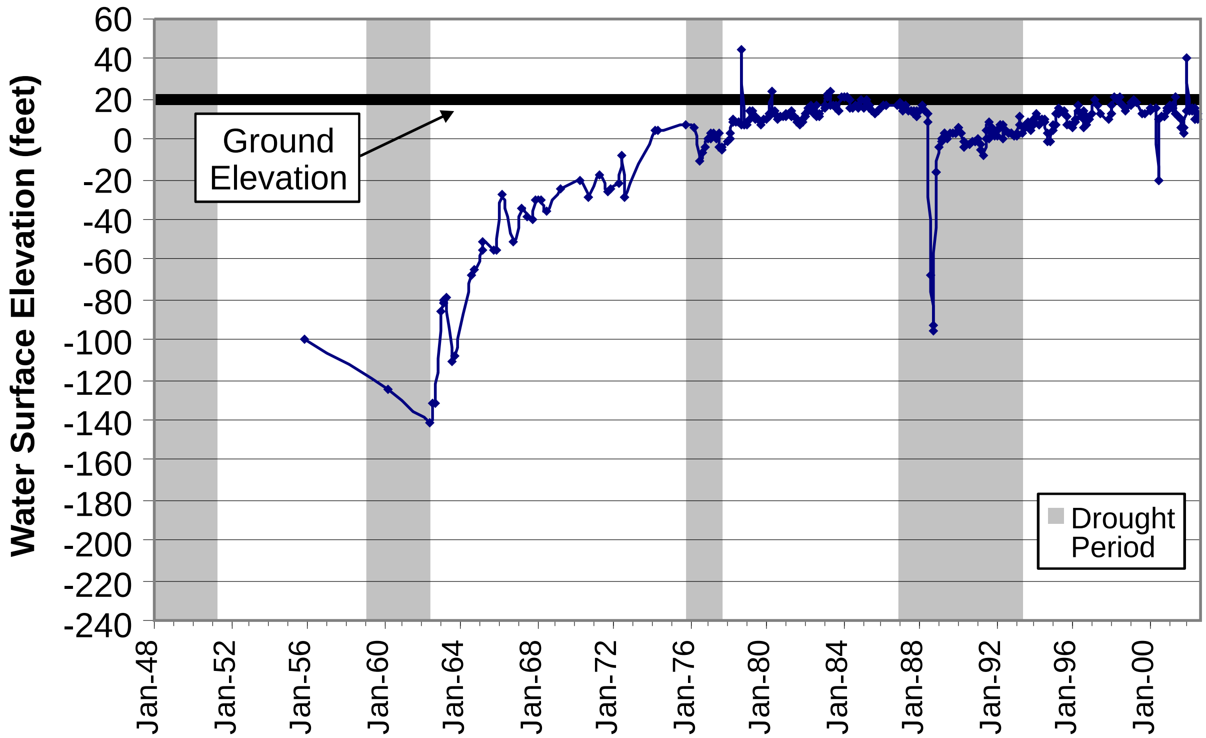
Customer acceptability, however, may require the City to install sufficient treatment at the wells to be used for drought or active supply such that the water quality is increased significantly or made comparable to the SFPUC water. This issue was covered in the City’s “Long-Term Water Supply Study”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



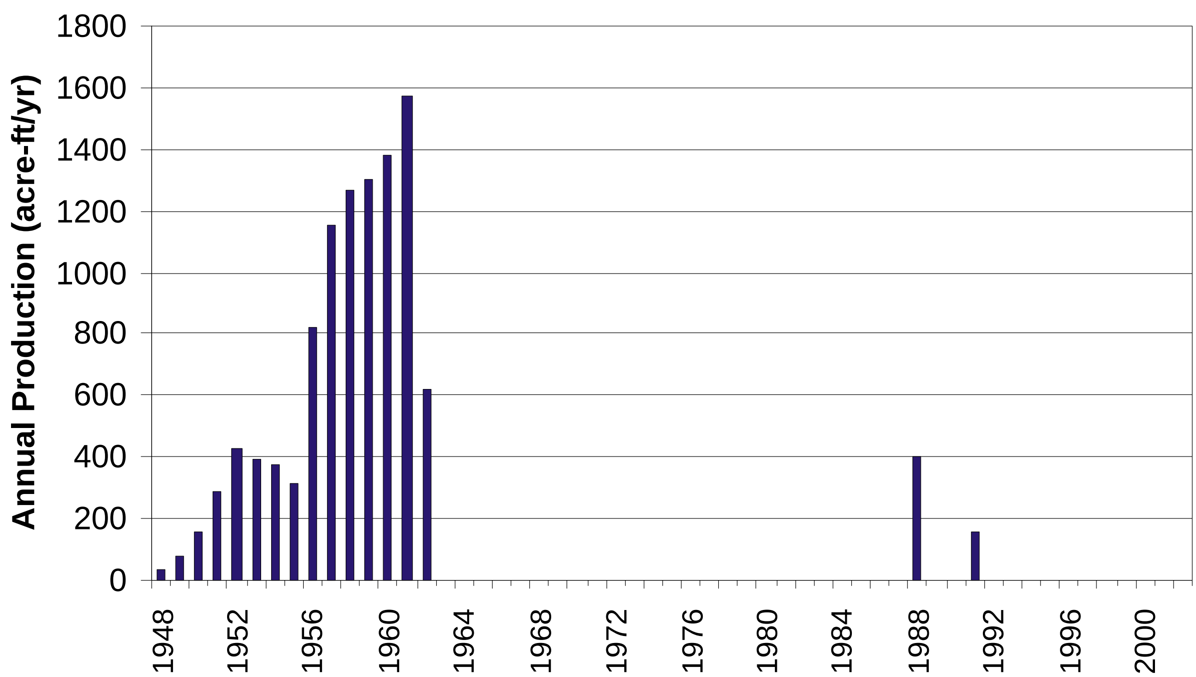


Figure 2
HALE WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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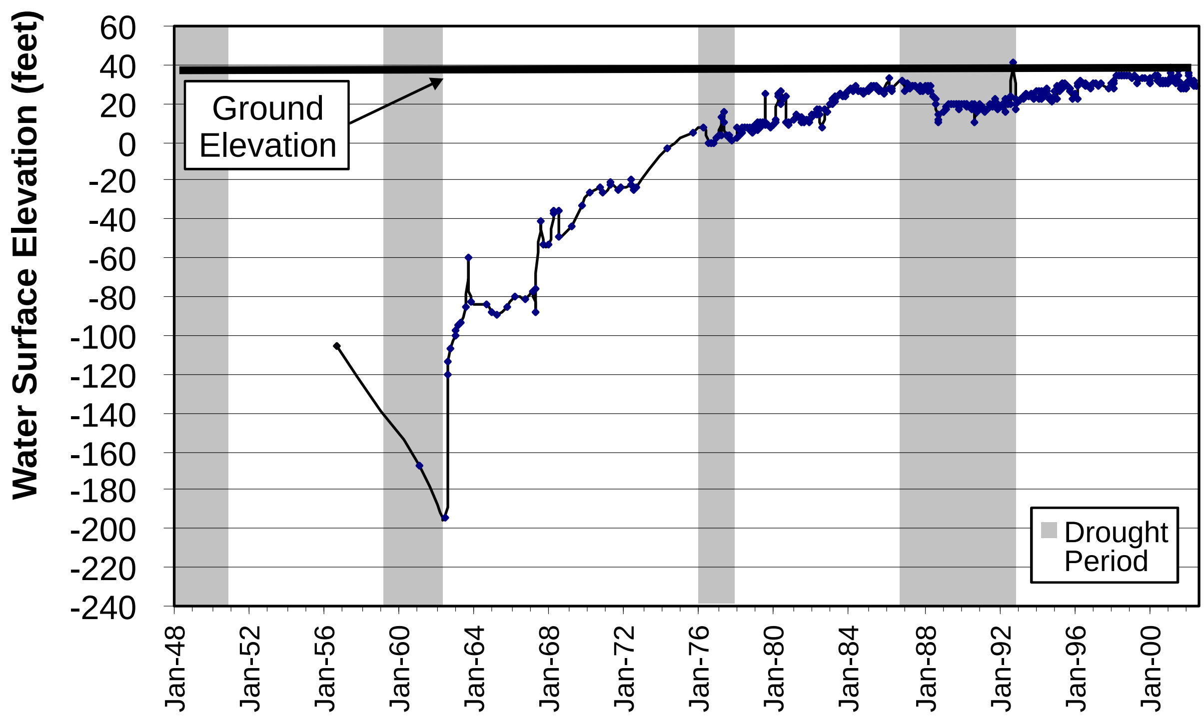

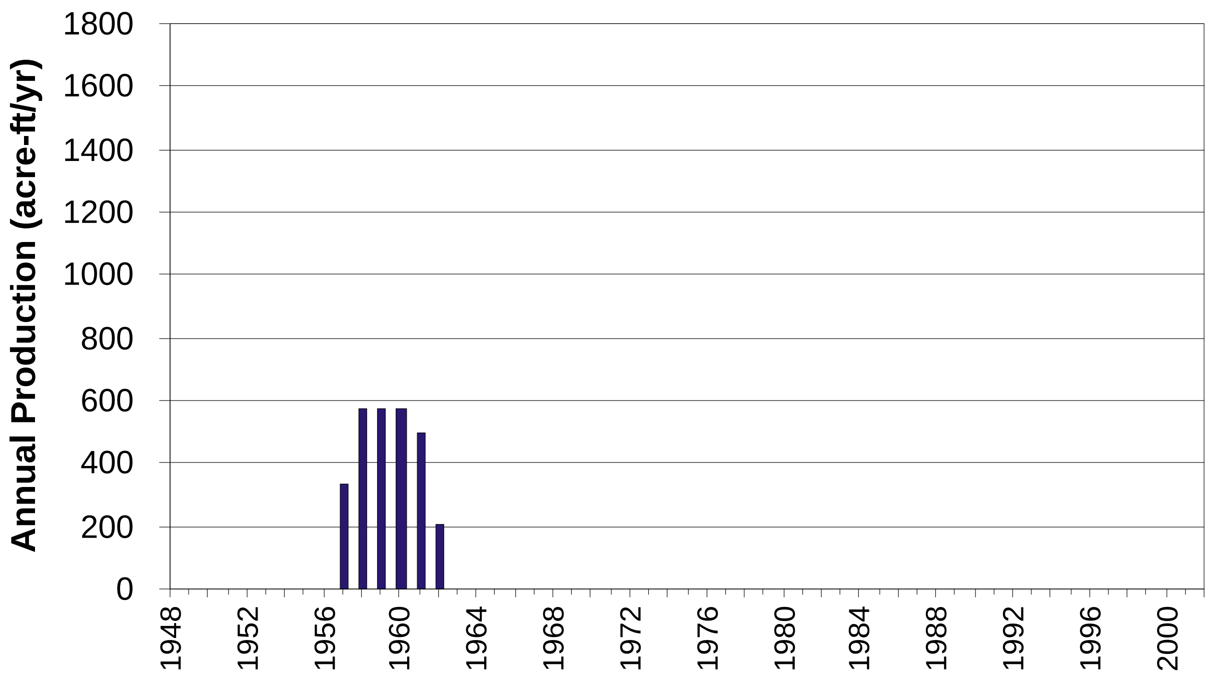

Figure 3
MATADERO WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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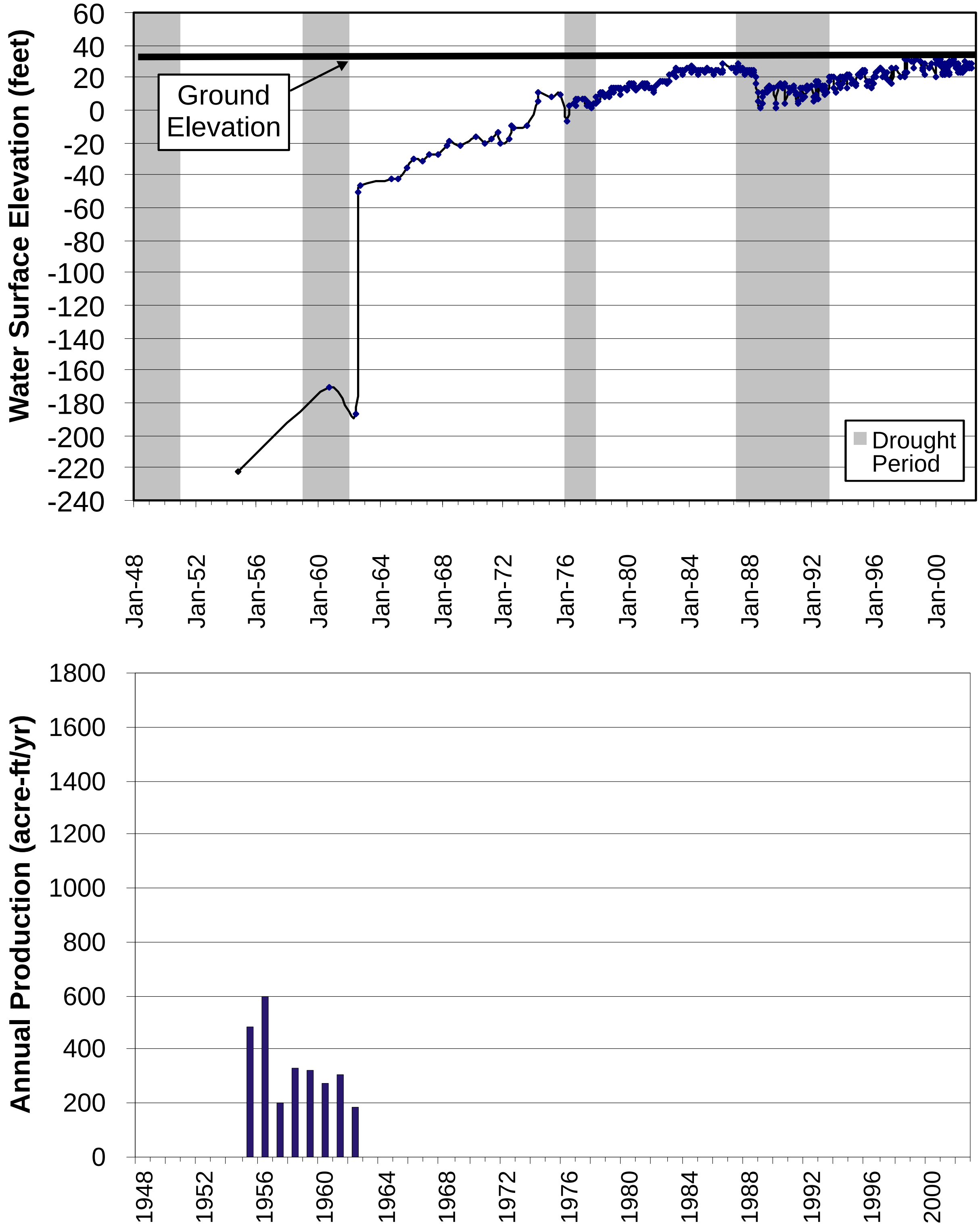

Figure 4
FERNANDO WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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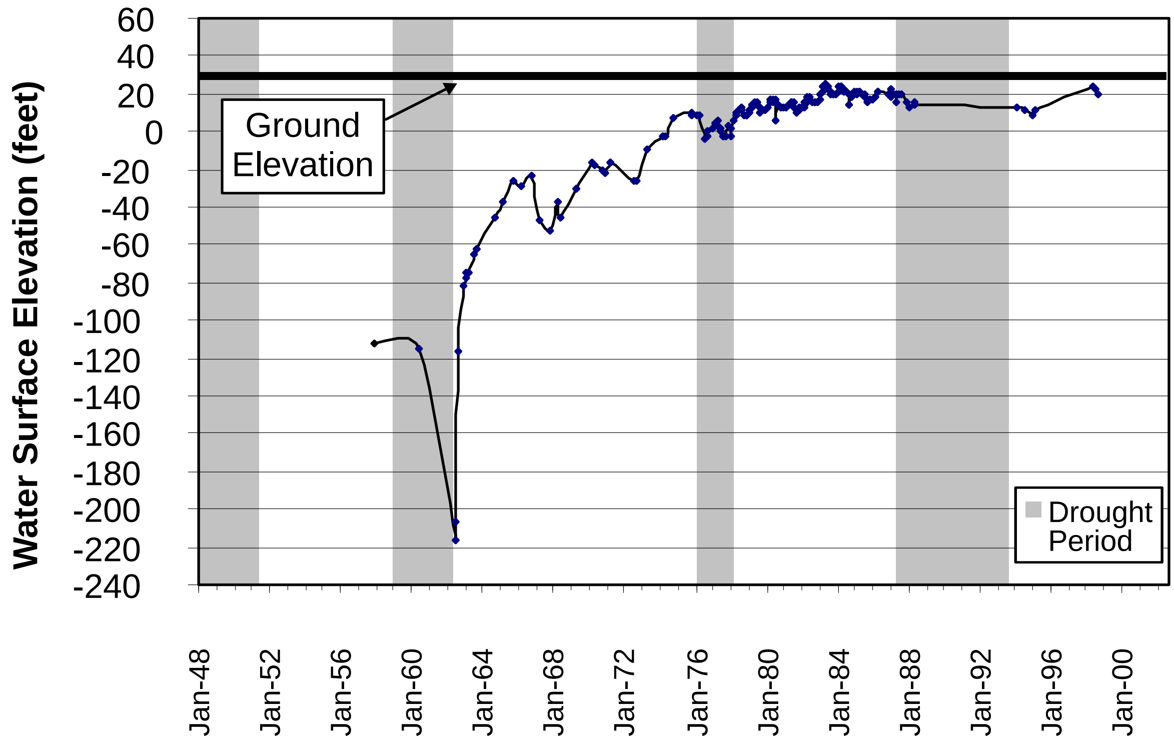

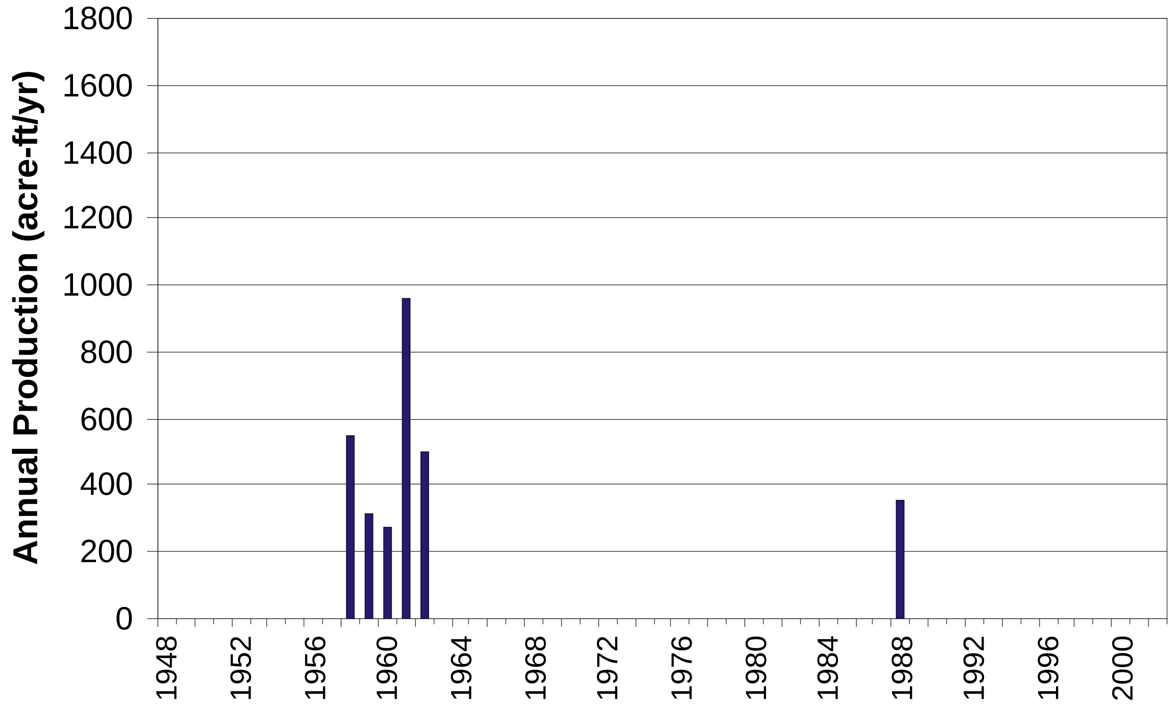

Figure 5
PEERS PARK WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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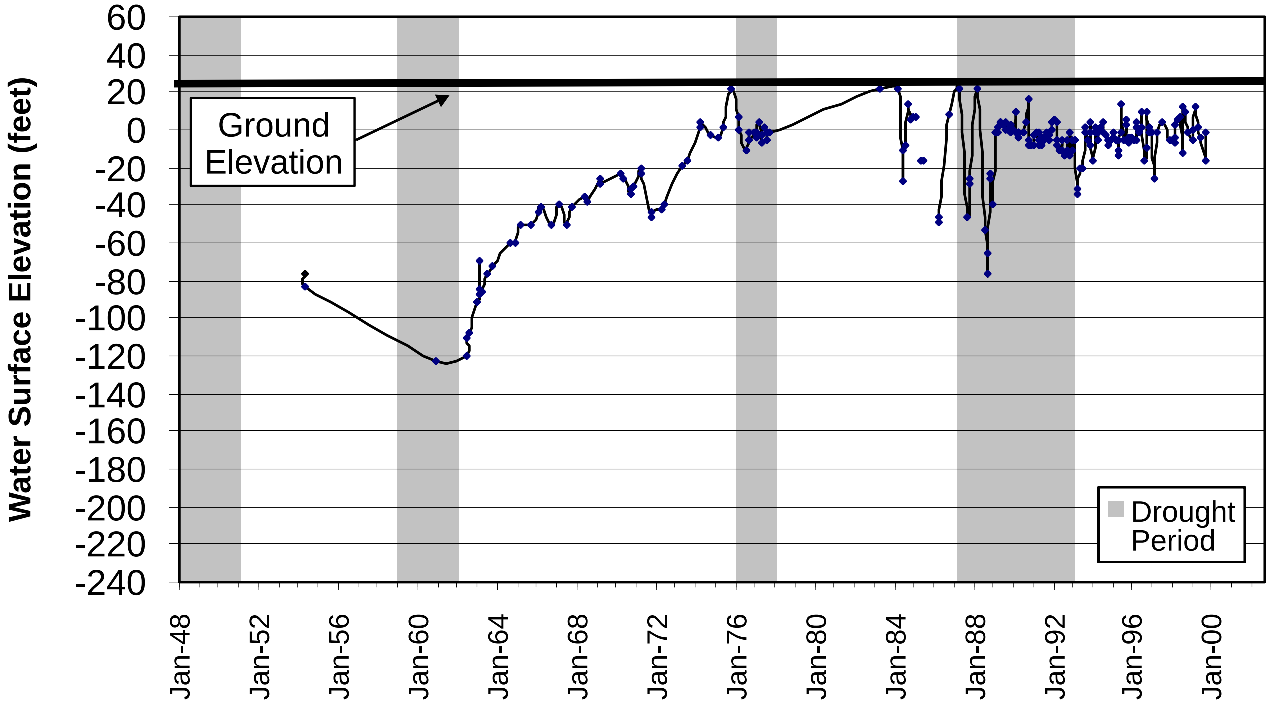

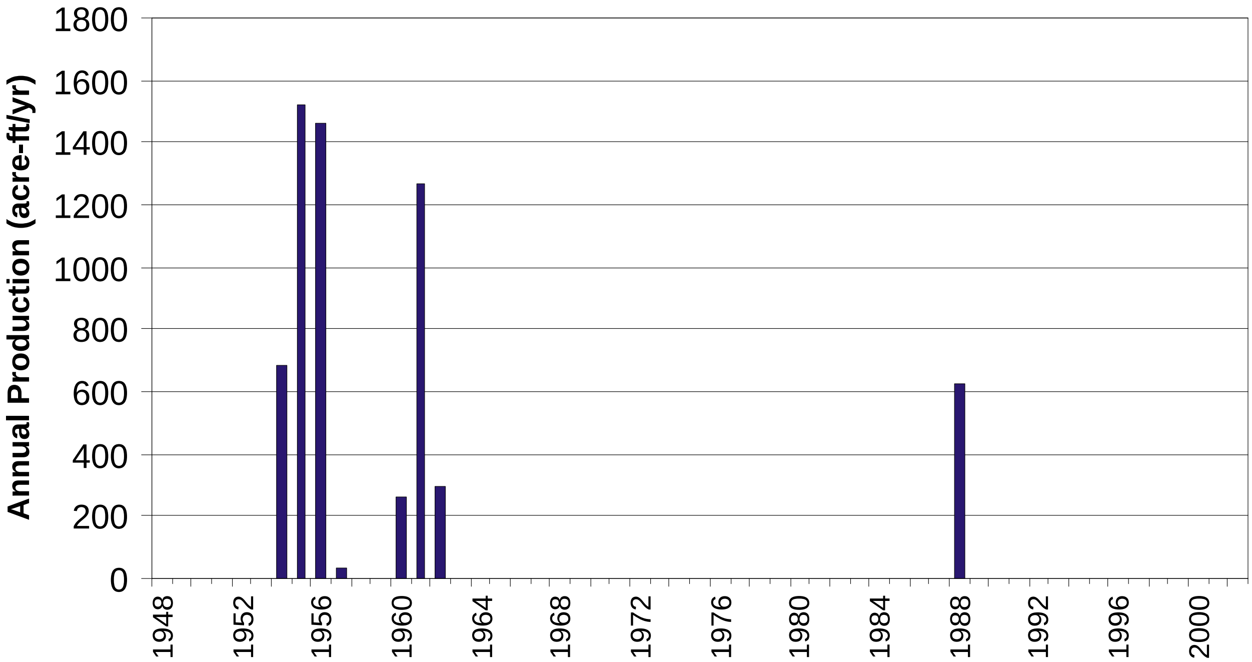

Figure 6
RINCONADA WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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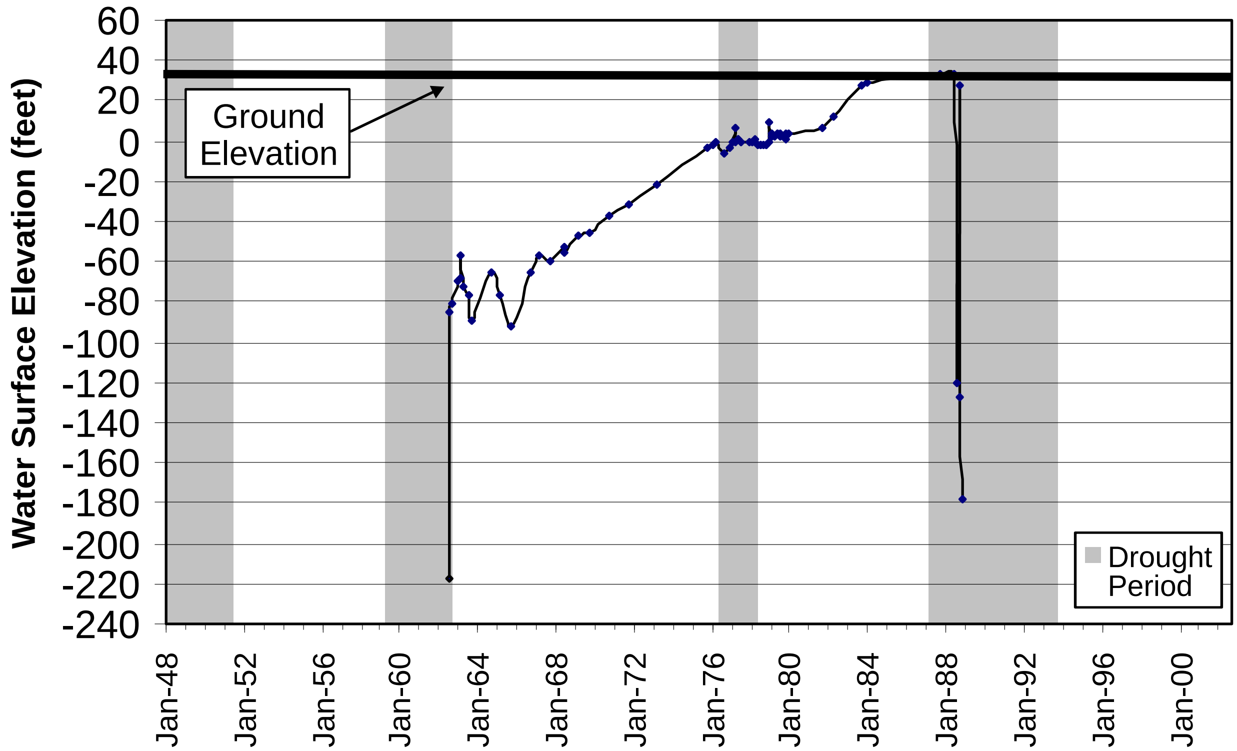

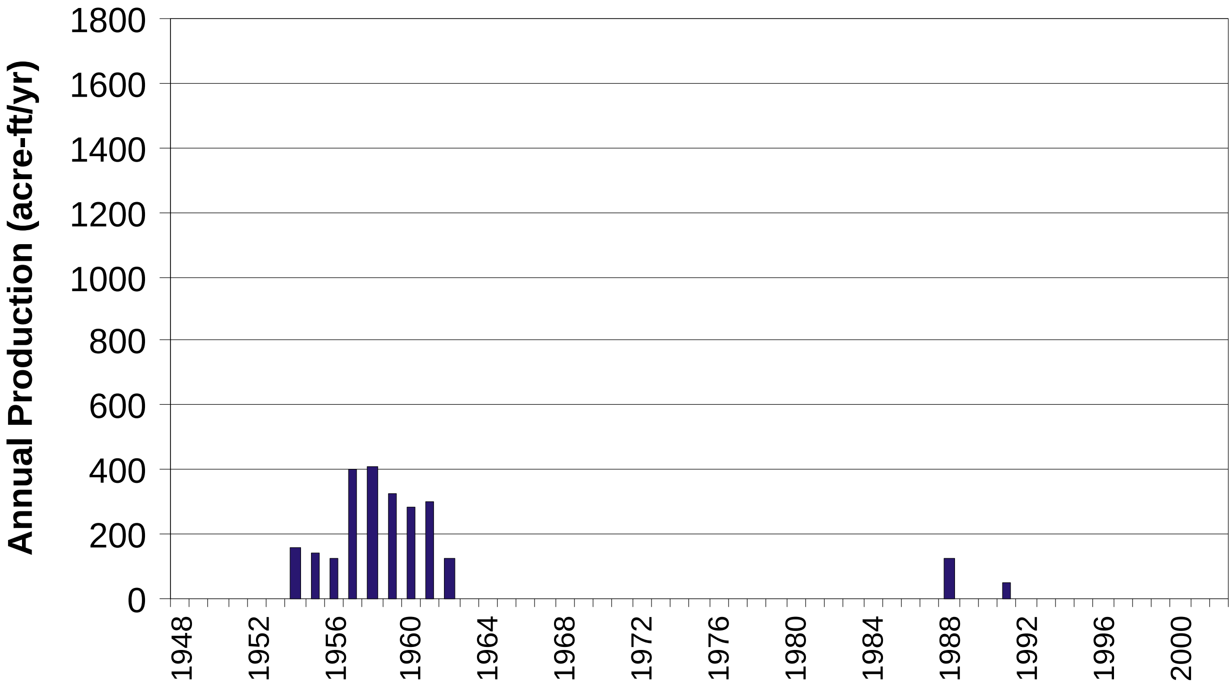

Figure 7
MEADOW WELL
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

Pa303f7-6589.cdr

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 Groundwater Supply Feasibility Study 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.

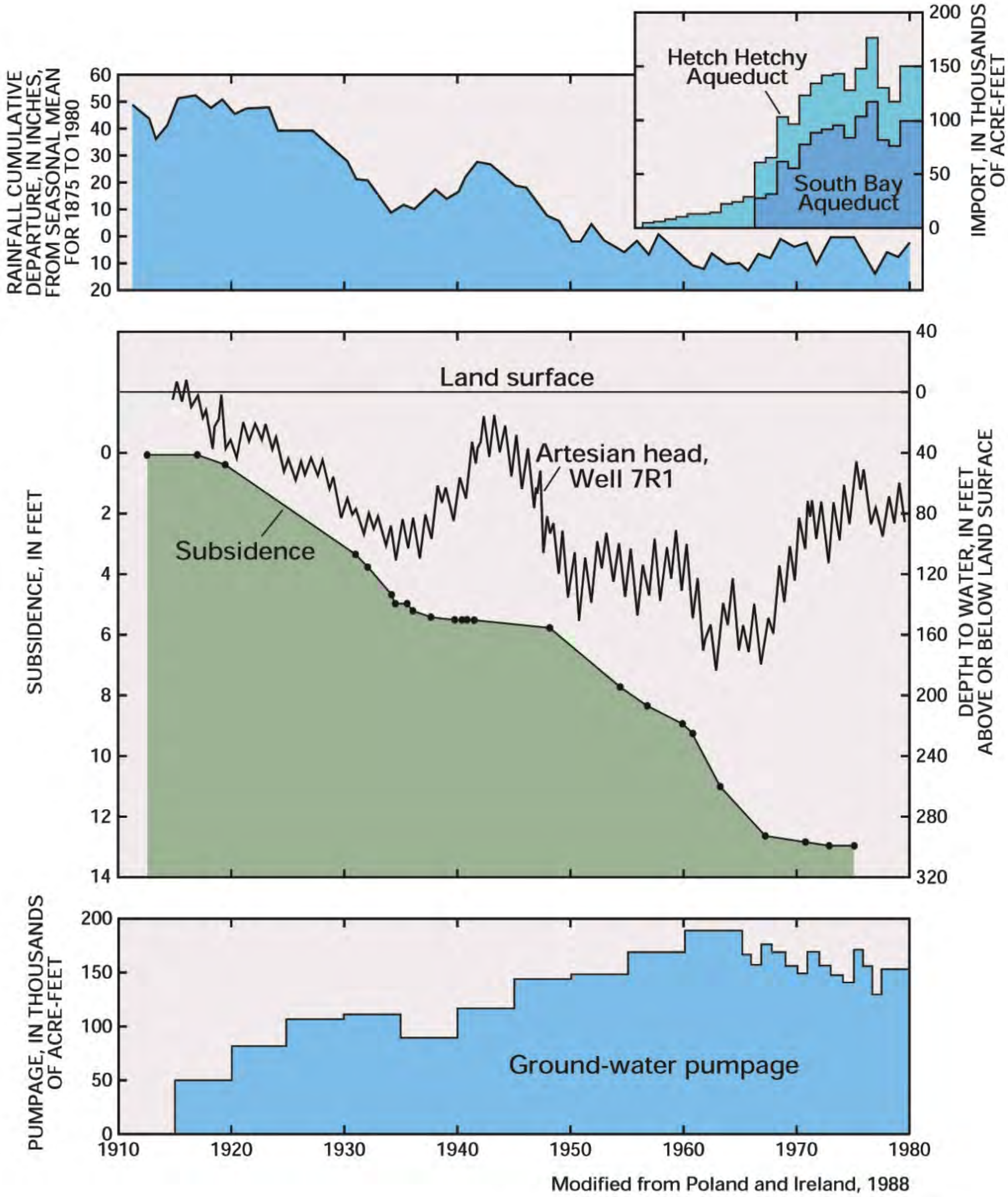

Figure 8
HISTORICAL DATA ON WATER USE, SUPPLY, AND SUBSIDENCE IN SAN JOSE, CA
GROUNDWATER SUPPLY FEASIBILITY STUDY
CITY OF PALO ALTO

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.

December 1, 2015

Save Palo Alto’s Groundwater requests the Policy and Services Committee to recommend the following for Council approval:

Institute an immediate moratorium on the issuing of dewatering permits for residential basements until:

1. State mandated drought restrictions are lifted and

2. The City prioritizes engaging a consultant, preferably with knowledge of the local aquifers to create a Groundwater Management Plan for Palo Alto

3. This Groundwater Management Plan should be incorporated Palo Alto’s Urban Water Management Plan, the next update which is due in July, 2016, and if practical, coordinated with efforts in San Mateo County as the San Francisquito Creek Sub-basin is shared between counties.

Specific concerns to be addressed in the Groundwater Plan:

a. Create and implement a sustainable groundwater budget for Palo Alto taking into account that this is a shared resource with neighboring cities and other entities.
b. Consider the prospect of climate change including possible periods of extended drought and exceptional rains and that rising sea levels might led to greater possibility of saltwater intrusion.
c. Integrate groundwater management policies to Palo Alto's Sustainability goals.
d. Protection of water levels in both the deep and surface components of the aquifer
e. Integrate groundwater management policies to Palo Alto's Sustainability goals.

Additionally, the Groundwater Management Plan needs to be considered in the update to Palo Alto’s Comprehensive Plan, specifically N-18 and other applicable policies.

If under Palo Alto's Groundwater Management Plan **the water budget** allows for dewatering, then:

1. Groundwater Pumping Allocations and Pricing
    a. Priority for dewatering should be given to public projects, e.g. the Public Safety Buildings
    b. Normal water rates should be charged for this water, and the water should be priced at or above replacement costs to the City
    c. Meter water to ensure accurate charges and to provide reliable data for the water budget
    d. Limit the issuance of dewatering permits to ensure that cumulative dewatering is within the groundwater budget

2. Best practices and zero-waste policies
   Adopt best practices and zero-waste policies for groundwater

a. The City will institute appropriate actions and policies to preserve a healthy groundwater level and flows with costs paid by the developing party, including
   i. requiring building practices and techniques that minimize dewatering, such as shallower pumping depths, shorter pumping periods, or methods that do not require dewatering
   ii. re-use of pumped water for (neighborhood) irrigation replacing use of potable water for irrigation
   iii. re-injection of the groundwater to the aquifer, preferably nearby
   iv. Explicit consideration should be given to the **cumulative effects of dewatering** at **multiple sites** in the same geographical area and require site-specific dewatering plans that minimizes the cumulative impacts on the nearby properties, including requiring coordinated dewatering of such sites when appropriate.

b. The City will create enforceable City policies and collect meaningful penalties when policies are violated

c. Establish a roadmap to achieve "Zero Dewatering" waste within 5 years.

3. Zoning
   Update zoning for basement construction by applying existing policy concepts to all underground construction:
   a. individual review,
   b. revised underground set back restrictions, including excavation,
   c. depth and volume restrictions,
   d. approved drainage requirements, specifically enhanced storm water collection and mitigation of the local impacts of a basement on groundwater flows,
   e. include basements, lightwells and below-grade construction and walls in FAR and SAR regulations.

4. Local Impacts of Dewatering
   The City will require a determination of impacts of groundwater pumping on nearby buildings, infrastructure and trees or landscaping
   a. Applicants would determine and monitor the approximate extent of the temporary groundwater zone of depression caused by pumping
   b. Data will be readily available to the public online and of suitable quality to provide a basis for both understanding the aquifer and soils and to provide documentation in the event of property damages

5. Storm Water Handling and Aquifer Recharge
   Applicants will minimize and mitigate the impacts and costs of basements on the City's storm water handling and maximize local aquifer recharge capabilities.

6. Avoidance of multi-year adverse impacts
   An qualified consulting firm will review Palo Alto's Water Budget every 2 years. Other than for emergency purposes, whenever water outflows exceed inflows an immediate moratorium on issuing dewatering permits will occur.

Submitted at Committee meeting by Peter Drekmeier

MEMORANDUM

1

TO: UTILITIES ADVISORY COMMISSION

FROM: UTILITIES DEPARTMENT

DATE: FEBRUARY 13, 2013

SUBJECT: Utilities Advisory Commission Review and Discussion of the 2013 Preliminary Assessment of Water Resource Alternatives

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RECOMMENDATION

Staff requests that the Utilities Advisory Commission discuss the Preliminary Assessment of Water Resources Alternatives and the proposed next steps in the update of the Water Integrated Resource Plan (WIRP). No action is required.

EXECUTIVE SUMMARY

An Integrated Resource Plan provides a detailed evaluation of current and potential resources and policies and provides a blueprint to guide resource procurement and optimization for the future. The City completed its first Water Integrated Resource Plan (WIRP) in 1993, and updated the WIRP in 2003. Almost ten years have passed since the last WIRP, and it is time for an update to ensure policies and guidelines are consistent with community preferences and the changes that have occurred to the City of Palo Alto Water Utility. The WIRP update will include several phases, starting with the attached Preliminary Assessment of Water Resource Alternatives. The Preliminary Assessment describes each potential water resource alternative available to the City using information currently available. The next phase will be a more detailed analysis of various supply portfolio alternatives.

Staff is seeking feedback from the UAC on the proposed alternatives identified for further review in the next phase.

BACKGROUND

The City prepared its first Water Integrated Resource Plan (WIRP) in 1993 when the City was faced with a decision to participate in a regional recycled water expansion program. The 1993 WIRP assessed the costs and benefits of the recycled water project compared to other supply alternatives, and ultimately concluded that recycled water was not cost effective relative to existing supply.

In 2003, the City updated the WIRP. The 2003 WIRP indicated that supplies from the San Francisco Public Utilities Commission (SFPUC) were adequate during normal years, but additional supplies were needed in dry years to avoid shortages. The key conclusions from the 2003 WIRP analysis were:

- The City's existing contractual entitlement with the SFPUC provides adequate supplies;
- The cost to connect to the Santa Clara Valley Water District (SCVWD) treated water pipeline was prohibitive;
- Continuous use of groundwater is not recommended;
- The City should continue to evaluate recycled water; and
- Continue the current Demand Side Measure programs and explore additional measures.

In December 2003, Council adopted WIRP Guidelines (Attachment A) for the development of new water resources and the preservation of existing supplies, which are summarized below:

1. Preserve and enhance SFPUC supplies
2. Continue to advocate for an interconnection between SFPUC and SCVWD
3. Participate on the development of cost effective regional recycled water programs
4. Scope water conservation programs to comply with Best Management Practices (BMPs)
5. Maintain emergency water conservation measures to be activated in case of droughts
6. Retain groundwater supply options in case of changed future conditions
7. Survey community to determine its preferences regarding the best water resource portfolio

<u>2003 WIRP Guideline Summary Review</u>
A summary of the current situation with respect to each of the 2003 WIRP Guidelines is provided below.

Guideline #1 - Preserve and enhance SFPUC Supplies. This guideline had objectives including that: a) the SFPUC regional water system be rebuilt; b) the cost of improvements is fairly allocated; c) future water needs can be met; d) there are adequate supplies during drought; e) the community prepare for potential water outages; f) the City implement cost effective water conservation activities; g) water received must meet drinking water standards; h) the Master Contract is properly implemented and a new contract is in place prior to 2009; and i) there is ongoing support of efforts to protect health, safety and economic well-being of the water customers and community.

The guideline was critical when the 2003 WIRP was completed since the SFPUC had not yet adopted its Water System Improvement Program (WSIP) and the City's contract with SFPUC would expire in June 2009. In May 2008, the SFPUC adopted the WSIP and since then has been earnestly implementing the rebuild of the regional system. In June 2009, a new Water Supply Agreement was executed with San Francisco that resolved such issues as fair cost allocation, drought supply allocation, and water quality assurances. In addition, the City Council adopted the 2010 Urban Water Management Plan (UWMP) that establishes goals for water efficiency resources (Staff Report #1688).

Guideline #2 - Advocate for an interconnection between the SFPUC and the SCVWD. In 2003 the SCVWD evaluated extending its treated water pipeline to serve Palo Alto and other north county water retailers. During SCVWD's preparation of the Water Supply and Infrastructure Master Plan in 2012, staff again requested the SCVWD analyze a pipeline extension and reliability interconnection with the SFPUC system. The SCVWD declined to evaluate an extension in the plan, but indicated it may be considered in a future infrastructure reliability master plan.

Guideline #3 – Actively participate in development of cost effective regional recycled water plans: In 2006, the City completed a Recycled Water market Survey Report to determine potential customers within the City, evaluate potential pipeline alignments, and provide preliminary cost estimates. In 2008, the City completed a Recycled Water Facility Plan, which identified a preferred pipeline alignment and prepared costs estimates for the preferred project. In 2010, the City of Mountain View and the Regional Water Quality Control Plant (RWQCP) completed a new recycled water pipeline to serve customers in the Mountain View area. Since 2010, the City has developed a Mandatory Use Ordinance, a Salinity Reduction Policy (CMR 121:10), is preparing environmental documents for the Palo Alto project, and has been actively pursuing grant and low interest loan opportunities. Most recently, the RWQCP completed a Long Range Facilities Plan (Staff Report #2914), which includes an assessment of the current and future recycled water program and identifies program needs.

Guideline #4 – Focus Water DSM Programs to comply with BMPs: The City is a signatory to the California Urban Water Conservation Council's Memorandum of Understanding (MOU) regarding urban water conservation. The City strives to implement programs that meet or exceed the current BMPs as directed in the MOU and the City's 2010 UWMP contains aggressive water efficiency goals.

Guideline #5 - Maintain Emergency Conservation Measures to be activated in case of droughts: The 2010 UWMP contains the actions and measures that will be implemented in response to a drought.

Guideline #6 – Retain Groundwater Supply options in case of changed future conditions: The City is currently developing the Emergency Water Supply and Storage Project. Although the primary purpose of the project is to provide emergency water supplies during a catastrophic interruption of SFPUC service, it includes the capability for further retrofits to some or all of the new and refurbished wells for normal year use. However, the project's Environmental Impact Report (EIR) includes a mitigation measure limiting groundwater pumping to a maximum of 1500 AFY during a drought. The SCVWD, in its role as the groundwater steward for Santa Clara County, recently completed an update to its Groundwater Management Plan. As part of the process, staff requested additional analysis on the groundwater basin in the Palo Alto area. This additional information may assist the City's effort to modify the 1500 AFY limitation, if there is an interest in doing so.

Guideline 7 – Survey Community to determine its preference regarding the best water resource portfolio. In June 2004, staff presented the results of the community survey to the UAC. The survey polled the community on the use of groundwater during a drought, and the results indicated water quality issues were a primary concern. The report recommended the City await the completion of the Emergency Water Supply and Storage project, and then proceed with an evaluation of using groundwater as a supplemental source during a drought.

DISCUSSION

It has been almost a decade since completion of the last WIRP. Several key milestones have occurred since then, and the water utility landscape continues to evolve in response to legislation, the regulatory environment, and community preferences. The changes since the 2003 WIRP are driving the need to re-evaluate existing conditions to determine if adjustments are needed.

2013 WIRP Update

The 2013 WIRP update will review and make necessary adjustments to the existing WIRP guidelines so they are consistent with existing policies and reflect community preferences. The completion of the Preliminary Assessment (Attachment B) is the first step in the development of the 2013 WIRP.

The Preliminary Assessment provides a general evaluation of current resources and potential future water resource alternatives based on the best available information. In some cases, the evaluation of the resource option is based on consultant reports and analysis that was performed over 10 years ago. Staff has refreshed the analysis to provide a current representation as best as possible.

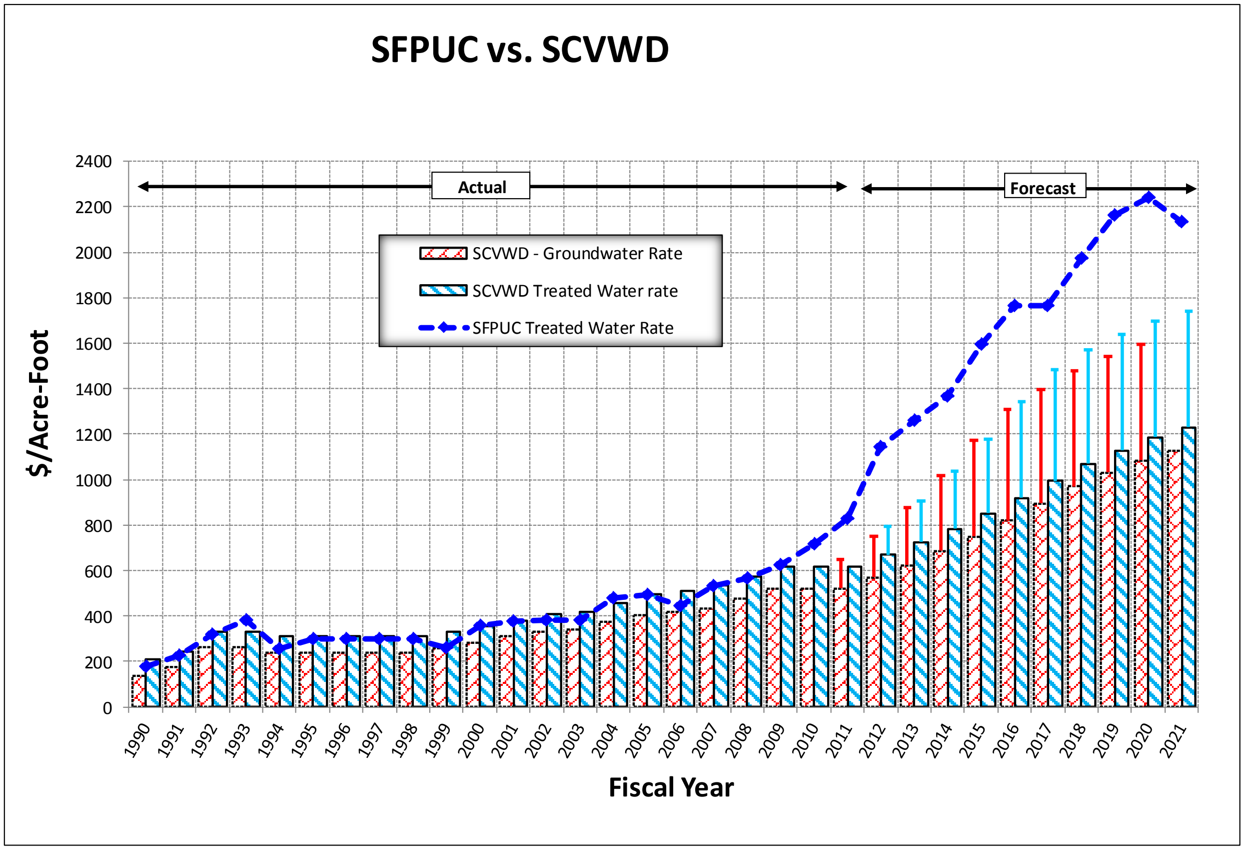
The potential water resources described in the Preliminary Assessment include:

1. Water from the SFPUC
2. Groundwater
3. Treated Water from the SCVWD
4. Recycled Water
5. Demand-Side Management
6. Sale of the City's Individual Supply Guarantee

Water resources that were evaluated in the 2003 WIRP process, but are not included in this Preliminary Assessment, include desalination, small scale groundwater wells for irrigation, and treated contaminated groundwater.

One of the major changes since the 2003 WIRP is that the cost of SFPUC water has increased significantly and has become much more expensive than water from the SCVWD as shown in Figure 1 below.

Figure 1: Actual and Forecast Cost* of SFPUC and SCVWD Water Supplies



* The bars for the SCVWD costs show a higher cost scenario that includes higher CIP spending.

Given the current and projected costs of water from the SFPUC and SCVWD, a rough estimate of the total annual costs can be calculated if all of the City's potable water supplies came from either the SFPUC, SCVWD treated water, or groundwater. Table 1 below shows the estimated annual cost in 2013, 2015, and 2020 for those three sources.

Table 1: Estimated Cost of Water Supply Alternatives

	FY 2013	FY 2015	FY 2020
Water needs (AF/year)	13,500	14,243	14,971
Unit Cost ($/AF)			
SFPUC supplies	$1,259	$1,594	$2,134
SCVWD treated water	$725-905	$850-1180	$1185-1695
Groundwater	$625-805	$750-1080	$1085-1595
Annual Cost ($million) with:			
100% SFPUC supplies	$17.00	$22.70	$31.95
100% SCVWD treated water	$9.7-12.21	$12.1-16.8	$17.74-25.3
100% Groundwater (1)	$9.7-12.21	$12.1-16.8	$17.74-25.3

(1) Cost includes O&M cost of $100/AF for operating the City's wells

As shown in Table 1, there are potentially significant cost savings if the City discontinued using water from the SFPUC and replaced it with groundwater or SCVWD treated water. However, there are also water quality impacts that the community will need to determine are acceptable. In addition, since the groundwater may not meet secondary drinking water quality standards, there may be additional costs for treatment that are not included in these cost estimates.

Issues with Current Water Supplies

Besides the increasing cost of supplies from the SFPUC, the City's current water supply is vulnerable to water supply shortages in dry years. The current plans for dealing with these shortages are to request, and provide incentives for, customers to reduce water usage. In addition, groundwater is available as a supplemental supply in droughts. The new well planned at El Camino Park can be blended with SFPUC supplies in the new reservoir prior to introduction to the City's distribution system to ensure that the water meets all water quality standards. Presently, the City can use 1,500 acre-feet/year (AFY), or about 12% of the City's current annual usage, of groundwater.

Water Supply Options to Further Evaluate

Based on the Preliminary Assessment, staff has identified several water supply portfolio options that merit further evaluation. This evaluation may involve additional analysis and/or consultant assistance to provide more meaningful data for the various supply options to be properly characterized and evaluated. Before a recommendation can be developed, several issues require additional study and evaluation. These relate to the use of groundwater, SCVWD treated water, recycled water, and the sale of the City's unused ISG to SFPUC supplies. The issues for each of these resource options that need more in-depth evaluation are described below.

1. **Groundwater** – The 1,500 AFY mitigation measure limitation on the use of groundwater reduces the City's flexibility for using groundwater in droughts and in normal years. Staff plans to pursue modification of that restriction. This may require additional groundwater modeling and possibly an updated environmental review process. Depending on the amount of groundwater the City would seek to use, the supporting analysis could require intensive groundwater modeling and coordination with SCVWD, neighboring agencies and other stakeholders.

2. **SCVWD treated water** – Since the City has no current connection to SCVWD's treated water system, using treated water would require an extension of the SCVWD's West Pipeline to an interconnection point at Page Mill Road. An evaluation of this option may require an updated West Pipeline extension study similar to the one done in 2003. The study would evaluate the costs and cost allocation scenarios for the interconnection. Implementation of this alternative would require the City to execute several new contracts and revise the existing contract with the SFPUC. Staff anticipates the SCVWD will perform the necessary environmental reviews for a West Pipeline extension.

3. **Recycled water** – Recycled water is a unique, non-potable supply source that would augment the portfolio with a locally controlled, diverse supply capable of providing dual benefits from a water and wastewater perspective. As discussed in the Preliminary Assessment, the evaluation of a recycled water extension to serve the Stanford Research Park is underway and a recommendation on a future recycled water project depends on securing an outside funding source. Following completion of the environmental document, staff will prepare a financial feasibility report and make recommendations on an expansion of the recycled water distribution system.

4. **Sale of the City's unused Individual Supply Guarantee (ISG) to SFPUC supplies** – Water transfers can be complicated and require time to structure. Considering recent events that have provided indicative pricing for a potential transaction, staff recommends the City begin the evaluation of a transfer of the City's ISG. While potential revenues are a major factor in the recommendation to move forward, staff has been monitoring the differential between water consumption and the City's ISG for some time. In light of the historical and projected ISG surplus, a sale of a small portion of the City's ISG may be in the best interest of the community. Proceeds from a sale could reduce water rates or provide funds for increased conservation programs or the recycled water project.

The evaluation of recycled water and a sale of some of the City's ISG are proceeding independently. Examples of water supply portfolios that staff proposes to evaluate in more detail are shown in Table 2.

Table 2: Water Supply Portfolios to Evaluate

Portfolio	SFPUC supplies	SCVWD Treated Water Supplies	Groundwater
Status Quo	100% of normal year needs	None	Up to 1,500 AFY for supplemental supply in droughts
Increased Groundwater	50% of normal year needs	None	50% of normal year needs
Treated Water Usage	50% of normal year needs	50% of normal year needs	Up to 1,500 AFY for supplemental supply in droughts
Only Treated Water and Groundwater	None	50% of normal year needs	50% of normal year needs

NEXT STEPS

Preparation of the 2013 WIRP will proceed through FY 2013, and will likely extend into FY 2014 depending on the level of additional studies and outside consultant assistance that is appropriate. Staff will return to the UAC with more detailed information and supporting analysis for the different water supply portfolio options. Staff will also evaluate a potential ISG sale and return to the UAC with a recommendation on moving forward with a transaction. Finally, staff will continue ongoing efforts to complete an extension of the recycled water system to serve customers in the Stanford Research Park and return to the UAC with a financing plan once there is a reasonable expectation that supplemental outside funding can be secured. Following selection of preferred options based on the additional evaluations in the next phase, staff will prepare a Draft Water Integrated Resource Plan and propose modifications to the WIRP Guidelines.

ENVIRONMENTAL REVIEW

The UAC's review and discussion of the Preliminary Assessment of Water Resource Alternatives does not meet the California Environmental Quality Act's definition of a "project" under Public Resources Code Section 21065, thus no environmental review is required.

ATTACHMENTS

A. 2003 Water Integrated Resource Plan Guidelines

B. 2013 Preliminary Assessment of Water Resource Alternatives

PREPARED BY: **NICOLAS PROCOS,** Senior Resource Planner

REVIEWED BY: **JANE RATCHYE,** Assistant Director, Resource Management

DEPARTMENT HEAD:

VALERIE O. FONG
Director of Utilities

WIRP Guidelines

Adopted by Resolution by the City Council on December 8, 2003 [CMR:547:03]

Guideline 1 – Preserve and enhance SFPUC supplies: With respect to the City of Palo Alto Utilities' (CPAU's) primary water supply source, the San Francisco Public Utilities Commission (SFPUC), continue to actively participate in the Bay Area Water Supply and Conservation Agency (BAWSCA) to assist in achieving BAWSCA's stated goal: "A reliable supply of water, with high quality, and at a fair price." Objectives in support of that overall goal include:

A. <u>That the regional water system gets rebuilt cost-effectively and that BAWSCA monitor implementation of AB 1823</u> – San Francisco should safeguard the water system against damage from earthquakes and other foreseeable hazards. BAWSCA will monitor progress on the system repairs and on completing the requirements of the legislation that the BAWSCA agencies supported to oblige San Francisco to repair and rebuild the regional system.

B. <u>That the cost of improvements is fairly allocated</u> – San Francisco should commit to maintaining cost-based pricing, with the costs of the wholesale water system shared between the City and its wholesale customers based on their proportionate share.

C. <u>That future water needs can be met</u> – San Francisco must evaluate the ability of the regional system to meet future supply and capacity requirements and must use the BAWSCA agencies' long-term water demand forecasts as the basis for regional water demand projections.

D. <u>That there are adequate supplies during droughts</u> – San Francisco should arrange back-up supplies for dry years and should "drought proof" the entire service area, not just San Francisco itself. If rationing becomes necessary, San Francisco should use a system that allocates available water between San Francisco and wholesale customers in a way that (1) is fair and (2) avoids penalizing long-term conservation efforts and/or development of alternative supplies, such as recycled water.

E. <u>That communities prepare for potential water outages</u> – San Francisco should coordinate with the BAWSCA agencies to develop a crisis management plan.

F. <u>That agencies implement cost-effective water conservation activities</u> – San Francisco should provide agencies enough information so that they can prepare for possible outages, including the provision of conservation programs for their communities. BAWSCA can act as coordinator for these programs to improve the cost-effectiveness of agencies offering such programs.

G. <u>That water received must meet drinking water standards</u> – San Francisco should continue to protect the purity of Hetch Hetchy water and commit to provide its wholesale customers with water that meets EPA and California drinking water standards.

H. <u>That the Master Contract is properly implemented and a new Master Contract is in place prior to 2009</u> – San Francisco should commit to maintaining cost-based pricing, with the costs of the wholesale water system shared between the City and its wholesale customers based on their proportionate share.

I. <u>That there is ongoing support of efforts to protect health, safety and economic well being of the water customers and communities</u> – BAWSCA should maintain the support of the many allies who supported the legislative effort to ensure San Francisco repairs, rebuilds, and maintains the regional system.

Guideline 2 – Advocate for an interconnection between SFPUC and the District: Work with the Santa Clara Valley Water District (District) and the SFPUC to pursue the extension of the District's West Pipeline to an interconnection with the SFPUC Bay Division Pipelines 3&4. Continue to re-evaluate the attractiveness of a connection to an extension of the District's West Pipeline.

Guideline 3 – Actively participate in development of cost-effective regional recycled water plans: Re-initiate discussions with the owners of the Palo Alto Regional Water Quality Control Plant (PARWQCP) on recycled water development. In concert with the PARWQCP owners, conduct a new feasibility study for recycled water development. Since the feasibility of a recycled water system depends upon sufficient end-user interest, determine how much water Stanford and the Stanford Research Park would take.

Guideline 4 – Focus water DSM programs to comply with BMPs: Continue implementation of water efficiency programs with the primary focus to achieve compliance with the Best Management Practices (BMPs) promoted by the California Urban Water Conservation Coalition.

Guideline 5 – Maintain emergency water conservation measures to be activated in case of droughts: Review, retain, and prioritize CPAU's emergency water conservation measures that would be put into place in a drought time emergency.

Guideline 6 – Retain groundwater supply options in case of changed future conditions: Using groundwater on a continuous basis does not appear to be attractive at this time due to the availability of adequate, high quality supplies from the SFPUC in normal years. However, SFPUC supplies are not adequate in drought years and circumstances could change in the future such that groundwater supplies could become an attractive, cost-effective option. Examples of changing circumstances could be that the amount of water available to CPAU from the SFPUC for the long-term is reduced. This could occur if regulations or legislation require additional water to be made available to the Tuolumne River fisheries. In addition, in the future allocations or entitlements to SFPUC water may be developed. If those allocations are based on the dry-year yield of the system, allocations to all the users of the system, including CPAU, could be well below their current and projected future needs. CPAU should retain the option of using groundwater in amounts that would not result in land surface subsidence, saltwater intrusion, or migration of contaminated plumes.

Guideline 7 – Survey community to determine its preferences regarding the best water resource portfolio: Seek feedback from all classes of water customers on the question of whether to use groundwater during drought to improve drought year supply reliability. At the same time, seek feedback on the appropriate level of water treatment for groundwater if it were to be used in droughts. Survey all classes of water customers to determine their preferences as to the appropriate balance between cost, quality, reliability, and environmental impact.

ATTACHMENT B

PRELIMINARY ASSESSMENT OF WATER RESOURCE ALTERNATIVES

CITY OF PALO ALTO UTILITIES

February 2013

2013 Preliminary Assessment

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List of Acronyms

AFY	Acre Feet per Year
BAWSCA	Bay Area Water Supply and Conservation Agency
BMP	Best Management Practice
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
DSM	Demand Side Management
EIR	Environmental Impact Report
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission

GWMP	Groundwater Management Plan
ISA	Interim Supply Allocation
ISG	Individual Supply Guarantee
ISL	Interim Supply Limitation
MGD	Million gallons per day
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
PEIR	Program Environmental Impact Report
PPM	Parts per Million
RWQCP	Regional Water Quality Control Plant
SCVWD	Santa Clara Valley Water District
SFPUC	San Francisco Public Utilities Commission
SRF	State Water Resources Control Board State Revolving Fund
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TRC	Total Resource Cost
UAC	Utilities Advisory Commission
UWMP	Urban Water Management Plan
WIRP	Water Integrated Resource Plan
WSA	Water Supply Agreement
WSIP	Water System Improvement Program

I. Introduction

Preparation of a Preliminary Assessment of Water Resource Alternatives is the first step towards development of a Water Integrated Resource Plan (WIRP). The Preliminary Assessment collects the available information and data about all water resource alternatives available to the City of Palo Alto. The following are a summary of the main drivers for updating the WIRP at this time.

a) *Cost Increases* – The San Francisco Public Utilities Commission (SFPUC) is midway through the $4.6 billion Water System Improvement Program (WISP), which includes an upgrade of the regional water system. As a result of the WSIP, the cost of SFPUC water has risen dramatically and will continue to do so. With the increase in costs, other alternatives are increasingly competitive with SFPUC supplies.

b) *SFPUC Wholesale Water Charge* – The SFPUC currently collects the wholesale revenue requirement primarily through a volumetric water rate. The SFPUC may propose changes to the current wholesale rate structure that include a fixed charge based on the Individual Supply Guarantee. Since the City has a relatively high Individual Supply Guarantee, this could change the City's cost dramatically and make other alternatives more cost-effective.

c) *Dry year need* – The City has an Individual Supply Guarantee of 17.07 million gallons per day (MGD) from the SFPUC system. The City has no foreseeable supply deficiency in normal years, but SFPUC supplies are inadequate during dry years. A critical question to address is the level of reliability the City will provide to residents and businesses and at what cost.

d) *Disposition of "Surplus" SFPUC* Individual Supply Guarantee– The City currently uses substantially less than its Individual Supply Guarantee. Considering long lead times to execute water transfers, it may be the time for the City to proceed towards a sale of a portion of the Individual Supply Guarantee. The sale could generate revenue for a variety of options, including increased dry year reliability, conservation programs, a recycled water project, or to reduce rates.

e) *Alternative Supplies* – The Santa Clara Valley Water District's (SCVWD's) groundwater and treated water charges have historically been similar to the cost of SFPUC supplies. Over the last few years, and for the foreseeable future, SCVWD water charges will be lower than SFPUC charges, making groundwater or a connection to the SCVWD's treated water system potentially cost-effective alternatives to SFPUC water.

f) *Use of Palo Alto Groundwater System* – The City has recently refurbished the five older wells, developed two new wells and is completing another new well. One or more of the wells could be used to provide supplemental dry year supplies or as an alternative to SFPUC supplies during normal years.

g) *Legislative & Regulatory Risks* – The City's 2010 Urban Water Management Plan (UWMP) incorporates recent and future legislative and regulatory requirements to provide a comprehensive forward looking review of the water utility. A major new development is Senate Bill 7x-7 (2009), which requires a 20% reduction in per capita water use by 2020.

II. Background

The first WIRP was prepared largely because the City was faced with a decision to participate in a regional recycled water program. This 1993 WIRP assessed the costs and benefits of a recycled water project compared to other supply alternatives, and ultimately determined that recycled water was not cost effective relative to existing supplies. In 1999, the City began working on a new WIRP, and completed the effort with approval by the City Council of the WIRP Guidelines in December 2003 (CMR 547:03). During the process to prepare the 2003 WIRP, several studies were conducted to inform the effort:

1. ***Water, Wells, Regional Storage, and Distribution System Study, 1999, Carollo Engineers*** – This study identified system improvements to the distribution system to meet water demands and fire flows following a catastrophic interruption of service on the SFPUC system. Among the recommendations was to refurbish the 5 existing wells and construct three new wells and a new water storage tank.

2. ***Long Term Water Supply Study, 2000, Carollo Engineers*** – The report examined the issues and costs of using new or rehabilitated wells as active sources of supply. The alternatives examined in the report included: (1) Using the wells for active supply either on a long term basis or during droughts; (2) using groundwater for irrigation; and (3) connecting to the SCVWD treated water pipeline.

3. ***Groundwater Supply Feasibility Study, 2002, Carollo Engineers*** – The report evaluated whether operating one or two of the City's water wells as active supplies would cause significant decrease in groundwater levels or deterioration in groundwater quality".

4. ***Santa Clara Valley Water District's West Pipeline Extension Conceptual Evaluation Final Report, 2003, SCVWD.*** – The report evaluated an extension of the existing SCVWD West Pipeline to enable an interconnection of the Palo Alto and SCVWD systems at Page Mill turnout.

The 2003 WIRP indicated that SFPUC supplies were adequate during normal years, but additional supplies were needed in dry years to avoid shortages. Since SFPUC supplies were adequate in normal years, the following conclusions were drawn:

1. The City's existing Individual Supply Guarantee provides adequate supplies;
2. The cost to connect to the SCVWD treated water pipeline was prohibitive;
3. Continuous use of groundwater is not recommended;
4. The City should continue to evaluate recycled water;
5. Continue the current Demand Side Management programs and explore additional measures; and
6. Additional supplies are needed in a drought.

Following approval of the 2003 WIRP, staff surveyed residential customers to gain a sense of community preferences on the use of groundwater during a drought. The survey asked respondents to rank several options for water supply during a drought: (A) blend groundwater with existing SFPUC supplies; (B) use no groundwater; and (C) treat groundwater at the well location prior to introduction to the distribution system.

Survey respondents generally preferred Options B (no groundwater) and C (treat groundwater), but Option A (blend groundwater) was not soundly rejected. The results of the survey were presented to the UAC in June 2004. Based on the results staff made the following recommendations:

1. Do not install advanced treatment systems for the groundwater at this time. This option is expensive, both in terms of capital and operating costs.
2. Blending at an SFPUC turnout is the best way to use ground water as a supplemental drought time supply while maintaining good water quality.
3. Staff should await the conclusion of the environmental review process before proceeding with any site selections for wells to be used in dry years.
4. Actively participate in the development of long term supply plans with the Bay Area Water Supply and Conservation Agency (BAWSCA) and/or SCVWD.
5. Continue efforts identified in the Council approved WIRP guidelines:
    a. Evaluate a range of demand side management options to reduce long term water demands.
    b. Evaluate feasibility of expanding recycled water.
    c. Maintain emergency water conservation measures to be activities in case of droughts.

III. Water Supply History

The water utility was established on May 9, 1896, two years after the City was incorporated. Local water companies were purchased at that time with a $40,000 bond approved by the voters of the 750-person community. These private water companies operated one or more shallow wells to serve the nearby residents. The city grew and the well system expanded until nine (9) wells were in operation by 1932.

In December 1937, the City signed a 20-year contract with the City and County of San Francisco for water deliveries from the newly constructed pipeline bringing Hetch Hetchy water from Yosemite to the Bay Area. Water deliveries from San Francisco commenced in 1938 and well production declined to less than half of the total citywide water demand.

A 1950 engineering report noted, "The capricious alternation of well waters and the [San Francisco] water...has made satisfactory service to the average consumer practically impossible." Groundwater production increased in the 1950s leading to lower groundwater tables and increasing water quality concerns.

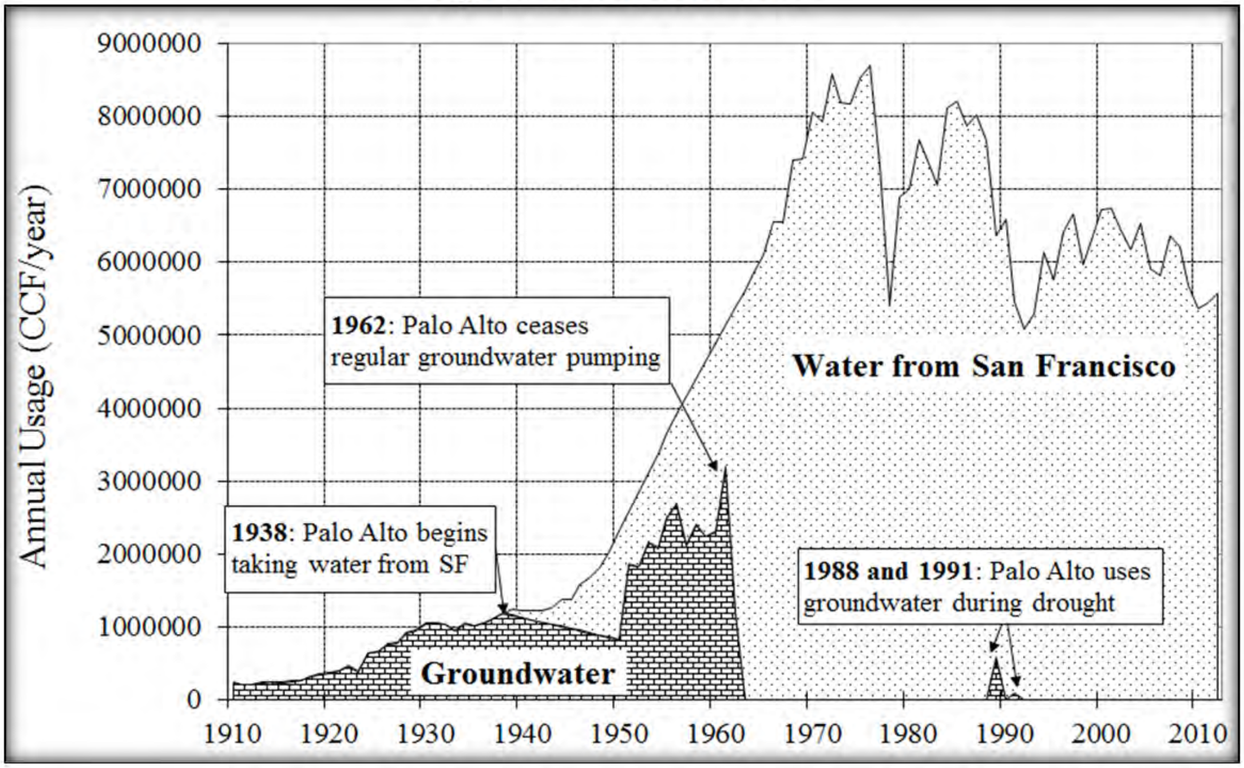
In 1962, a survey of water softening costs to City customers determined that the City should purchase 100% of its water supply needs from the San Francisco. A 20-year contract was signed with San Francisco and the City's wells were placed in a standby condition. Since 1962 (except for some very short periods) the City's entire potable water has come from San Francisco's Hetch Hetchy regional water system administered by the SFPUC.

In 1974, several wholesale customers joined Palo Alto and filed a lawsuit against the San Francisco in protest of an increase in water rates that was higher for wholesale customers than it was for direct retail customers. In 1984, settlement negotiations resulted in the "Settlement Agreement and Master Water Sales Contract between the City and County of San Francisco and Certain Suburban Purchasers in San Mateo, Santa Clara and Alameda Counties". The 25-year agreement was approved in 1984. The 1984 agreement included the creation of a "Supply Assurance" equal to 184 million gallons of water per day (MGD) for the benefit of the wholesale customers.[1] The agreement included a mechanism to allocate the 184 Supply Assurance between the wholesale agencies. The City's allocation, or Individual Supply Guarantee (ISG), is 17.07 MGD. Each agency's ISG is perpetual in nature and survives termination or expiration of the water supply contract with San Francisco.

[1] The Supply Assurance is expressed as an annual average and does not constitute an obligation on the part of the SFPUC to meet daily or hourly peak demands.

In 2009, a new 25-year Water Supply Agreement (WSA) was executed between San Francisco and the City. The City's historical water use and supply sources are illustrated in Figure 1.

Figure 1: Historic Water Use



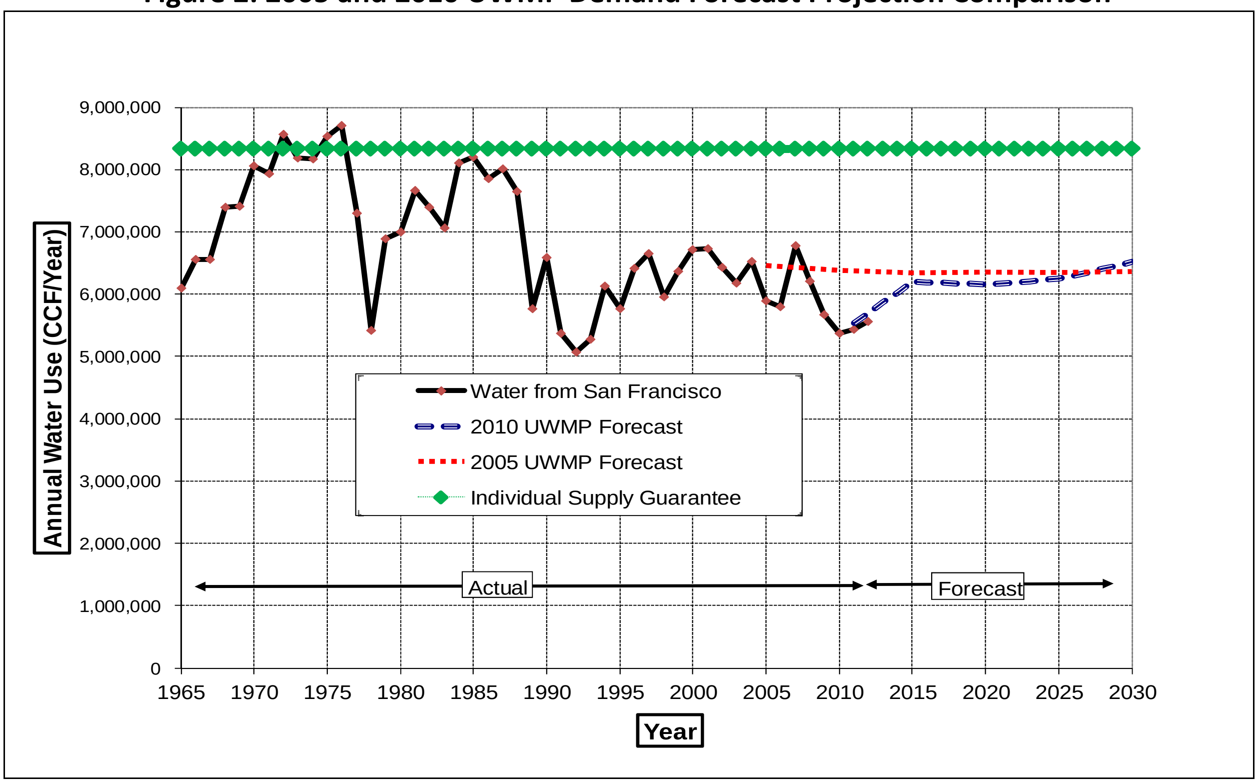
IV. Water Use Projections

The City of Palo Alto Utilities (CPAU) regularly prepares water supply and demand forecasts to prepare financial forecasts, to meet regulatory requirements, or as part of ongoing regional planning efforts. Like many water agencies in California, the City has experienced a significant drop in water use since 2006, which is largely attributable to weather, water conservation, and the recent economic recession.

Urban Water Management Plan (UWMP)

The UWMP is submitted to the Department of Water Resources every five years, and City Council approved the most recent 2010 UWMP in June 2011 (Staff Report 1688)[2]. Water demands forecast for the 2010 UWMP are shown in Figure 2 below. For comparison purposes, the forecast from the 2005 UWMP is also included in Figure 2. The water use projection results are revealing in that the City, along with most water agencies in California, did not anticipate the dramatic drop in water demand from 2007 to 2009. Potable water demands from 2009 to the present appear to have leveled off and have begun to trend upwards again, albeit slowly, and it remains to be seen if water demands will follow the increase forecasted in the 2010 UWMP.

Figure 2: 2005 and 2010 UWMP Demand Forecast Projection Comparison



[2] Typically, UWMPs are due December 31 of years ending in 0 and 5. However, a six-month extension was granted to allow suppliers to comply with new legislation (Senate Bill X7-7).

Water Conservation Bill of 2009

The City is subject to ongoing changes in the regulatory and legislative environment, though few are as explicit as SB X7-7, the Water Conservation Bill of 2009. SB X7-7 was enacted in November 2009 and requires water suppliers to reduce the average per capita daily water consumption in their service territories 20% by 2020. To monitor the progress towards achieving the 20% by 2020 target, the bill also requires urban water retail providers to reduce per capita water consumption 10% by 2015. Figure 3 illustrates the projected 2015 and 2020 state-mandated compliance targets and provides preliminary information on the City's need for future action to meet SB7x-7 requirements.

Figure 3: 20% by 2020 Compliance Forecast

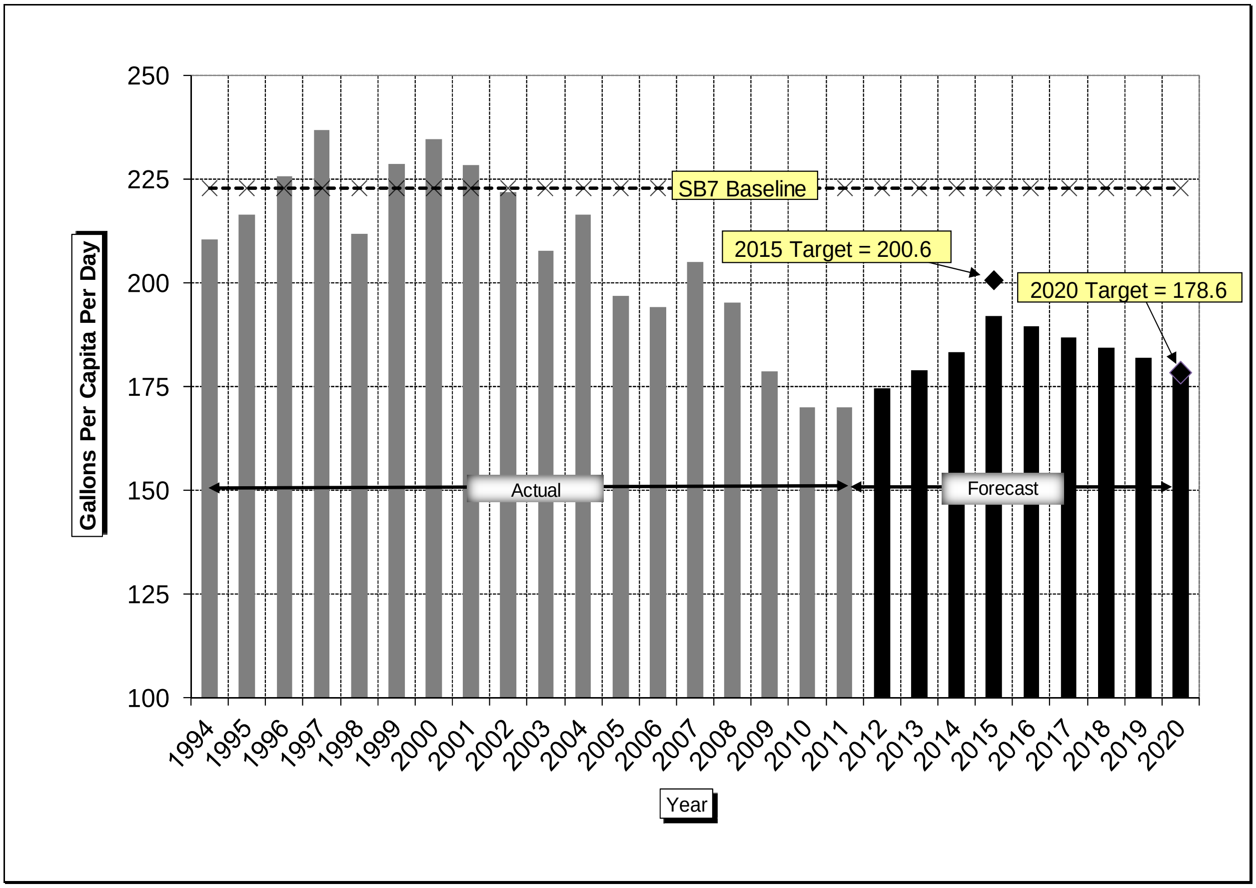
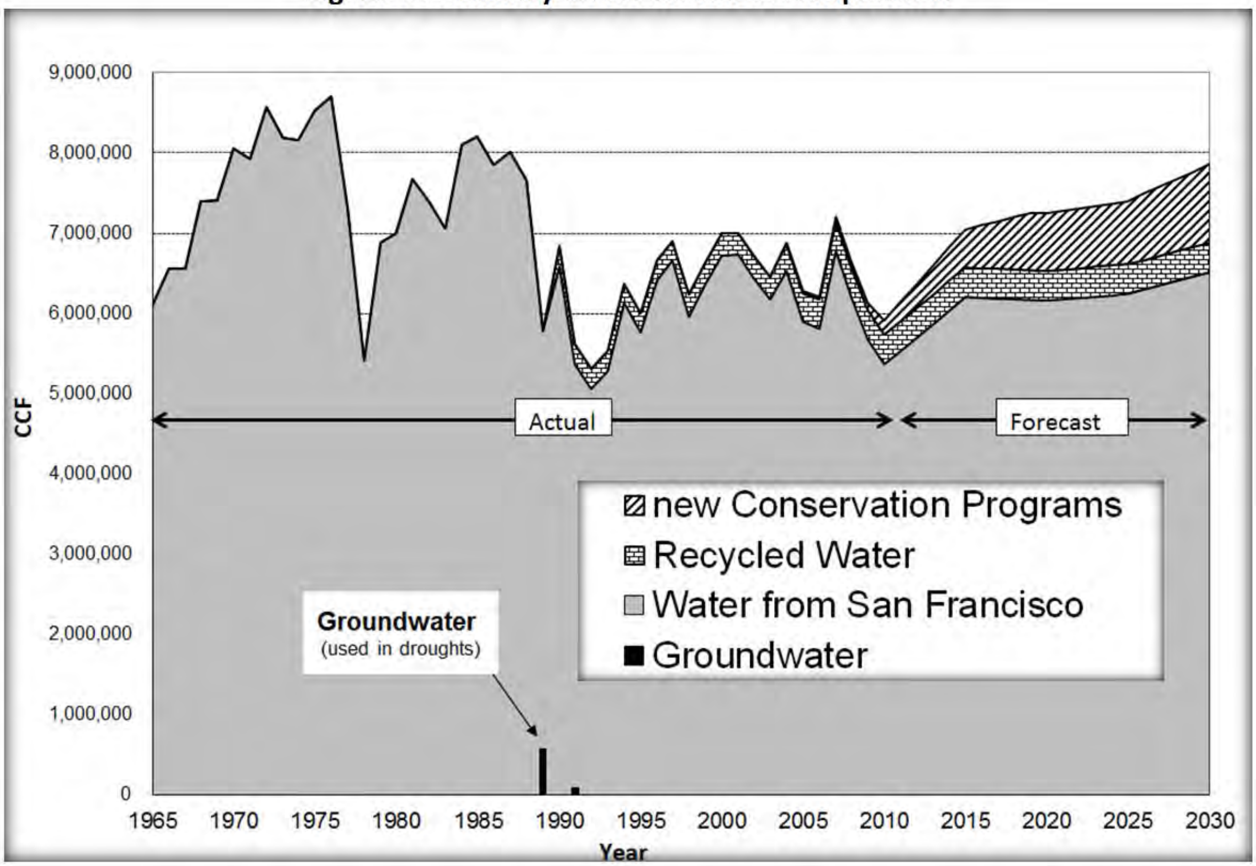


Figure 3 indicates that the City is on track to meet both the 2015 and 2020 state-mandated compliance targets.

Summary Water Resource Mix

The 2010 UWMP provided detailed information on baseline water resources through 2030. SFPUC supplies were assumed to remain the primary potable supply for the foreseeable future, but were not forecasted to increase dramatically over the 20-year planning horizon. Recycled water consumption was projected to continue at current levels and no expansion was assumed in the 2010 UWMP. Finally, demand side management and conservation program penetration and savings were projected to increase dramatically from the 2005 UWMP. A representation of the future water resource mix is provided in Figure 4.

Figure 4: Summary Water Resource Composition



V. Attributes Evaluated and Water Resource Alternatives Examined

Attributes Evaluated for each Water Resource Alternative

In this section, each potential water resource option is evaluated to allow each alternative to be compared to each other. The purpose of this evaluation is to provide the best available information on each water resource alternative and to identify data deficiencies that need to be addressed. The attributes evaluated for each alternative are listed below:

1. **Availability** – The quantity, timing, peak flow or capacity, and any expected changes over time.
2. **Cost** – The capital and O&M costs of the proposed action (including system upgrades, project lifetime, energy costs, chemicals, technical innovation, customer costs, etc.), the manner which the cost is incurred (pay-as-you-go, debt finance, etc.).

3. **Water Quality** – All options must meet water quality regulations, but options may differ in their relative water qualities (i.e. taste, odor, color, hardness, mineral content, trace levels of contaminants, etc.).
4. **Long Term Reliability** – What is the reliability of the source under different conditions? What future conditions could affect water deliveries?
5. **Emergency Robustness** – Will the resource perform under various scenarios, including an interruption of SFPUC supplies?
6. **Environmental impacts** – Are there anticipated environmental impacts and what level of environmental review is required?
7. **Sensitivity to Regulations** – Is the resource vulnerable or does it have strength in view of existing or impending federal, state, or local regulations?

Water Resource Alternatives Examined

The water resource alternatives evaluated in this report include:

1. Water from the SFPUC
2. Groundwater
3. Treated Water from the SCVWD
4. Recycled Water
5. Demand-Side Management
6. Sale of the City's Individual Supply Guarantee

Water resources that were evaluated in the 2003 WIRP process, but are not included in this Preliminary Assessment, include:

1. *Desalination* – BAWSCA is evaluating several desalination alternatives as part of recent long range supply studies. When this effort is complete, this alternative can be evaluated.

2. *Small scale irrigation wells* – The City is focusing its efforts on the capital program to improve the municipal well system to meet the dual purpose of providing emergency and supplemental potable supplies. Currently, individuals may drill their own wells without City review or permits, but are subject to rules and restrictions of the Santa Clara Valley Water District (SCVWD) and must obtain a permit from the SCVWD. The City does have the option of using small wells for irrigation of large landscapes, such as for City parks. However, the cost to maintain and operate small wells and locate a site for such facilities is problematic.

3. *Treated Contaminated Groundwater* – There are several entities in the City that treat contaminated groundwater and discharge the groundwater to the storm drain system and, to a lesser extent, the sanitary sewer system. The primary purpose of these facilities is to remediate contaminated groundwater with finite operations. The Santa Clara County Oregon Expressway dewatering pumps are the exception, and they discharge significant amounts of nuisance groundwater to the storm drain system to

keep the underpass dry. The City evaluated the capture and conveyance of the Oregon Expressway groundwater for irrigation purposes and determined the effort would require significant conveyance and storage infrastructure investments that are not cost effective.

VI. Water from the SFPUC

The City currently purchases 100% of its potable supplies from the SFPUC under the 2009 Water Supply Agreement (WSA). The WSA is administered for the City by the Bay Area Water Supply and Conservation Agency (BAWSCA). BAWSCA represents the interests of 24 cities and water districts and two private utilities that purchase wholesale water from the San Francisco regional water system. These entities provide water to 1.7 million people, businesses and community organizations in Alameda, Santa Clara and San Mateo counties. The City of Palo Alto is a member of BAWSCA and has a City Council appointed representative on the BAWSCA Board of Directors.

Availability

The City's right to water from the SFPUC system is embodied in the 2009 WSA. The City's Individual Supply Guarantee (ISG) of 17.07 MGD is a perpetual right, but the delivery of water is subject to interruption for reason of water shortage, drought, or emergency.

<u>Normal Year SFPUC Supplies</u>
While the City's ISG is 17.07 MGD, the City's water needs are currently only about 11.5 MGD. The WSA includes an interim water delivery limitation[3] from the SFPUC system of 265 MGD until its expiration in 2018. The City's share of the interim limitation, or its Interim Supply Allocation (ISA), is 14.70 MGD. Based on the water demand forecast from the 2010 UWMP, there is no foreseeable need for additional supply beyond the City's Individual Supply Guarantee, or the ISA.

<u>Dry Year SFPUC Supplies</u>
SFPUC's WSIP includes a goal of no greater than a 20% system-wide supply reduction on the SFPUC system during a drought. The 2009 WSA includes a water shortage allocation plan to share water from the regional system between the SFPUC retail and wholesale customers during a shortage of up to 20% (Tier I plan). The wholesale customers further divided the wholesale allocation based on a formula adopted by all the wholesale customers (Tier II plan). The detail of the allocation methodology is included in the City's 2010 UWMP (Section 7 – Water Shortage Contingency Plan) and was approved by City Council in February 2011 (Staff Report 1308). The Tier II formula expires in 2018, unless extended by mutual agreement of the BAWSCA members. Table 1 summarizes the effect of the water shortage allocation formula on

[3] This limitation applies to all users of the San Francisco regional water supply system, the City of San Francisco and all the BAWSCA member agencies.

Palo Alto during a 20% SFPUC system-wide reduction under low demand and high demand scenarios.[4]

Table 1: City Of Palo Alto Water Shortage Allocation

	Palo Alto Allocation (low demand)	Palo Alto Allocation (High demand)
(a) Baseline Demand (MGD)	11.63	13.33
(b) Drought Allocation (MGD)	8.94	10.011
(c) Reduction from Baseline Demand (b-a) (MGD)	-2.69	-3.32
(d) Percentage reduction from Baseline Demand (c/a)	-23.12%	-24.90%

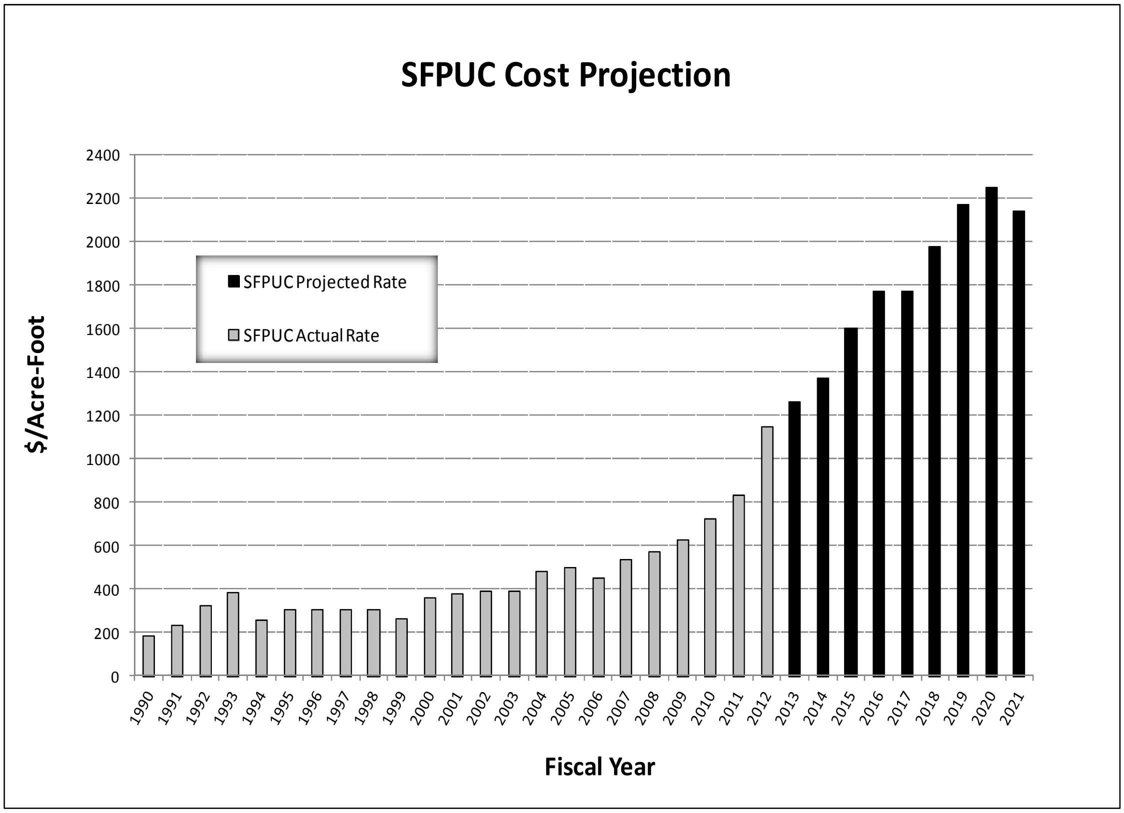
The results in Table 1 indicate that the City will experience a water supply deficit of 23-25% in the event of a 20% system-wide water shortage on the SFPUC system.

[4] In general, changes in Palo Alto demand patterns track many of the other BAWSCA members. However, the ultimate allocation to each BAWSCA agency depends on many factors, including the water use of each agency relative to each other. For these reasons, staff can only provide an approximation of the potential cutback.

Cost

The City purchases 100% of its potable water supply from the SFPUC, with the current cost structure composed of a volumetric charge and a small fixed monthly meter charge. With the $4.6 billion WSIP well underway, the cost of SFPUC water has increased sharply. Recent region-wide water consumption declines have intensified the problem since the cost is spread over fewer sales units. The historic and projected cost of SFPUC water is illustrated in Figure 5.

Figure 5: SFPUC Actual and Projected Cost of Water



While the SFPUC charges wholesale customers based on how much water is used, the costs of the SFPUC system are almost entirely fixed costs – in other words, even if usage drops the cost to operate the system (O&M, debt service, etc.) remains essentially the same[5].

The SFPUC water cost projections in Figure 5 assume that the current rate structure remains in place. However, the WSA provides some flexibility for the SFPUC to adjust rate structures and the SFPUC recently signaled an interest in exploring alternative rate structures[6] including increasing the fixed charge component and allocating charges based on the ISG, rather than actual water usage. The City's share of the costs paid by the BAWSCA agencies (the "Wholesale Revenue Requirement"), steadily decreased from 8% in 1998 to 7.2% in 2010 as the City's proportional share of water purchases dropped relative to the other BAWSCA agencies. In

[5] The SFPUC system is largely gravity fed, so little variable O&M is required for water deliveries.
[6] SFPUC Comments, July 2012 BAWSCA Board of Director's meeting

recent years the City's share of the Wholesale Revenue Requirement has increased slightly, probably as a result of several SFPUC customers making economic decisions to reduce SFPUC purchases to minimum amounts in favor of other, less costly supplies. The City's ISG of 17.07 MGD is approximately 9.23% of the total BAWSCA agencies' Supply Assurance of 184 MGD. If collection of the Wholesale Revenue Requirement were to be based on each agency's ISG, the City could pay 20-30% more for water annually, with little apparent increase in benefit.

Water Quality

SFPUC supplies are extremely high quality. See Table 4 which lists key water quality parameters for SFPUC water, SCVWD treated water and groundwater. Water provided by the SFPUC is a mix of Hetch Hetchy water and water from the East Bay and Peninsula reservoirs. In an average year, Hetch Hetchy water makes up 85% of the mix. Due to maintenance requirements, the SFPUC typically will shut down the Hetch Hetchy supply for a period during the low demand winter months and draw from the local reservoirs. It is not unusual to experience temporary water quality changes due to these events, though the water still meets all drinking water quality standards.

Since completion of the 2003 WIRP, there were two noteworthy operational changes on the SFPUC system that related to water quality: In 2004, the SFPUC starting using chloramine instead of chlorine as the primary drinking water disinfectant. In 2005, San Francisco began adding fluoride to the water supply. Up until then, the City introduced fluoride at the SFPUC turnouts, but ceased to do so once the SFPUC began providing fluoridation from a centralized facility[7].

Long Term Reliability

Recent demand projections do not forecast a normal year supply deficiency, given the perpetual nature of the City's Individual Supply Guarantee. However there is one situation where the City's Individual Supply Guarantee could be reduced. Under the terms of the 1962 contract between it and San Francisco, the City of Hayward's contractual entitlement from the SFPUC system essentially equals its water demand. In theory, since the collective Supply Assurance of the wholesale customers cannot exceed 184 MGD, if Hayward's water usage increases substantially, the other wholesale agencies could experience a proportional ISG reduction to ensure the 184 MGD limit is not exceeded. The most recent water use projection shows this will not be an issue until at least 2030, and it will proceed gradually in any event.

SFPUC's level of service goal is to meet dry year delivery needs while limiting rationing to a maximum 20% system wide reduction in water service during extended droughts. However,

[7] In 1957 the voters in Palo Alto adopted a measure that requires fluoride be added to the City's water supply (Palo Alto Municipal Code Section 12.24.010).

recent events have called into question the SFPUC's ability to maintain a level of service of no greater than 20% reduction[8].

BAWSCA and its member agencies are developing the Long Term Reliable Water Supply Strategy to quantify when, where, and how much additional supply reliability and new water supplies are needed throughout the BAWSCA agencies' service area through 2035. The report revealed that several agencies have normal year needs in excess of their ISG and all agencies have varying dry year deficiencies. The report also identified several potential resource alternatives to address these shortfalls, including desalinization, recycled water, and water transfers.

The BAWSCA report (Section 3.2 of the Phase IIA report) includes a representation of potential dry year cutbacks based on historic hydrologic conditions for the period from 1920 through 2002. The analysis used the SFPUC hydrologic system's operational model to evaluate the frequency and magnitude of droughts on the system over the 83 years with all WSIP related projects complete. The results, as shown in Table 2, indicate there is little supply cutback risk under low demand scenarios, but the risk rises as demands increase.

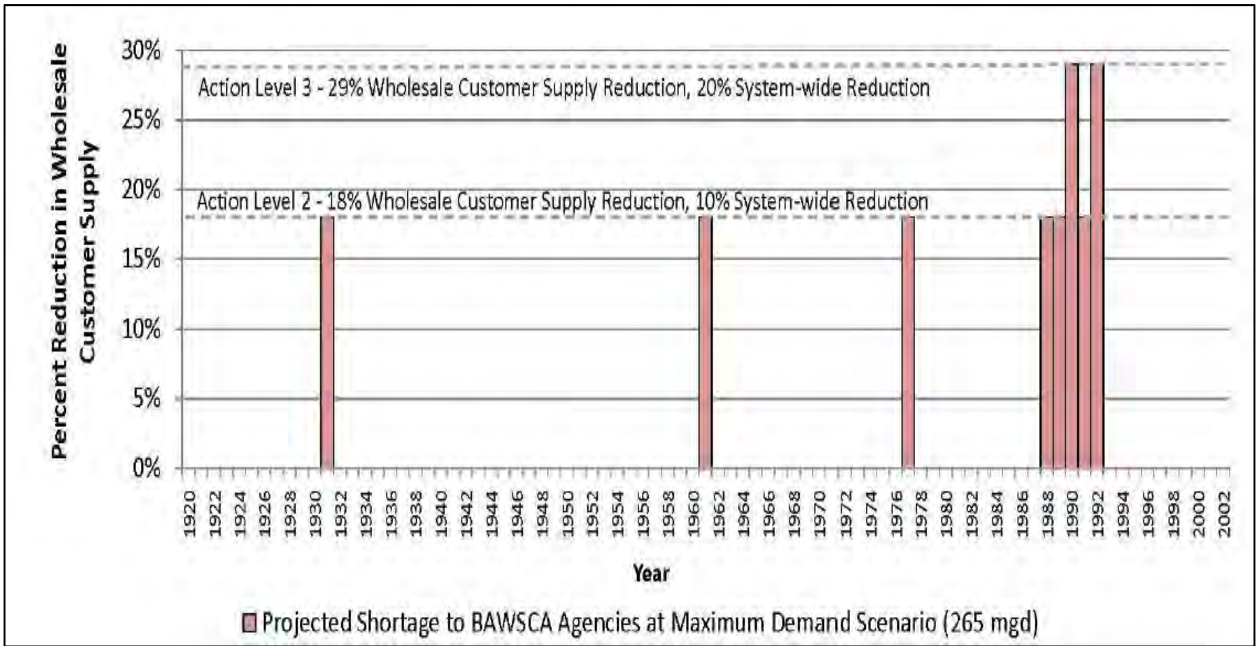
Table 2: Dry Year Shortfall under different demand scenarios

Demand Scenario	Number of Years of Projected Supply Cutbacks to the Wholesale Customers Over 83-year history	
	18% Average Wholesale Customer Supply Cutback (10% System-wide shortfall)	29% Wholesale Customer Supply Cutback (20% System-wide Shortfall)
Minimum Demand Scenario (224 MGD)	0	0
Intermediate Demand Scenario (252 MGD)	7	1
Maximum Demand Scenario (265 MGD)	6	2

[8] Environmental flow requirements at Crystal Springs and Calaveras Dam were greater than anticipated. A 2 MGD water transfer between the Modesto Irrigation District and SFPUC was also rejected recently by the MID Board.

Figure 6 provides a representation of the supply cutbacks that would have been experienced under the maximum demand scenario using historic hydrologic data with all WSIP projects complete. The results provide an illustration of the frequency and magnitude of droughts in the past under the high demand scenario, and are helpful in framing future dry year risks. As shown, over the 83 year hydrologic period, there would have been 8 years with water shortages – 6 years with a 10% system-wide reduction and 2 years with a 20% system-wide reduction.

Figure 6: Historic Water Shortages at Maximum Demand Level (265 MGD)



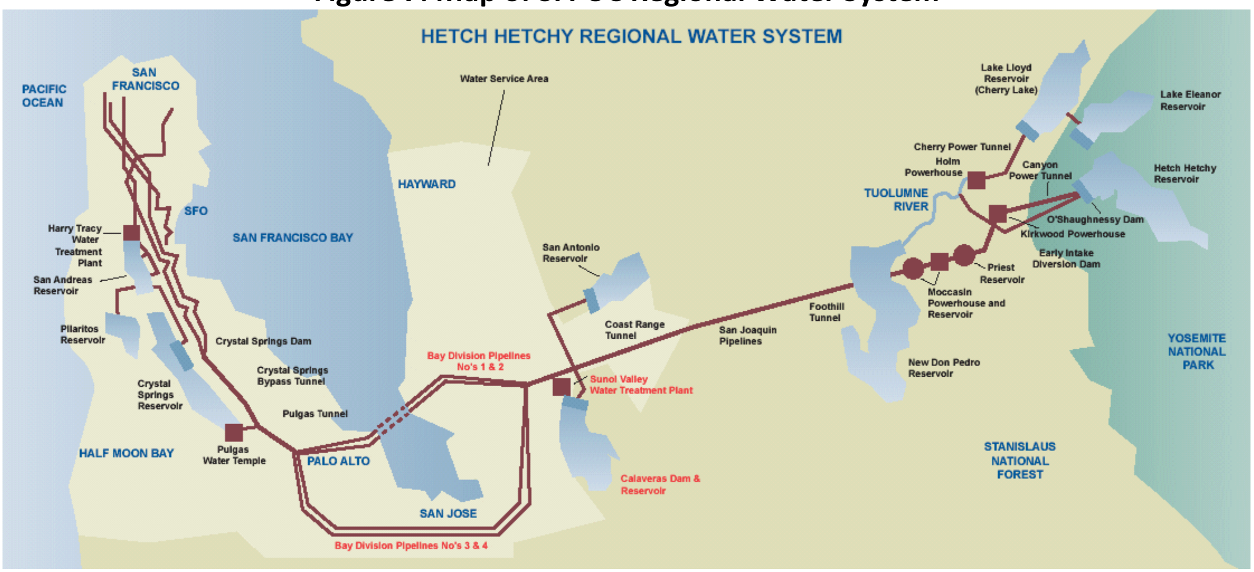
Clearly there is a potential deficiency in SFPUC supplies during dry years, though the overall impact and frequency will depend on decisions related to dry year contingency plans and future portfolio adjustments that could be made to remedy the supply deficiency. As identified in the 2010 UWMP, the City has developed a Water Shortage Contingency Plan for implementation during a drought. The Water Shortage Contingency Plan identifies several stages of drought response, depending on the degree of supply reduction required. Responses range from informational outreach to severe water use restrictions and modified rate structures. The City also has the option of pumping groundwater as supplemental supply in water shortage situations. This option is discussed in more detail in the section on groundwater.

Emergency Robustness

Since the SFPUC is the City's only potable supply source, the City is vulnerable to service interruptions on the SFPUC system. One of the major drivers behind the WSIP was to address reliability deficiencies, which under some circumstances could have resulted in an interruption of SFPUC service for up to 60 days following a catastrophic event such as an earthquake. The

WSIP level of service objective for seismic reliability is to deliver basic service[9] within 24 hours after a major earthquake. The performance objective is to provide delivery to at least 70 per cent of the turnouts in each region, and full restoration to meet average day demand within 30 days after a major earthquake. Palo Alto may be better situated than other agencies in having two distinct connection points to the SFPUC system: three SFPUC connections are served by the Palo Alto Pipeline connection to Bay Division Pipelines 1 and 2, and two SFPUC connections are served by Bay Division Pipelines 3 and 4. Figure 7 below is a map of the SFPUC regional water system.

Figure 7: Map of SFPUC Regional Water System



The City is currently completing the Emergency Water Supply and Storage project. The primary goal of the project is to maintain basic water service and fire-flows in all pressure zones in the City following a catastrophic interruption of SFPUC service. The project allows the City to maintain water supply in the event that the SFPUC supplies are disrupted.

Environmental impacts

The SFPUC supply is the current baseline supply source for the City of Palo Alto. Subsequent sections analyze several alternatives to the current and projected supply mix, and the resulting potential environmental impacts. Increased water use within an agency's ISG does not require any action by an agency's governing body, and therefore does not trigger any California Environmental Quality Act (CEQA) review obligation.

Sensitivity to Regulations

For many water systems in California, the availability of water supplies depends on many factors, including legislative and regulatory changes that may impact future supply conditions.

[9] Basic service is defined as average winter month usage.

The SFPUC system is no different, and has several future regulatory risks that could impact water supply reliability and/or cost[10]:

1. Federal Energy Regulatory Commission (FERC) relicensing of the Don Pedro Project
    a. State Water Resources Control Board (SWRCB) 401 Certification of FERC relicense
    b. Endangered Species Act (ESA) Section 7 consultation for FERC relicense
2. Central Valley Total Maximum Daily Load regulations
3. Bay- Delta proceedings (SWRCB, Legislative actions)
4. ESA Habitat Conservation Plans for SFPUC local watersheds

The SFPUC manages these risks, with support from BAWSCA and the wholesale customers.

VII. Groundwater

The Santa Clara Valley Water District (SCVWD) manages an integrated water resources system that includes the management of groundwater, supply of potable water, flood protection and stewardship of streams on behalf of Santa Clara County's 1.8 million residents. The SCVWD manages ten (10) dams and surface water reservoirs, three (3) water treatment plants, nearly 400 acres of groundwater recharge ponds and more than 275 miles of streams. The SCVWD provides wholesale water and groundwater management services to municipalities, private water retailers, and individual property owners operating groundwater wells in Santa Clara County.

Although the City currently purchases all of its potable water from the SFPUC system, the City maintains close involvement with the SCVWD as it is an important water wholesaler and the steward of groundwater resources in Santa Clara County. The city also partners with the SCVWD on conservation activities. The community is represented on the SCVWD Board of Directors by the District 7 Director. The City's mayor also appoints a representative to represent the City on the SCVWD Commission, an advisory body to the SCVWD Board of Directors.

The SCVWD's 2012 Water Supply and Infrastructure Master Plan describes how the SCVWD will support future water supply needs and reliability. The adopted strategy identifies conservation, increased recycled water use, indirect potable reuse, additional groundwater recharge ponds, grey water, imported water reoperations, and dry year options as important components of the plan.

The City of Palo Alto has several policies embodied in the Comprehensive Plan that relate to groundwater and water supplies. The policies don't provide a preference for the use of

[10] Source: SFPUC's 2010 UWMP

groundwater, but indicate preservation of groundwater conditions is of critical importance to the City. The relevant policies are listed below, with program elements, if applicable:

1. ***POLICY N-51****: Minimize exposure to geologic hazards, including slope stability, subsidence, and expansive soils, and to seismic hazards including ground shaking, fault rupture, liquefaction, and land sliding.*
2. ***POLICY N-18****: Protect Palo Alto's groundwater from the adverse impacts of urban uses.*
    a. *PROGRAM N-22: Work with the SCVWD to identify and map key Groundwater recharge areas for use in land use planning and permitting and the protection of groundwater resources.*
3. ***POLICY N-19****: Secure a reliable, long-term supply of water for Palo Alto.*

Availability

As a city in Santa Clara County, Palo Alto has the ability to pump groundwater with the understanding that SCVWD will appropriately manage the groundwater resources in the county. Groundwater conditions throughout the county are generally very good[11]. Groundwater elevations have generally recovered from overdraft conditions throughout the basin since the 1987-1992 drought, inelastic land subsidence has been curtailed, and groundwater quality supports beneficial uses.

Background

The SCVWD last published a Groundwater Management Plan (GWMP) in 2001. Since that time, SB 1938 and other legislation have amended the requirements for groundwater management plans. The 2012 GWMP was prepared under existing groundwater management authority granted by the District Act. The purpose of the 2012 GWMP is to characterize the SCVWD groundwater activities in terms of basin management objectives, strategies, and outcome measures.

General groundwater conditions in the area are detailed in the SCVWD 2012 GWMP. The City of Palo Alto overlies the Santa Clara sub basin. The Santa Clara sub basin is divided into upper and lower aquifers, which are separated by low permeability clays and silts. The SCVWD refers to these as the shallow and principal aquifer, with the latter generally defined as 150 feet below ground surface. The principal aquifer is the primary drinking water aquifer, and is the source for the any increased reliance on groundwater to meet current or future demands. The upper, or shallow, aquifer is of poorer quality and has limited uses beyond small to medium size distributed irrigation systems. The SCVWD is responsible for managing the groundwater basin to ensure there is adequate supply and overdraft conditions are minimized.

The SCVWD accomplishes this goal by maximizing conjunctive use, the coordinated management of surface and groundwater supplies, to enhance supply reliability. Programs to accomplish this goal include the managed recharge of imported and local supplies, in-lieu

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[11] SCVWD 2012 Groundwater Management Plan

groundwater recharge through the delivery of treated surface water[12] and acquisition of supplemental water supplies, and programs to protect, manage and sustain water resources.

Managed and in lieu recharge programs are in balance with withdrawals and the basin is not currently in overdraft conditions. The groundwater conditions in the Santa Clara sub-basin vary, and groundwater pumping from different locations will have different effects depending on location, elevation, recharge conditions, and pumping activity.

Emergency Water Supply and Storage Project

As part of the Emergency Water Supply and Storage project, the City has refurbished five older wells, constructed two new wells, and is constructing another new well and a new 2.5 million gallon storage reservoir and pump station. The primary goal of the project is to improve the City's emergency water supply capability. Together with the City's existing water storage system, the project will support a minimum of eight hours of normal water use at the maximum day demand level and four hours of fire suppression at the design fire duration level and will be capable of providing normal wintertime supply needs during extended shutdowns of the SFPUC system. The proposed project would provide up to 11,000 gallons per minute (gpm) of reliable well capacity and an additional 2.5 million gallons of water storage for emergency use. The groundwater system may also be used to a limited extent during drought emergencies, but is subject to the following mitigation measures, as stated in the Environmental Impact report (EIR) completed for the project[13]:

1. An aquifer test shall be conducted following the City's well construction and rehabilitation efforts to verify the basin's response to pumping; and

2. Emergency demand pumpage shall be limited to 1,500 acre-feet (AF)[14] in one year. Following this level of pumpage, groundwater production shall be restricted until groundwater levels recover to pre-pumping levels.

All wells are currently permitted and designated by the California Department of Public Health as "Standby" and, as such, can only be used for 5 consecutive days up to 15 days in a year[15].

Once the project is complete, the wells may collectively supply up to 1,500 AF per year during a drought, with restrictions on when the wells can resume pumping following that level of groundwater extraction. It is important to note that the pumping restriction only applies to the project as defined in the CEQA documents. This includes the 5 existing wells and 3 new wells. Individual property owners can install their own wells and pump groundwater.

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[12] The SCVWD and the Santa Clara County SFPUC customers are partners in conjunctively managing the water resources in the county. The SFPUC customers in the county have contracts with the SFPUC. The SCVWD has no contractual relationship with the SFPUC.

[13] Environmental Impact Report, Emergency Water Supply and Storage project, Mitigation Measure 3.5-4(a) & 4(b)

[14] 1500 AF/Year is equal to 1.34 MGD, or approximately 12% of FY 2012 water consumption

[15] California Code of Regulations, Title 22, Section 64414(c).

The pumping restrictions for the well system are mitigation measures in the EIR prepared for the Emergency Water Supply and Storage project. Any increase in the current restriction could require new or supplemental environmental review. The SCVWD has indicated that the process to increase the current limitation will require supporting information on the sustainable yield of the groundwater basin in order to demonstrate increased pumping by the City will not have significant impacts[16].

The capacities of the City's wells are listed in Table 3. As shown in the table, if all 8 wells were used full time, they could produce 13.3 MGD, which is equivalent to almost 15,000 AF per year.

Table 3: Projected Well Capacities

Name	Capacity (MGD)	Status
Fernando	0.5544	Refurbished Well/Fully Operational
Hale	1.8432	Refurbished Well/Fully Operational
Matadero	0.864	Refurbished Well/Fully Operational
Peers	1.872	Refurbished Well/Fully Operational
Rinconada	4.464	Refurbished Well/Fully Operational
Eleanor Pardee	1.296	New Well/Fully Operational
Library	1.008	New Well/Fully Operational
El Camino Park	1.44	New Well/Under Construction
Total	**13.3**	

During the drought in the late 1980's, substantial pumping by pumpers in the county and neighboring jurisdictions resulted in a dramatic drop in the groundwater levels in the area. It is possible that this scenario could happen again during a drought of similar magnitude if imported water supplies were reduced. The SCVWD adopted level of service goals as part of its 2012 Water Supply and Infrastructure Master Plan effort, including the development of water supplies designed to meet at least 100% of average annual water demand identified in the SCVWD 2010 UWMP during non-drought years and at least 90 percent of average annual water demand in drought years[17]. This goal is a countywide goal and includes Palo Alto demands.

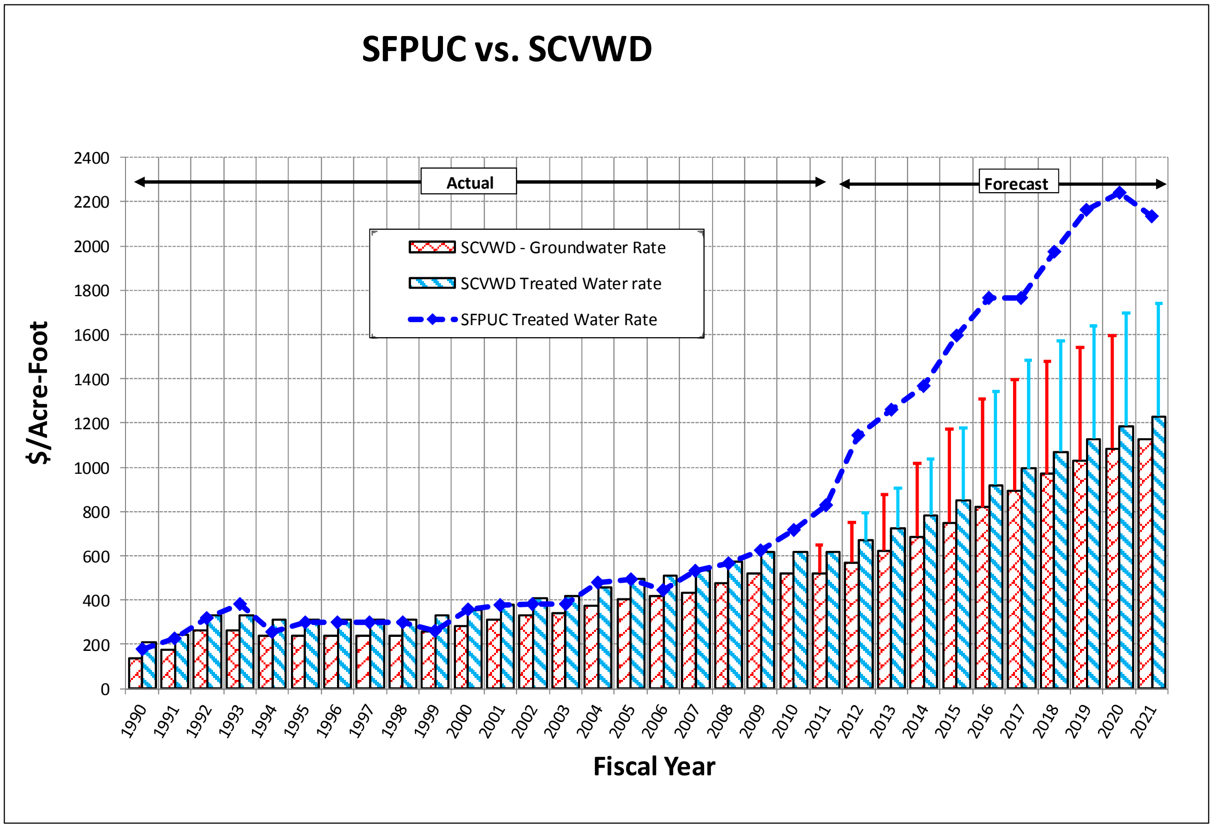
Cost

The SCVWD levies a groundwater extraction fee, or "pump tax", on each acre-foot of water that is pumped from the groundwater basin. The charge varies depending on a variety of factors, including pumpage type (agriculture vs. municipal) and geographic location in the County. Historically, the cost of groundwater (including the pump tax and the O&M cost of operating a well) has been comparable to the cost of SFPUC supplies. However, due to the increasing cost of SFPUC water due to the WSIP, the cost to pump groundwater is projected to be less than the cost of SFPUC supplies (Figure 8). While the costs of SCVWD groundwater and treated water

[16] In summer 2012, staff met with SCVWD representatives to discuss the current limitation and the process to increase/remove the limitation.
[17] SCVWD Board Agenda Item 4.2, June 12, 2012

are also projected to rise over the next decade due to capital investment requirements, the cost of SCVWD water is likely to be less than SFPUC supplies. The vertical lines above the groundwater and treated water bars in Figure 8 represent the SCVWD high cost scenario, and reveal that the cost differential between SFFPUC and SCVWD water remains significant even under a SCVWD high cost scenario.

Figure 8: Projected SFPUC and SCVWD[18] Water Rates



Water Quality

The water quality of the groundwater is considered good, though historically the groundwater in the area has had iron (Fe), manganese (Mn) and Total Dissolved Solids (TDS) levels that exceed secondary[19] drinking water quality standards.

All potable water scenarios must comply with water quality requirements. Staff currently samples the wells based on the conditions outlined in the California Department of Public Health (CDPH) permit(s). The City may be out of compliance with secondary standards on a

[18] The SCVWD sets groundwater and treated water rates according to water pricing policies and SCVWD Board direction. In general, treated water charges are slightly higher than groundwater charges to account for O&M costs to pump groundwater. However, at times, the SCVWD may adjust rates to encourage use of groundwater instead of treated water, or vice versa depending on the health of the underground water supplies.

[19] Primary drinking water quality standards apply to contaminants that affect health while secondary standards apply to those constituents that affect aesthetics, taste and odor.

short term basis during emergencies, but for full-time operation the City must be in compliance with secondary standards or apply for a waiver[20]. The waiver requires justification and includes a community survey to establish support for the provision of water that exceeds secondary standards. The community survey must demonstrate a high degree of acceptance to justify the waiver.

Key water quality parameters for groundwater, water from the SFPUC and treated water from the SCVWD are compared in Table 4. All of these sources meet primary drinking water standards. The table lists several secondary standards and a sampling of other parameters.

Table 4: Water Quality Parameters for Various Water Sources

Water Source	Fe (ppm)	Mn (ppm)	TDS (ppm)	Sodium (ppm)	Hardness (as CaCo3) (ppm)	Turbidity (NTU)
Drinking Water Quality Standard	.300	.050	500	N/A	N/A	5
SFPUC Water (1)	ND	ND	132	13.5	57	0.16
SCVWD Treated Water (2)	ND	ND	209	37	90	0.07
Groundwater (3)	0.25-1.3	0.13-0.31	440-710	75-170	-	0.33-7.7

(1) SFPUC values are average water quality values reported by the SFPUC in its 2011 Water Quality Report
(2) Average values from 2011 SCVWD Rinconada Water Treatment Plant Water Quality Data Summary
(3) Based on the City's well water testing records
ND = non detect

<u>Normal Year Groundwater Supplies</u>

Several treatment and blending options for the wells were evaluated in 2000 in the "Long Term Water Supply Study":

1. Blend water with SFPUC water to meet water quality limits for manganese and iron. The blended water will meet regulatory limits, but will have TDS levels 2-3 times the current level in the distribution system[21].
2. Provide iron and manganese treatment at each well site. The water will likely not exceed TDS limits, but it will be 5-7 times the current levels in the distribution system.
3. Provide iron and manganese treatment at each well site and blend with SFPUC supplies to reduce the well water TDS levels.
4. Provide iron, manganese and TDS treatment at each well site. The treated water at the injection point will be comparable to SFPUC supplies.

The estimated present dollar cost of each option is provided in Table 5 for information purposes. The treatment options focus on the costs to address the elevated iron, manganese and TDS levels under several water quality scenarios.

[20] Title 17 Code of Regulations, Chapter 64449.2
[21] Upon completion of the Emergency Water Supply and Storage project, the El Camino Well water can be blended with SFPUC water in the new 2.5 million gallon storage tank in El Camino Park in a similar manner to Option 1.

Table 5: Well Treatment Alternative Preliminary Cost Analysis

	Treatment Options[22]			
	1 (blend)	**2** (treat for Fe, Mn)	**3** (treat for Fe, Mn and blend)	**4** (treat for Fe, Mn and TDS)
Capital Cost[23] (Total for 5 wells)	\$8.5-10.8 M	\$8.5-10.8 M	\$9.4 - 11.8 M	\$37.4 - 46.7 M
	Well production			
Acre feet per year	6300	12800	2500	12800
% of total Potable Demands	50%	100%	25%	100%
	Water Quality[24]			
TDS (500 ppm)	130-300	440-700	120	120
Manganese (<0.05 ppm)	0.04-0.05	<0.05	<0.01	<0.05
Iron (<0.3 ppm)	0.08-0.3	<0.3	0.05-0.06	<0.3

The new and refurbished wells are being constructed with chlorine disinfection injection points and the capability to accommodate fluoride and other needed chemical injection points. The use of the wells on a regular basis will require a detailed operational plan and some or all of the sites will need modifications to accommodate backup power, chemical storage, and any equipment associated with the selected treatment option. Not all sites will have the space to accommodate these additional requirements. These and other additional operating and capital costs will need to be incorporated as part of a future detailed cost-benefit analysis.

The various treatment options will generate waste streams with elevated levels of iron, manganese, TDS, and chemical residuals used in the treatment process. It is unknown if this can be discharged to the storm drain system. Options to address this issue include onsite treatment facilities at each site or discharging the raw waste stream to the wastewater collection system for delivery to the Palo Alto RWQCP[25]. In addition to these unknown costs, there may be several challenges that may need to be addressed related to wastewater constituent changes from the RWQCP.

<u>Dry Year Groundwater Supplies</u>
The City's new well and reservoir at El Camino Park is currently being configured to blend with SFPUC supplies so the El Camino Well can be relied upon to provide groundwater during a drought up to the 1500 AFY limitation. As a result of blending, the water will meet all secondary water quality standards, but will be of lesser quality when compared to SFPUC supplies. To bring the water quality to a level comparable to SFPUC supplies, the City will need to install Iron, Manganese and TDS filtration at the new El Camino well site.

[22] Costs are only those costs incurred by Water Utility. Customer costs, including water softening or filtration devices will be additional costs borne by individual customers
[23] All costs were adjusted from the estimates in the 2000 study to provide a likely cost range in 2012 dollars.
[24] Manganese and Iron have single consumer acceptance contaminant levels, while TDS is a consumer acceptance contaminant level <u>range</u> (recommended = 500; short term= 1000 and upper limit = 1500)
[25] Discharges to the wastewater collection system for treatment at the RWQCP have associated costs that are not included in the preliminary cost estimates.

Long Term Reliability

The wells are an important resource during a drought and could be an important resource to serve a portion of the normal year potable needs in the City. With the current 1500 AFY dry year groundwater extraction limitation, there is little risk any dry year pumping program could result in significant impacts to the groundwater basin[26].

Since SCVWD manages the groundwater in Santa Clara County, any plans to increase Palo Alto's groundwater pumping would need to be discussed with the SCVWD.

Emergency Robustness

The City's wells are being maintained to provide emergency service during a catastrophic interruption of SFPUC supplies. If the portfolio changes in the future such that groundwater becomes part of the normal year supply, emergency preparedness will need to be evaluated further to ensure the resource can perform under various scenarios. Such an increase could result in the need for the SCVWD to construct recharge facilities to ensure that the county's groundwater supplies are properly maintained. If imported water supplies are required to be delivered to the recharge facilities, those supplies need to be identified.

Environmental impacts

The use of the wells to meet dry year needs is currently permitted subject to a pumping limitation of 1500 AF per year. A significant increase to this limitation could require supplemental environmental review. Staff anticipates issues such as sustainable yield, dry year availability, subsidence risk, saltwater intrusion, dewatering of local creeks and contaminated plume migration, would be considered in such an environmental analysis.

Sensitivity to Regulations

An area of concern is future State and Federal water quality regulations for potable water. Changes in regulations could make the groundwater supply less attractive and more expensive due to additional treatment. This becomes less of an issue depending on the level of treatment that is chosen.

[26] The 1500 AFY limitation is a CEQA derived mitigation measure that has undergone the public review process.

VIII. SCVWD Treated Water

Besides being the manager of groundwater in Santa Clara County, the SCVWD also produces and delivers treated drinking water to water retail agencies in the county. Long-term plans of the SCVWD include extending the treated water pipeline from its current terminus at Foothill Expressway and Miramonte Road to a Palo Alto connection point at Foothills Expressway and Arastradero Road (a distance of about 4.5 miles). The SCVWD calls this extension the "West Pipeline Extension". However, the project would only be constructed if the City requested water supply from the SCVWD and signed a treated water contract.

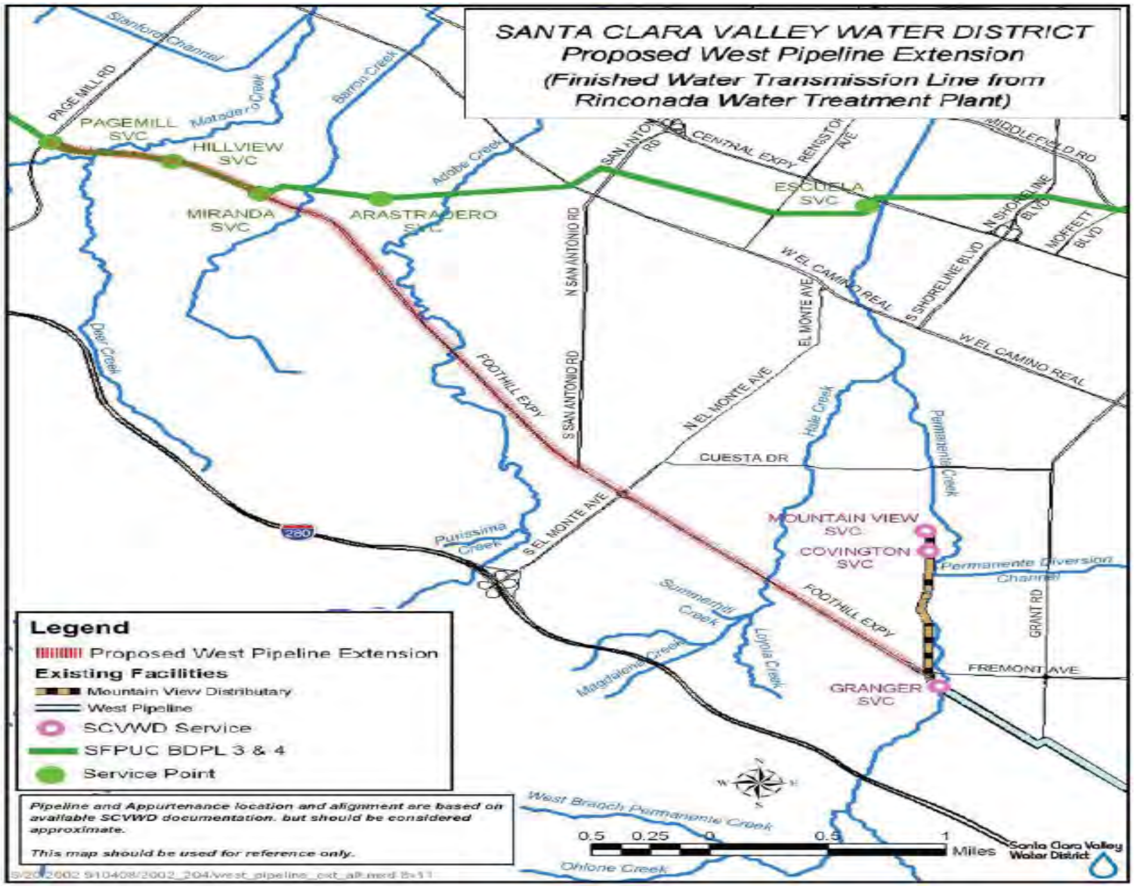
Background

In 1999, the City sent a letter to the SCVWD advising it that information was needed to analyze the City's option to connect to the SCVWD treated water West Pipeline. The SCVWD responded with an estimated cost for the extension of the West Pipeline that would have to be fully borne by Palo Alto. In February 2002, Palo Alto and four other county retailers requested that the SCVWD conduct a feasibility study of a West Pipeline extension from both a supply perspective and the additional reliability of having an additional interconnection with the SFPUC system. The SCVWD prepared a report on extending the West Pipeline, entitled: "Santa Clara Valley Water District's West Pipeline Extension Conceptual Evaluation Final Report"[27]. The report evaluated an extension of the existing SCVWD West Pipeline to enable an interconnection of the Palo Alto and SCVWD systems at Page Mill turnout[28]. A map of the potential project is provided in Figure 9.

[27] The City of Palo Alto participated in the preparation of the 2012 Water Supply and Infrastructure Master Plan (WSIMP). As part of that process, staff requested the SCVWD include the West Pipeline extension for project consideration. The SCVWD noted in the Final 2012 WSIMP that the project is not recommended in the WSIMP because it does not contribute to long-term supply reliability. However, the SCVWD stated that it would be considered during a planned Infrastructure Reliability Master Plan.

[28] The SFPUC and the SCVWD have an emergency interconnection near Milpitas that could theoretically be used to wheel water to Palo Alto. Staff does not anticipate it will be feasible to wheel normal year supplies via the intertie, but the use of the intertie during dry years may be possible. However, in general the SCVWD system is more dry year sensitive than the SFPUC system, so it is unclear whether supplies would be available to be wheeled to Palo Alto via this mechanism.

Figure 9: West Pipeline Extension Map



Availability

If the City requested that the SCVWD extend the West Pipeline to serve the City, the terms of the treated water contract would determine the availability and amount of water that would be delivered during normal years. The SCVWD has a diverse water supply portfolio, including State Water Project, Central Valley Project, and local reservoirs. SCVWD's 2010 UWMP and its 2012 WSIMP indicated the SCVWD anticipates having adequate supplies to meet future needs until 2030 when minor deficits begin to materialize. However, those projections do not assume any treated water deliveries to Palo Alto. In addition, there is no guarantee that the water will be available during dry years.

Cost

SCVWD's West Pipeline Extension Report provided detailed cost estimates for several pipeline configurations, which are summarized in Table 6. Both scenarios require a new parallel pipeline from Rinconada Water Treatment plant to the current terminus of the West Pipeline at Miramonte Road. From there, a new pipeline would be constructed to Page Mill Road. The cost differential between the two scenarios is largely attributed to different pipe sizing requirements and an intertie pump station.

Table 6: SCVWD Treated Water Connection Summary Costs[29]

Alternative	Assumptions	Total Cost of Alternative ($million)	Cost to SFPUC ($million)	Cost to New Retailers ($million)	Rate Increase to SCVWD Retailers ($/AF)
Parallel and Extension	• Existing treated water contractors and new retailers share cost of parallel pipe • New retailers pay for extension	94-114	N/A	Palo Alto: 44-67 Purissima Hills: 5-9	$5-8
Parallel, Extension and Intertie	• Existing treated water contractors and new retailers share cost of parallel pipe • SFPUC pays for half of incremental cost of intertie • Existing and new retailers share cost of extension and half of incremental cost of intertie	127-154	18-22	Palo Alto: 23-41 Purissima Hills: 4-10 Stanford University: 4-8	Pump Tax: 11-14 Treated Water: 15-22

The report concluded that the City and neighboring jurisdictions must pay for the costs of constructing the extension via a "take or pay" contract, which is a common payment mechanism for all agencies in the county that purchase SCVWD treated water. The amount of the take or pay contract is determined by the amortized construction costs divided by the annual treated water rate. For example, if Palo Alto's obligation for a West Pipeline extension was $30 million with an annual cost of $2 million (using an interest rate of 3%/year for a 20-year financing period), and the treated water rate was $634.60 per AF[30], then Palo Alto would be required to purchase about 3,150 AF/year, or about 25% of the City's water usage in FY 2012.

During the term of the contract, the City would have limited ability to adjust its annual water purchase from the SCVWD. There are several agencies in Santa Clara County that purchase both SCVWD and SFPUC treated water, and they are subject to minimum "take or pay" contract provisions by <u>both</u> providers. The City would receive similar treatment. The cost estimates in Table 6 do not account for any distribution system improvements that may be required to configure Palo Alto's distribution system to receive SCVWD treated water.

Recently, the City conducted an evaluation of property tax collected by SCVWD from Palo Alto property owners. It is not uncommon for water districts to rely wholly, or in part, on property related taxes to build water systems or for surplus capacity for future users. The SCVWD has historically relied on taxes to some degree to purchase imported water and fund local

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[29] Cost of additional supply is not included in project cost. Costs have been escalated 3-5% from 2003 dollars to provide a representation of potential costs ranges.
[30] This is SCVWD's treated water rate for FY 2013

groundwater and treated water programs, and continues to do so. The results of the property tax evaluation revealed Palo Alto taxpayers have contributed to the development of the SCVWD water supply, distribution and treatment system, and will likely continue to do so in the future. This information could be helpful in determining an equitable sharing of the capital costs of an extension to serve areas of the county that have historically supported the SCVWD system.

Water Quality

See Table 4 in the groundwater section for a comparison of certain water quality parameters of SCVWD's treated water, SFPUC water, and groundwater.

Carollo Engineers evaluated the SCVWD treated water line in the Long Term Supply Study and provided information on the issues of blending SCVWD supplies with SFPUC supplies. In general, SFPUC supplies are of superior quality to SCVWD supplies, but there were several specific issues that were identified in the previous study. If there is interest in moving forward with an interconnection with the SCVWD system, additional analysis will need to be performed to determine if the previous issues still remain, and what additional issues have arisen. On the positive side, the SCVWD's recent decision to include fluoridation at their treatment plants removes the need to provide fluoridation at the interconnection points to ensure the water supply complies with the municipal code. In a similar manner, the SFPUC has completed the transition to chloramine from chlorine for residual disinfection. This removes some water quality related issues associated with blending treated water from different sources that use different disinfectants. However, there may be other issues related to water quality that could require the two water supplies to be isolated in the distribution system. This would result in water from difference sources being provided to customers depending on their location in the distribution system.

Long Term Reliability

It is likely the SCVWD has little surplus imported water to allocate to Palo Alto, so the details of a potential supply arrangement will need to be evaluated further. During the drought in the late 1980's, SCVWD supplies from both the state and federal sources were significantly reduced. It is not clear what level of drought protection would be provided, though the recent level of service commitment by the SCVWD indicates that there would be no greater than 10% reduction in supplies during dry years.

Emergency Robustness

In 2003, the SCVWD initiated the Water Utility Infrastructure Reliability Project to determine the current reliability of its water supply infrastructure (pipes, pump stations, treatment plants) and to appropriately balance level of service with cost. The project measured the baseline performance of critical SCVWD facilities in emergency events and identified system vulnerabilities. The study concluded that the SCVWD water supply system could suffer up to a 60-day outage if a major event, such as a 7.9 magnitude earthquake on the San Andreas Fault, were to occur. Less severe hazards, such as other earthquakes, flooding and regional power outages had less of an impact on the SCVWD, with outage times ranging from one to 45 days.

The level of service goal identified for the Infrastructure Reliability Project was “Potable water service at average winter flow rates available to a minimum of one turnout per retailer within seven days, with periodic one day interruptions for repairs.” In order to meet this level of service goal, the project identified a recommended portfolio to mitigate the risks. The SCVWD has been implementing the recommended portfolio. The project is expected to reduce the post-earthquake outage period from 45-60 days to 7-14 days.

In 2007, the SCVWD created a stockpile of emergency pipeline repair materials including large diameter spare pipe, internal pipeline joint seals, valves, and appurtenances. The stockpile marks a significant increase in reliability of the SCVWD water supply system, as it helps to reduce outage time following a large earthquake from approximately 60 to 30 days. The SCVWD still needs to complete several other emergency planning projects to meet the goal of reducing outage time to 30 days. These include developing a post-disaster recovery plan, developing mutual aid agreements or expanding participation in the California Water/ Wastewater Agency Response Network , setting up contractor, welder, and equipment rental company retainer agreements, and setting up post-earthquake pipeline inspection teams. The addition of groundwater wells and line valves to the SCVWD system will further reduce outage time following a large earthquake from 30 days to 14 days. The wells will allow the SCVWD to convey supplies from the groundwater basin to the treated water pipelines following a hazard event to meet the project’s level of service goal. The line valves will allow the SCVWD to isolate damaged portions of pipelines.

If the West Pipeline was extended to provide potable water service to Palo Alto, the City would have one connection to the SCVWD system[31], compared to 5 connections to the SFPUC system. It is unclear what level of reliability would be provided in the event of catastrophic event. The SFPUC level of service goal following an earthquake is to provide for average wintertime demands with delivery to 70% of the turnouts within 24 hours following a major earthquake. The SCVWD level of service goal provides for service resumption to one turnout within 7 days of a similar event, though the location of a Palo Alto interconnection at the end of the treated water line may be a weak point, so it is unclear if there will be adequate supplies or system pressures to provide meaningful service. In addition, the SCVWD plans on extracting groundwater for raw water delivery to the treatment plants and on to the retailers during an emergency. The Emergency Water Supply and Storage project will serve this purpose for Palo Alto.

[31] There may be additional connection options to a new SCVWD treated water pipeline, such as a new extension to the existing Arastradero SFPUC turnout. However, the cost of additional connections was not included in the initial cost estimate and would likely be borne by the City. Additional connections may allow increased use of and more efficient distribution of SCVWD treated water, though they may not provide any additional reliability assurances.

Environmental Impacts

A West Pipeline extension will require CEQA review. The SCVWD would be the lead agency for the CEQA process.

Sensitivity to Regulations

The SCVWD imports water from both the State and Federal water projects, and is vulnerable to actions that impact those sources. Since publication of the 2003 WIRP, federal and state water deliveries have been reduced on several occasions due to Delta related issues. The Bay Delta Conservation Plan is currently underway to address the co-equal goals of water supply reliability and environmental sustainability. The most likely water conveyance solution will be a tunnel underneath the Delta from an intake on the Sacramento River to the South Delta Diversion/Pumping facilities. Such a facility will take decades to build and the costs will likely be borne by State and Federal water contractors, including the SCVWD.

IX. Recycled Water

The City of Palo Alto operates the Regional Water Quality Control Plant (RWQCP), a wastewater treatment plant, for the East Palo Alto Sanitary District, Los Altos, Los Altos Hills, Mountain View, Palo Alto, and Stanford University. Approximately 220,000 people live in the RWQCP service area. Of the total plant flow, about 60 per cent is estimated to come from residences, 10 per cent from industries, and 30 per cent from commercial businesses and institutions.

In 1992, the City and the other RWQCP partners completed a Water Reclamation Master Plan (Master Plan). The Master Plan identified a three stage implementation for recycled water in in the RWQCP service area.

In 1995, City Council certified the Final Program Environmental Impact Report (PEIR) for the Master Plan projects. At the same time, Council decided not to pursue any of the recommended expansion stages of a water recycling system as the cost could not be justified. Council adopted a water recycling policy, which included continuation of the existing programs and monitoring of conditions that would trigger an evaluation of the Master Plan. The Water Recycling Policy described five conditions that would trigger evaluation of the Master Plan projects:

1) Changes in the RWQCP discharge requirements
2) Increased mass loading to the RWQCP
3) Requests from partner agencies or other local agencies
4) Availability of federal or other funds
5) Water supply issues:
    a. Water shortages
    b. Legislative or Regulatory Initiatives
    c. Advanced treatment for potable reuse.

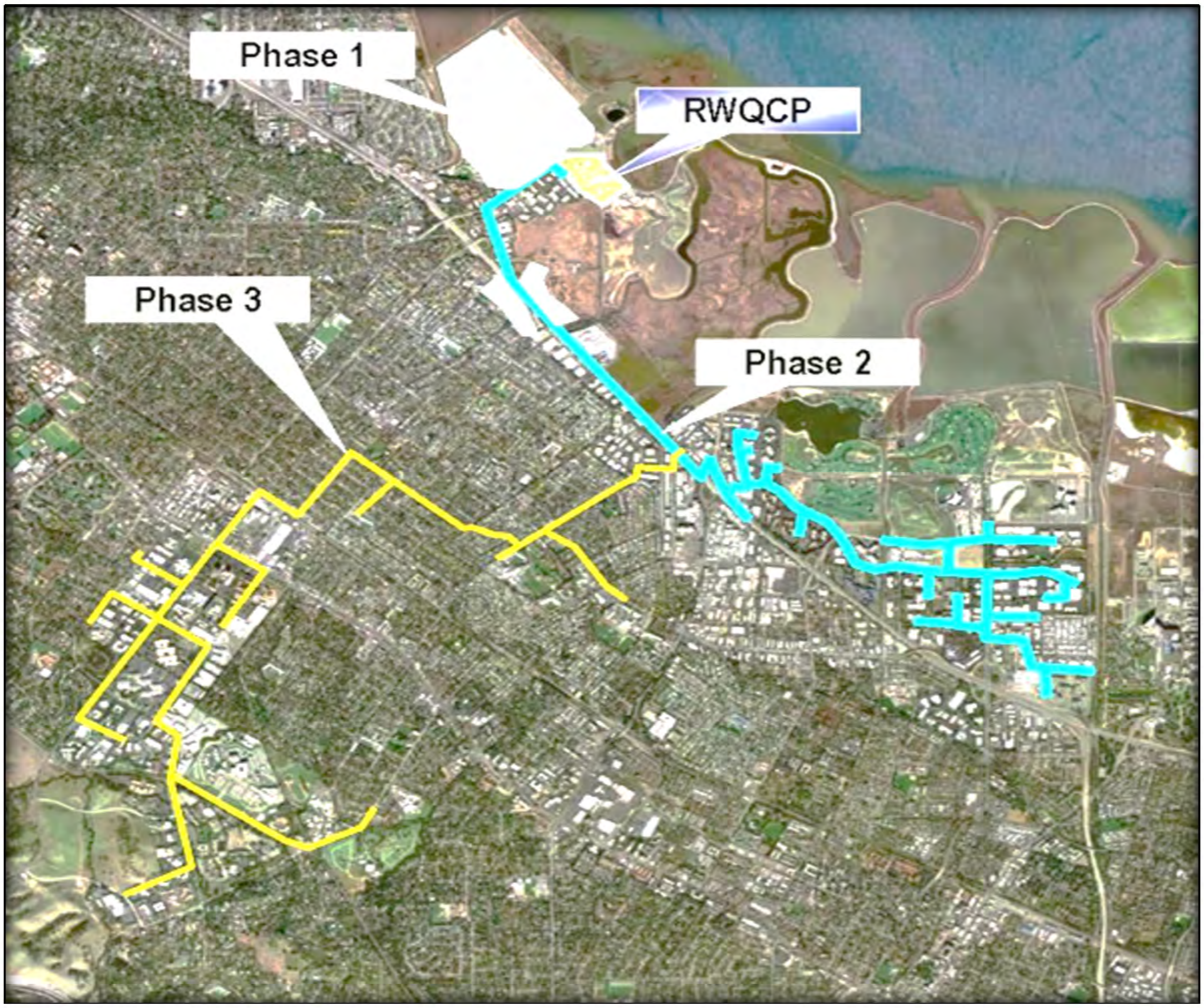
Since the Master Plan, the City prepared a recycled water survey in 2006 and a Facility Plan in 2009 for a project to deliver recycled water to the Stanford Research Park. The Facility Plan had four goals:

1) Define recycled water alternatives and identify a recommended project;
2) Develop a realistic funding strategy
3) Develop an implementation strategy ; and
4) Provide a basis for any future state and federal grant requests for the Project.

Since completion of the Facility Plan, the City initiated the environmental review process for the project and is currently working on an Environmental Impact Report (EIR) for the project. The City is also focusing on outside funding sources to improve the project economics.

The Facility Plan provided a comprehensive overview of the proposed recycled water project to serve the Stanford Research Park. The project would connect to the recently completed recycled water transmission line serving the Mountain View area and extend through the City to serve the target area. A schematic of the proposed project including water demands and pipe sizes is provided in Figure 10.

Figure 10: Proposed Recycled Water Project



Availability

The average dry weather flow capacity of the RWQCP is 38 MGD. The average treated wastewater discharge to the San Francisco Bay is approximately 22 MGD. In theory, all of this could be captured for reuse. Several RWQCP partners, including Palo Alto, have a contractual entitlement to the treated wastewater in proportion to the amount of wastewater that is sent to the RWQCP[32]. Palo Alto's FY 2011 flow share to the plant was approximately 39.2%, or 8.624

[32] Personal communication with James Allen, RWQCP Plant Manager, November 2012

MGD. However, operational constraints and plant configuration limit the recycled water production capability from the RWQCP.

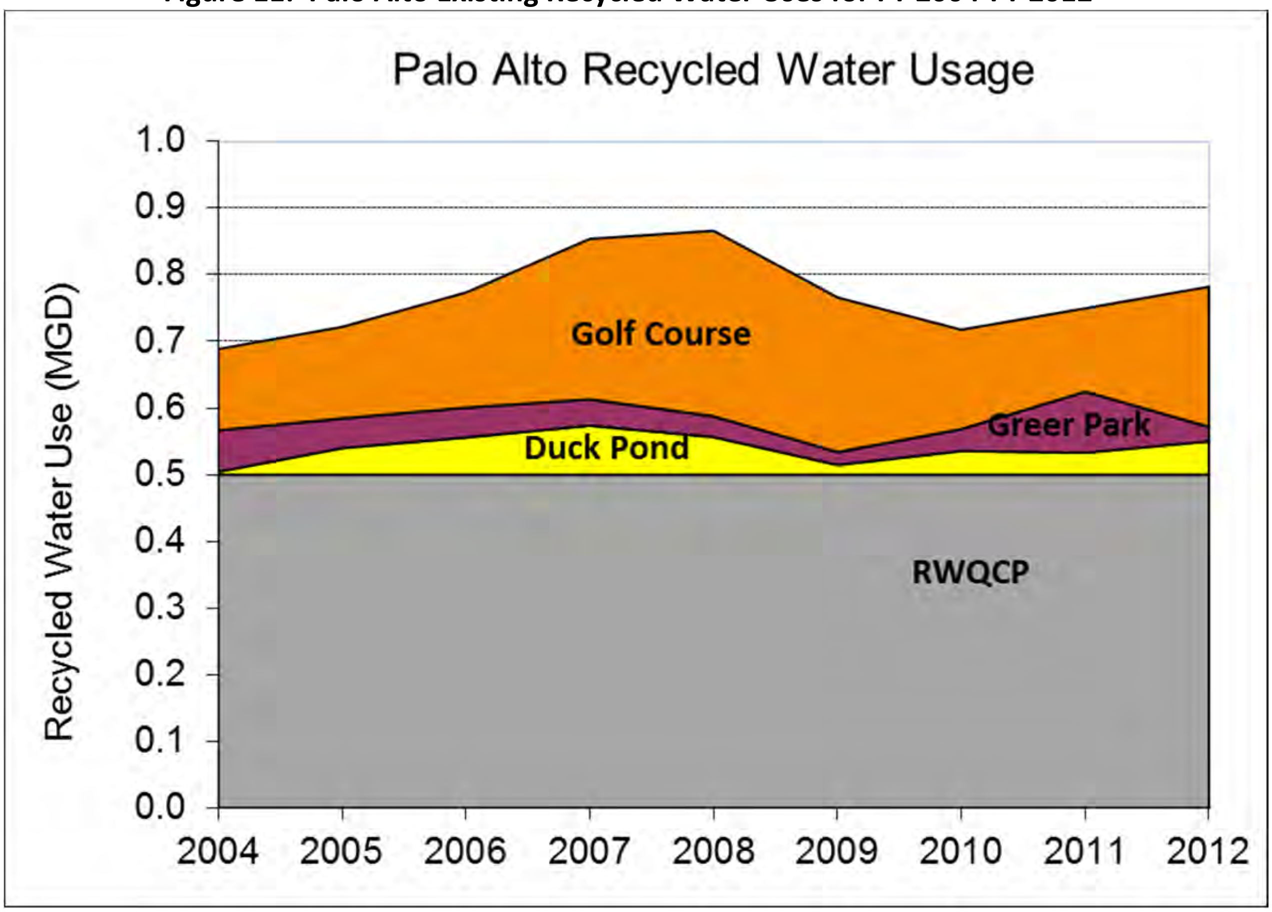
The RWQCP collaborates with the partners to ensure needed capital improvements for future recycled water expansion goals are incorporated into long range plans. Considering the RWQCP's primary role to provide wastewater treatment services for the partners and to ensure the RWQCP meets all associated regulatory and permit limitations, the necessary improvements to accommodate a substantial increase in recycled water deliveries are not a priority for the foreseeable future. In the meantime, the RWQCP can deliver up to 4.5 MGD of recycled water via coagulation and filtration through a multi-layered filter and disinfection process. This additionally treated effluent meets California Department of Health Services Title 22 requirements for "unrestricted reuse". The new ultraviolet (UV) disinfection banks can add 6 MGD of recycled water production (8 MGD with an extra bank). The RWQCP plans to use UV as backup to the filtration/chlorination recycled water treatment train. Future plans include consolidating the systems into a 10.5 MGD recycled water facility, but this would require some modifications in plant piping and storage tanks to get bottlenecks out of the system.

In constructing the project to extend the recycled water distribution system to serve the City of Mountain View, the CPAU Water Fund paid $1 million and committed to pay an additional $1 million connection fee in the event the project to serve the Stanford Research Park was built. By virtue of this arrangement, the CPAU Water Fund has secured capacity on the pipeline for future use. The RWQCP cannot currently meet projected recycled water demands under peak conditions, and additional pumping capacity and possibly storage is needed to accommodate all project users. Palo Alto's recycled water project capital costs include the cost of retrofitting the RWQCP pump station to accommodate incremental recycled water deliveries to serve the Stanford Research Park.

The RWQCP has had a robust recycled water program for many years, including a substantial amount for RWQCP onsite needs and irrigation at Greer Park, the Duck Pond and the Palo Alto Municipal Golf Course.   As shown in Figure 11, the RWWCP uses about 0.5 MGD annually (about 560 AFY) for irrigation around the plant as well as some cleaning and treatment processes.   Greer Park and the Duck Pond have each used about 0.04 MGD (45 AFY) on average over the past five years while the Palo Alto Municipal Golf Course has used about 0.2 MGD (230 AFY) on average over the past five years.

The 2009 Facility Plan identified about 0.8 MGD of new recycled water usage for the project to expand the recycled water distribution system. The project would primarily serve the Stanford Research Park area and the bulk (90%) of the recycled water would be used for irrigation purposes.

Figure 11: Palo Alto Existing Recycled Water Uses for FY 2004-FY 2012



Cost

The Facility Plan included a detailed cost plan to build the project (Table 7). The gross project cost is approximately $33 million, though this does not include potential outside funding sources that could lower the project cost.

Table 7: Recycled Water Gross Cost Estimate [1,2]

Description	Cost
Backbone Pipeline	$12,900,000
Lateral Pipeline	$5,000,000
User Retrofits and Connections	$1,400,000
Booster Pump Station	$900,000
RWQCP Pump Station Improvements	$800,000
Subtotal	**$21,000,000**
Construction Unknown @ Planning-Level (30%)	$6,300,000
Total Construction Cost	**$27,300,000**
Engineering and Construction Management (15%)	$4,100,000
Right of Way Costs (5%)	$1,100,000
Connection fee	$1,000,000
Total Capital Cost	**$33,500,000**
Annualized Capital Costs [3]	$2,300,000
Annual O&M Costs	$200,000
Total Annualized Cost	**$2,500,000**
Estimated Recycled Water Yield [4]	900 AFY
Unit Cost, Annualized ($/AFY)	**$2,700**

Notes:

1. Costs based on Mountain View/Moffett Field Recycled Water Pipeline bid information (average bid estimate, April 2007, ENR: 9103); San Jose Lower Silver Creek Reach 3 construction (January 2005); San Jose Highway 87 Detour II Sanitary Sewer Reconstruction Phase II (Feb 2005); and City of Palo Alto Recycled Water Market Survey Report (June 2006).
2. All costs are adjusted to March 2008 dollars
3. Annualized costs developed based on an interest rate of 5.5% and a period of 30 years.
4. Rounded to nearest 50 AFY.

The cost estimates in Table 7 were developed for 2009 Facility Plan using March 2008 dollars and will need to be updated to reflect current capital and O&M costs. Based on the 2008 data, the recycled water cost is approximately $2,700/AF, compared to an SFPUC cost of $1260/AF (2013) to $2240/AF (2020). However, these cost estimates do not reflect several grant and low interest funding programs that the City has been pursuing that will help lower the unit cost of the recycled water to a more competitive level with SFPUC costs. These funding options are listed below:

1. ***Title 16 -*** The Bureau of Reclamation's water reclamation and reuse program is authorized by the Reclamation Wastewater and Groundwater Study and Facilities Act of 1992 (Title XVI of Public Law 102-575). The City of Palo Alto is a member of the Bay Area Recycled Water Coalition, a group of regional recycled water projects that collaborate to pursue federal funding for recycled water projects. In order to receive federal funding, all projects must receive federal authorization. The City is currently seeking authorization in the House of Representatives for a federal award of $8.25 million (H.R. 3910). Obtaining authorization is a first step and subsequent steps include submittal of

appropriation requests until the full authorized amount is received. While authorization provides a degree of certainty on a grant award, receipt of the full grant amount will depend on annual appropriations and the federal political process.

2. ***Proposition 84 through IRWMP*** – The City is pursuing Proposition 84 grant funds through the Bay Area Integrated Regional Water Management Plan. The BAIRWMP project list was recently updated and the City will have the option to submit funding requests during future funding rounds.

3. ***State Revolving Fund Low Interest Loan –*** The City can apply for low interest construction loans through the State Water Resources Control Board State Revolving Fund (SRF) program. The program provides 20 year loans with an interest rate equal to half of the most recent General Obligation bond interest rate. The most recent SRF interest rate is 1.7%, though the historical rate is typically in the 2-2.5% range. SRF loans have several attractive features, including a payment plan that commences 1 year after construction and the avoidance of bond issuance costs.

The Title 16 and SRF loan programs represent the best State and Federal funding opportunities for the project at this time. The City's recycled water project is on the SRF project list, and staff does not anticipate that obtaining an SRF loan will be problematic. However, obtaining Title 16 authorization for the project will be critical to making the project economically viable. An SRF loan and an $8.25 million federal grant would improve project economics such that recycled water would become competitive with SFPUC potable water within 4-6 years.

The City's recycled water project was identified in BAWSCA's Long-term Regional Water Supply Strategy as a project with near term development potential to meet future water supply needs. Inclusion in the BAWSCA report does not change the project, but it does position the project for innovative funding opportunities with another BAWSCA agency in exchange for some equivalent benefit. Such a partnership could be combined with State and Federal funding sources to further improve project economics.

Water Quality

The recycled water from the RWQCP meets Title 22 requirements for unrestricted reuse. The main purpose of the Palo Alto recycled water project is to offset the use of high quality imported SFPUC water for irrigation and cooling purposes. A major challenge for the project is acceptance by the landscape community of using recycled water for irrigation purposes. Certain landscapes are particularly vulnerable to the higher salinity that is present in recycled water, especially those areas with poor drainage and clay soils.
The RWQCP and the plant partners are undertaking efforts to address the elevated salinity levels in the recycled water by establishing the Salinity Reduction Policy and evaluating the wastewater collection system for areas where elevated salinity levels indicate Inflow and Infiltration may be an issue. For example, the City of Mountain View is currently spending $3-4

million to line a sewer trunk line that has indications of saline water intrusion. This large project may yield a significant salinity reduction when complete in February 2013.

Long Term Reliability

Recycled water is one of the most reliable new water supply sources. As previously mentioned, CPAU has paid for a future connection to the pipeline that extends from the RWQCP to serve Mountain View, which has a maximum capacity of 21 MGD. With the addition of the UV banks, the recycled water production train could provide up to 10.5 MGD of recycled water. As it is local, it is more reliable than imported supplies, which rely on lengthy networks of pipes, pumps and storage facilities. In droughts or other water shortage situations, landscape water use is normally targeted for the largest reductions, but recycled water use would not be subject to such reductions.

Additional recycled water use will increase the City's allocations of SFPUC water in drought times. Since the drought allocation formula is based on both a seasonal component and overall water use, increased use of recycled water would provide a double benefit since it lowers potable water use and also reduces the City's potable usage during the peak irrigation season. While it is difficult to assess future drought allocations since much depends on the actions of other agencies, staff estimates the Stanford Research Park recycled water project could reduce the dry year cutback by 10-20%.

Emergency Robustness

Recycled water will be used for irrigation purposes and, to a lesser extent, cooling. During a catastrophic emergency, CPAU will focus on operation of the emergency wells and the potable distribution system to ensure potable requirements and fire flows are maintained. The RWQCP will also focus its efforts on returning the RWQCP to normal operations. Recycled water does not provide additional emergency preparedness improvements over the current situation.

Environmental Impacts

The City has been preparing the requisite National Environmental Policy Act (NEPA) and CEQA documents for the project. The environmental review process has taken longer than anticipated, largely due to additional study of the use of recycled water on plants in areas of poor drainage and clay soils.

Sensitivity to Regulations

The recycled water supply is sensitive to regulations, but these can have both positive and negative impacts due to the unique nature of the recycled water supply. The RWQCP is subject to numerous regulatory requirements related to treated wastewater discharges to San Francisco Bay. The use of recycled water is recognized as one method to reduce discharges to the Bay and assists the RWQCP in complying with these requirements. For example, in March 2012, the Regional Water Board issued a Water Code Section 13267 Technical Report Order to

Bay Area wastewater dischargers, including the RWQCP, requiring submittal of information on nutrients in wastewater discharges (nitrogen and phosphorus). This information will be compiled over the next few years and will likely result in the development of future water quality objectives for the San Francisco Bay estuary. An increase in recycled water use would decrease the total nitrogen and phosphorus discharge to the Bay. As the regulatory environment for wastewater treatment plants becomes stricter, recycled water will become an increasingly useful tool to assist wastewater treatment plants in complying with these new regulations.

In February 2009, the State Water Resources Control Board adopted Resolution No. 2009-0011, which established a statewide Recycled Water Policy. This policy encourages increased use of recycled water and local storm water. It also requires local water and wastewater entities, together with local salt/nutrient contributing stakeholders to develop a Salt and Nutrient Management Plan for each groundwater basin in California. The SCVWD is the lead agency for this effort in Santa Clara County. Together with the benchmarks in the SCVWD 2012 GWMP, recycled water impacts on the groundwater basin will likely be monitored and subject to regulation in the event there are observed changes.

X. Demand-Side Management

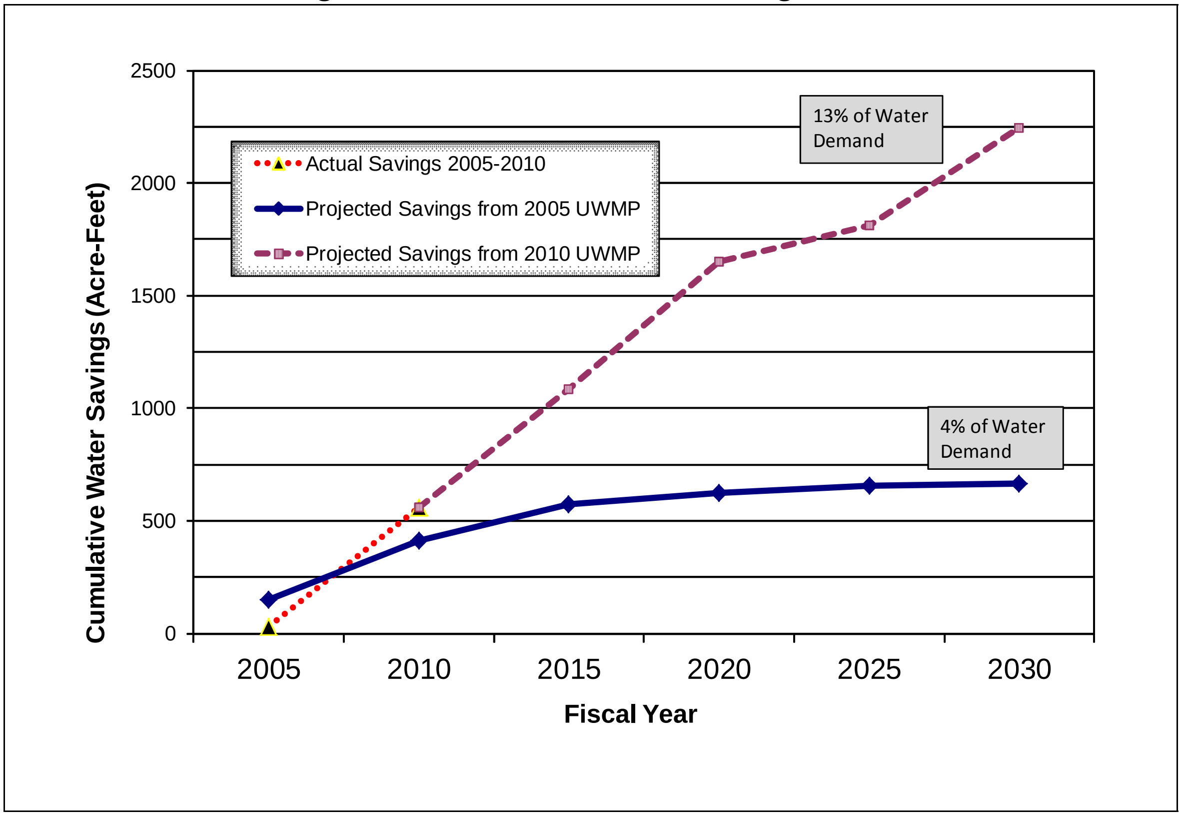
Demand-side management measures and Best Management Practices (BMPs) are measures that can be implemented to conserve water. The BMPs are included in the California Urban Water Conservation Council (CUWCC) Memorandum of Understanding (MOU). Water agencies that became signatories to the MOU pledged to implement the BMPs and to report progress biannually to CUWCC.

Since becoming a signatory to the MOU in 1991, the City has saved an estimated 4,135 AF of water through conservation program implementation. The 2010 UWMP contains the City's reports to the CUWCC, including compliance reports on the BMPs. The 2010 UWMP included an increased conservation program commitment, in large part driven by the requirements of SB X7-7.

Availability

BAWSCA has assisted its members in assessing the potential for water efficiency measures. In October 2008, as part of the adoption of the Water System Improvement Program (WSIP) Program Environmental Impact Report, BAWSCA coordinated the completion of the Water Conservation Implementation Plan, which provided a comprehensive analysis of cost effective conservation measures to identify additional programs that could assist the BAWSCA agencies in meeting future purchase limitations. Results from the Water Conservation Implementation Plan were also used to prepare the City's 2010 UWMP. Figure 12 shows the water conservation goals Council adopted when it approved the 2010 UWMP. Figure 12 also compares the conservation program commitment in the 2005 UWMP to the new commitments in the 2010 UWMP.

Figure 12: Water Conservation Savings Goals



The annual report to City Council on efficiency goals and achievements includes a summary for water demand side management goals and achievements as illustrated in Table 8.

Table 8: Water Savings vs. Goals

Year	Annual Savings Goal	Savings Achieved
FY 2008	0.34%	0.72%
FY 2009	0.34%	0.98%
FY 2010	0.34%	1.35%
FY 2011	0.90%	0.47%
FY 2012	0.91%	1.09%
FY 2013	0.91%	*In progress*

Note that the savings goal increased threefold starting in FY 2011. The increase is primarily a result of legislative requirements (SB 7x-7) that were captured in the 2010 UWMP. This aggressive goal is consistent with the City's longstanding policy of providing cost effective conservation programs to the community. Staff will monitor conservation program effectiveness and make necessary adjustments if it appears the current program is not meeting established targets.

Cost

It is the goal of the City to look for opportunities, innovative technologies, and cost effective programs that best utilize the water conservation budget. In FY 2011, the City dramatically increased conservation program savings goals to meet the requirements of SB7x-7. The 2010 UWMP contains a detailed analysis of the current suite of conservation measures that are offered by the City. For each program, the benefit/cost ratio from the Total Resource Cost (TRC) perspective is shown. The TRC cost-effectiveness test compares the total cost of implementing a measure, regardless of who pays. The costs include the cost of the device, any installation costs, and the implementation costs of the program (advertising, tracking, performance monitoring, rebate processing, etc.). The benefits include the avoided costs of water purchases. The Water Utility assesses each measure in terms of financial impact to the utility, which includes rebate costs as well as any other administrative costs borne by the Water Utility. The water savings summary through 2030 is provided in Table 9, including cost to the utility.

Table 9: Conservation Program Costs[33]

	2015	2020	2025	2030
Total Savings (Acre-feet)	672	560	168	448
Total Wastewater Savings (Acre-feet)	403	314	67	157
Total Outdoor Savings (Acre-feet)	269	246	101	291
Utility Implementation Cost ($2010)	$754,058	$370,843	$364,762	$387,604
Cost/Acre-feet	$1,122	$662	$2,171	$865

Table 9 illustrates that the aggregate conservation program is cost effective when compared to SFPUC supply alternatives.

As the cost of SFPUC water increases, many conservation programs become more cost effective, though the Water Utility adjusts conservation programs depending on several factors, including program penetration, community preferences and the TRC. Despite the very aggressive targets in the 2010 UWMP, it may be possible to further increase conservation program utilization to achieve additional savings.

Water Quality

Demand side measures do not present any water quality issues.

[33] The large increase in cost per acre foot in 2025 reflects regular captured savings less a drop off of savings from those measures initiated in the 2012-2020 time frame that begin to reach maturity. Water agencies offer rebates to make it more attractive for customers to install more efficient, and potentially costlier, measures. At some point in the future the measure reaches the end of its useful life and must be replaced. For some measures, the models assume the consumer will only have the choice of the more efficient model in the future and therefore no rebate is needed anymore. Absent a rebate, the Water Utility does not account for the savings anymore.

Long Term Reliability

Staff forecasts and tracks DSM program effectiveness, but the ultimate effectiveness for different programs varies substantially depending on many factors, including individual behavioral patterns. Much research has gone into evaluating the reliability of DSM, and some of that research could be useful to the City in future efforts to plan and evaluate program effectiveness. Due to the large differential between water demand and the City's Individual Supply Guarantee, there is no pressing need to strictly monitor DSM program effectiveness like there may be for an agency that is at risk of exceeding its Individual Supply Guarantee

Water efficiency during a drought is a more complicated issue. One issue is the concept of "demand hardening", which is the assumed loss of demand elasticity during a drought that results from water conservation programs implemented before the drought. In other words, the community may have little flexibility to reduce demand further if conservation programs have been truly effective. At the same time, there are certain DSM measures that are not suitable during normal years that can be implemented during dry years and achieve desired savings (i.e - steep rate increases, irrigation restrictions).

Emergency Robustness

The 2010 UWMP contains a summary of demand side options that can be implemented under various scenarios (Section 7 – Water Shortage Contingency Plan). During a catastrophic interruption of SFPUC supplies, the City will immediately initiate emergency supply options to meet potable demands and fireflow requirements. At the same time, the City will begin informational outreach programs to inform the community that emergency conditions are in effect and water consumption behavioral changes are required (i.e no irrigation).

For dry year scenarios, the City will implement informational outreach programs, incentive based demand-side management programs, and water audits. In addition, rate schedules may be modified, as appropriate, to reflect the water shortage conditions. Due to the SFPUC/BAWSCA drought allocation formula, conservation programs provide a benefit in reducing dry year cutback requirements. Conservation programs that specifically target irrigation demands will provide an additional benefit because of the seasonal component of the drought allocation formula.

Environmental Impacts

For the most part, demand side measures do not present any environmental issues. Measures that specifically target landscape conversions or efficiency changes have occasionally been the subject of concern by tree advocacy groups who are concerned about impacts on trees due to decreased landscape watering. The City includes information on proper tree maintenance for those customers converting to drought resistant landscapes.

Sensitivity to Regulations

Demand side measures are not limited by any regulations. However, additional requirements to implement measures may be proposed, or compliance with certain efficiency standards (e.g. per capita water use) may be required, especially if seeking State or Federal grant or loan assistance for a project such as the recycled water project.

XI. Individual Supply Guarantee Sale

Availability

The City currently purchases approximately 12 MGD of potable water from the SFPUC and has an Individual Supply Guarantee (ISG), of 17.07 MGD. A sale of surplus ISG could generate income for a variety of potential purposes. Over the past several years there has been increased interest in an ISG transaction, but the mechanism and value of the ISG has been difficult to establish, and this has hindered movement on this issue.

The City's current water use is approximately 12 MGD, and the recent 2010 UWMP forecasted the City's water use would increase slightly in the next few years, and then remain flat around 13.6 MGD through 2030. In the event the City transferred 1-2 MGD of its ISG to another party, recent forecasts do not anticipate this will impact the City's ability to meet normal year potable demands.

The SFPUC/BAWSCA (Tier II) drought formula is based on the weighted average of two components, the smaller of which is the ISG[34]. This is beneficial to the City since current consumption is well below the City's ISG. An ISG transfer would reduce that benefit and result in an increased dry year reduction requirement by the City. At the same time, this aspect of the role of the ISG in the drought formula would be viewed favorably by a purchasing entity as it would be acquiring normal year supply and improving its dry year allocation.

There are several possible uses for the funds from an ISG transaction, including increasing dry year supply reliability. Examples of potential projects that could reduce the dry year supply deficiency include retrofitting the City's wells to provide high quality groundwater, arranging a dry year water transfer arrangement that could be wheeled via the SFPUC system, or providing the funds necessary to complete the recycled water project, which is a "drought-proof" water supply resource.

Cost

In May 2010, the Purissima Hills Water District indicated an interest in purchasing 0.5 MGD of the City's ISG for a one-time payment of $1 million. The City declined the offer, citing several

[34] It is important to emphasize the Tier II formula expires in 2018, unless extended by mutual agreement of the Wholesale customers. It is possible the successor agreement to the current Tier II formula could be quite different, including a larger or smaller role for the ISG.

policy issues that needed resolution prior to any action to initiate an ISG transaction. With completion of the Tier II drought allocation process and the Interim Supply Limitation allocation process, the major policy obstacles have been addressed.

In September 2012, the City of Brisbane executed a term sheet with the Oakdale Irrigation District to transfer water to Brisbane. The transaction will require additional agreements with the Modesto Irrigation District and the SFPUC as intermediate parties. As is the case with PHWD, Brisbane's water use is close to its ISG and it needs additional supplies to meet anticipated needs. The term sheet is a preliminary step, but it provides a starting point to establish a proxy value for an ISG transaction. The term sheet contemplates a sale of up to 2,400 AFY, with a price of $500/AF for any delivered water and a price of $100 for any water not delivered (i.e, the difference between 2,400 AF and the delivered quantity). After five years, Brisbane must notify Oakdale Irrigation District how much water will be taken during the remainder of the agreement. All of that water is paid for at $500/AF, regardless of whether or not it is actually taken. If the City were to execute an agreement similar to the Brisbane/Oakdale transaction, a 2 MGD transfer might generate revenues of $224,000 to $1.1 million per year for the first five years, followed by up to $1.1 million per year for the duration of the transaction. Of course, such a transfer would also reduce the City's ISG from 17.07 MGD to 15.07 MGD.

Water Quality

A water transfer does not present any water quality issues.

Long Term Reliability

A 2 MGD water transfer would reduce the City's ISG from 17.07 MGD to 15.07 MGD. The City's current normal year water use is well below 15.07 MGD, and recent forecasts indicate that the City's usage will exceed 15.07 MGD for the foreseeable future. For dry years, a reduction in the City's ISG will result in an increased water reduction requirement. For dry years, the Tier II drought allocation formula has an ISG component so a reduction in ISG will negatively impact the City's allocation during a drought. Staff estimates a 2 MGD sale would require an additional 5-7% dry year cutback from the City or could increase reliance on groundwater. A thorough evaluation of such a sale is necessary to provide a more detailed assessment.

Emergency Robustness

A nominal ISG transfer would not impact the City's access to SFPUC supplies following a catastrophic interruption of SFPUC supplies.

Environmental Impacts

Staff anticipates that the receiving party will initiate any required environmental review under CEQA.

Sensitivity to Regulations

An ISG transaction is subject to Section 3.04 of the WSA. The SFPUC review is limited to determining if the proposed transfer complies with the Raker Act and whether the affected facilities in the Regional Water System have sufficient capacity to accommodate delivery of the increased amount of water to the proposed transferee. Section 3.04(a) of the WSA also specifies the City may "transfer a portion….to one or more other Wholesale Customers...", thus indicating an ISG transaction will likely be limited to another Wholesale Customer, or a third party that plans on receiving the water within the service territory of another Wholesale Customer.

Attachment B

CITY OF PALO ALTO

PUBLIC WORKS

P.O. Box 10250
Palo Alto, CA 94303
650.329.6951

January 2016

Draft Requirements for Submittal of a Determination of the effects of groundwater pumping on nearby buildings, infrastructure, trees, or landscaping.

Required information to be submitted in a report prepared by a qualified professional, to include following:

- Describe alternative construction methods considered by the owner/applicant and explain why dewatering is proposed for the project.
- Submit the following information:
  - Depth to groundwater, maximum depth of excavation (including utilities, pits, shafts, etc.) and proposed maximum depth of dewatering wells/pumping.
  - Description of dewatering technique, including: location of dewatering wells, size and anticipated flow from each pump. Include a schematic diagram showing pipe and pump sizes and locations and sizes of all tanks, fill station, pipe route to nearest storm drain inlet (including flexible and rigid pipe locations), and all street and sidewalk impacts including trenching, sawcuts, and asphalt patching between project site and storm drain inlet.
  - Anticipated dewatering flow rate and total dewatering duration.
  - Controls to be utilized (e.g., settling tank, turbidity curtain, etc.)
  - Location of anticipated discharge including final receiving water (Creek name or Bay)
  - All wells and other dewatering sites within a 400 foot radius (roughly one City block) of the property that may interact with dewatering activity, using information available from the City. State or show the exact location of these dewatering sites.
  - Determine the radius of influence (i.e. extent of cone of depression) from each dewatering well as a function of time, based on local soil and groundwater conditions. Prepare a map and cross sections of the cone(s) of depression. State whether it is reasonably likely that the proposed dewatering will cause effects (including settlement or movement) on off-site structures or infrastructure, including the right or way, easements, and utilities within public utility easements. State whether it is reasonably likely that the proposed dewatering will reduce the amount of water taken up by any vegetation or trees to a level that will affect the health or viability of the vegetation or trees. Utilize an Urban Forestry Sub Consultant (certified arborist) to verify any such effects on trees.
- To the extent that the qualified professional states that off-site effects are reasonably likely to occur, identify and implement avoidance measures to minimize the type and severity of those effects. Avoidance measures are also to be employed to the extent practical to minimize the

flow rate and duration of the pumping, even when off-site effects are not specifically identified. Avoidance measures may include, for example: reducing well count, well depth, well location, pumping rate, and/or duration of pumping; supplemental irrigation of trees or vegetation, soil amendment, or other plant protection methods recommended by a certified arborist; alternative dewatering or construction methods.

- Develop a monitoring plan to assess any actual effects on vegetation, trees, structures and infrastructure.
- The geotechnical study and description and extent of the cone of depression must be stamped by a California licensed Geotechnical Engineer and submitted to the City. This report will be made available for public review.

To → Mike Sartor
" Phil Bobel
1/4/16

I would like to clarify that savepaloaltosgroundwater.org is NOT against building residential basements. Basement construction presents many potential problems but **our focus remains on dewatering and the treatment of community groundwater as a vital community resource; not as construction waste.**

The Policy and Services Committee voted unanimously to send the issue of dewatering to the full City Council for discussion.

The Department of Public Works will present a 3 tiered approach including formulation of a site specific plan for any property issued a dewatering permit.

We ask the City Council to direct Staff to include in their recommendations the following:

1. **All community groundwater removed during construction shall be redirected and / or reused;** the Site Specific Plan shall describe how the pumped water will be used and/ or the method of replacement into the aquifer. Directing ground water into the storm drain is no longer acceptable.

2. **All extracted groundwater shall be metered; this will provide, for the first time, an accurate measurement of the amount of pumped groundwater.** Palo Alto can use this information to establish a database of extracted groundwater which will be useful for many purposes.

3. **During dewatering, the amount of permitted groundwater extraction shall not exceed a volume equivalent to water covering the lot to a depth of 5 (five) feet.** Installation of monitoring wells near and further from the construction site, as well as making this information easily available for public review should help monitor the effects on the water table, and should remain in place for a period of time long enough to establish recovery of the water table following pumping.

4. **The dewatering process shall be limited to 1 month.. Best construction practices, specifically having all contractors and subcontractors sequentially scheduled, should reduce excessive**

dewatering. Significant daily fines, similar to those for sedimentation discharge, should be assessed when dewatering exceeds allowed time. This would help put in place incentives for using best construction practices.

5. **A basement design, which does not impede the flow of water through the surrounding soils especially during normal or exceptional rainfall, shall be part of all site specific plans.** The basement must not present a flood or subsidence danger to surrounding homes.

In addition, we request the City Council apply the same Planning and Review requirements to all basement construction requiring dewatering as would apply to a 2 story home. Application of the FAR, and limiting basement depth, as previously discussed, should be considered.

Members of Savepaloaltosgroundwater.org look forward to continuing our work with the Council and Staff to address the issues we discussed this evening.

Thank you,

Rita Vrhel

Draft guideline for the maximum permissible quantity of water to be removed by dewatering (for residential basements)

Save Palo Alto's Groundwater

Current Practice

For a typical 15 foot deep dewatering for a 2500 square ft. basement on an 8,000 square foot lot, and assuming that 80% is dirt and the other 20% (0.2) extractable groundwater, the maximum amount of water attributable to the lot to be pumped would be 8,000 ft^2 x 15 ft x 0.2 = 24,000 ft^3. The City estimates the typical amount of water pumped per basement to be 1.2 million ft^3. Therefore, at most, 24,000 / 1,200,000 x 100% = 2% of the water is from the property being dewatered. This corresponds to water 150 feet deep over the entire property! Obviously, the remaining 98% is from surrounding properties. How is this fair to surrounding homeowners and to the greater community at any time, and especially in a time of drought and water restrictions?

Proposed Requirement

The guideline for limiting the amount of water removed during dewatering to five (5) feet per square foot of lot, i.e. a maximum of 40,000 cubic feet (300,000 gallons) from a 8,000 square foot lot was developed from two considerations:

1) Sustainability. The amount of rainfall on a lot is about 1.25 feet per year times the area of the lot. Of this, Todd Engineers estimated that 5 – 10% (0.0625 – 0.125 feet times the area) enters the shallow aquifer, and then potentially the deeper aquifer levels. The remainder either runs off, evaporates or is taken up by plants. Therefore, 5 feet of water depth corresponds to 4 years of (normal) rainfall or 40 to 80 years of absorption by the aquifer of rainfall from the specific property. For 15 dewatering projects, the amount of water pumped would correspond to groundwater accumulation from 600 – 1200 residences for an entire normal year.

2) Reducing groundwater withdrawn from surrounding properties. As noted above, the amount of water under a property can be estimated by the product of the area of the property, the distance that the water table is lowered and the effective porosity of the soils. The effective soils provide an estimate of the amount of water that will flow out of soils under gravity. The values range widely but for clays, the effective porosity of clay ranges from 0.01 – 0.18, (http://web.ead.anl.gov/resrad/datacoll/porosity.htm).

   For a basement that lowers the water table from 7 feet to 15 feet under the property, and 0.18 porosity (the high estimate), the amount of water from the property would be (15 – 7) x 0.18 ft = 1.44 feet of water covering the entire property.

   Permitting withdrawl of 5 feet of water per square foot means that at least (5-1.44)/5 = 71% of the water would come from surrounding properties. . In cases where the water table is lowered less, or the soils are less porous, a larger fraction of the water would come from surrounding properties. For example, if the water table was lowered 2 feet, and the same amount of water was pumped, then >90% of the water could come from surrounding properties.

CITY OF
PALO
ALTO

Guidelines for Dewatering During Basement Or Below Ground Garage Construction

February 2016

Overview

On February 1, 2016, Palo Alto City Council strengthened requirements designed to minimize the pumping and discharge of groundwater from basement (or below ground garage) dewatering during construction. Pumping of groundwater after the completion of basement construction has not been permitted for over a decade. In recent years, concerns that construction dewatering may be wasting water, potentially damaging structures, trees and vegetation, and depleting or altering the flow of groundwater, have arisen. Therefore Palo Alto has added new requirements.

Public Works only allows drawdown well dewatering of groundwater. Open pit dewatering of groundwater is disallowed. Open pit dewatering is allowed for rainwater that may accumulate at the bottom of an excavation, if water quality limits are met.

Groundwater dewatering is only allowed from April through October due to inadequate capacity in the City's storm drain system. Open pit dewatering of rainwater is allowed throughout the year, but must meet water quality requirements.

A geotechnical report must be submitted for the site (separate from the Geotechnical Study described below), and must list the highest anticipated groundwater level. Public Works recommends 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 found to be within 2 feet of the deepest excavation, a drawdown well dewatering system must be installed, or, alternatively, the contractor can excavate for the basement without a dewatering system in place and hope not to hit groundwater. However, if groundwater is hit, the contractor must immediately stop all work and must meet all of the following requirements prior to resuming work.

Public Works may require water to be tested for contaminants prior to initial discharge and at interval 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.

Below is a summary of the pre-existing requirements, with the recently adopted requirements included. The overall goal is to minimize the discharge of groundwater from basement construction dewatering. The requirements fall into four categories: 1) Fill stations are required so that others may fill water trucks or connect garden hoses for irrigation; 2) Use plans are required to demonstrate that the applicant/builder is arranging for use of as much of the pumped water as possible and minimizing storm drain discharge; 3) A Geotechnical Study is required (unless the owner/builder received the Planning Conditions of Approval, or submitted a Building Permit Application before January 14, 2016) to determine any potential effects and needed avoidance measures; and 4) Street Work/Dewatering permits are required (and are issued after requirements #1, #2 and #3 are completed).

1. Fill Station Requirements

   Fill Station requirements are explained in the attached "Fill Station Requirements" and are summarized in the check-list shown below:

   a) Locate the fill station box outside the fence to allow 24-hour per day access;
   b) Provide 2 ½" fire hose connection with a 25-foot (minimum) fire hose;
   c) Provide at least two hose bibs outside the fill station box for standard hose connections;
   d) Provide sufficient pressure to deliver 200 gallons per minute (gpm) in the fire hose and 10 gpm in the garden hose;
   e) Provide a "Water Filling Station" sign on the fill station box;
   f) Provide a "Non-Potable Discharge" sign on the discharge point;
   g) Supply log sheets, and a pen inside the box for truckers to show date and amount of filling;
   h) Provide a fill station box combination lock and give City the combination (617-3103);
   i) Provide sufficient flow meters and data loggers to determine both the water used through the fill station and the total water pumped from the ground;
   j) Protect against trip hazards with sidewalk bridges and appropriate signage as needed;
   k) Once water is in the tank, call Watershed Protection (650-329-2430/2122) for water quality testing;
   l) When Fill Station is ready, call Public Works Engineering Inspection (650-496-6929) for inspection; (Note: When the City determines that the site is too close to an area of ground water contamination, no fill station shall be provided.)

2. Use Plans

   A brief groundwater use plan must be prepared to show how the groundwater will be used to the extent practical. It shall be submitted with the Street Work/Dewatering Permit Application, and shall contain the following minimum provisions:

   a) Applicant distribution of City-provided door-hangers to advertise the availability of water; these are to be collected if still apparent after 24 hours.
   b) Applicant watering of on-site and neighboring vegetation, to the extent desired by owners;
   c) Applicant piping water to any nearby parks and schools as requested by City;
   d) Applicant trucking water one full-day per week to irrigation sites as directed by the City;
   e) Applicant using water on-site for dust suppression and other construction needs.

3. Geotechnical Study / Determination of Effects and Associated Avoidance Measures

   Conduct a Geotechnical Study to determine the radius of influence (i.e. extent of cone of depression) from each dewatering well as a function of time, based on local soil and groundwater conditions. All wells and other dewatering sites within a 400-foot radius (roughly one City block) of the property that may interact with dewatering activity, using information available from the City, shall be included in the study. State or show the exact location of these dewatering sites. Prepare a map and cross sections of the cone(s) of depression. State whether it is reasonably likely that the proposed dewatering will cause effects (including settlement or movement) on off-site private or public structures or infrastructure, including the right or way, easements, and utilities within public utility easements. State whether it is reasonably likely that the proposed dewatering will reduce the amount of water taken up by any vegetation or trees to a level that will affect the health or viability of the vegetation or trees. Utilize an Urban Forestry Sub Consultant (certified arborist) to verify any such effects on trees.

To the extent that the qualified professional states that off-site effects are reasonably likely to occur, identify avoidance measures to be implemented that will minimize the type and severity of those effects. Avoidance measures are also to be employed to the extent practical to minimize the flow rate and duration of the pumping, even when off-site effects are not specifically identified. Avoidance measures may include, for example: optimizing well count, well depth, well location, pumping rate, and/or duration of pumping; supplemental irrigation of trees or vegetation, soil amendment, or other plant protection methods recommended by a certified arborist; alternative dewatering or construction methods. Develop a monitoring plan to assess any actual effects on vegetation, trees, structures and infrastructure. The Geotechnical Study and description and extent of the cone of depression must be stamped by a California licensed Geotechnical Engineer and submitted to the City, and will be made available for public review. A Geotechnical Study Worksheet is attached.

4. Street Work/Dewatering Permit Application

A Street Work /Dewatering Permit must be obtained before any discharge from the site occurs. Public Works reviews and approves Dewatering Plans as part of a 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. Dewatering discharge to the storm drain system cannot occur between October 31 and April 1 to ensure that that the full capacity of the storm drain system is available for storm flows. The Dewatering Permit will not be issued by Public Works Engineering (650-329-2151) until the requirements of items 1-3 above have been met. Item #3 is only required if the Planning Conditions of Approval were not obtained, or the Building Permit Application was not submitted before January 14, 2016. If item #3 is not required, the attached Street Work/Dewatering Permit Application Checklist becomes the operative worksheet (as opposed to the Geotechnical Study worksheet).

The Street Work/Dewatering Permit Application must include documentation that the dewatering system has been designed to include measures such that the flow rate and the duration of pumping are minimized to the extent practical. These measures are to include, for example: optimizing well count and well locations; minimizing well depth, pumping rate, and duration of pumping. A Residential Street Work/Dewatering Permit will be issued for a maximum period of 10 weeks to ensure that minimization of pumping duration occurs. Administrative penalties beginning at $ 500 per day (and subsequently escalating) shall accrue following the permit expiration date, if pumping and/or discharge continues.

J. Michael Sartor, P.E.
Public Works Director

City of Palo Alto (ID # 6700)

City Council Staff Report

Report Type: Informational Report **Meeting Date: 4/11/2016**

Summary Title: Update on Recycled Water Planning Efforts and Groundwater Studies

Title: Update on Recycled Water Planning Efforts and Groundwater Studies in partnership with Santa Clara Valley Water District

From: City Manager

Lead Department: Public Works

Recommendation:
This report is provided for information only and requires no Council action.

Executive Summary
The purpose of this report is to provide Council an overview of the advances being made to develop alternative water supplies, both regionally and in Palo Alto. Alternative water supplies include:

- Recycled Water from wastewater plants like Palo Alto's;
- Purified Water from reverse osmosis plants like San Jose's;
- Increased groundwater use coupled with groundwater recharge;
- Local rainwater/storm drain system harvesting;
- Sub-regional wastewater "scalping" plants for small communities/districts; and
- Individual building use of graywater and treated blackwater.

Palo Alto is working through a variety of groups and committees to conduct planning for alternative water supplies. Key collaborators include Palo Alto's five Partners in its Regional Water Quality Control Plant (RWQCP), the other recipients of San Francisco PUC (Hetch-Hetchy) water, and other agencies in Santa Clara and San Mateo Counties. An important next step is the execution of several contracts to explore the potential use of key alternative supplies.

The first such contract is a feasibility study on the installation of an advanced water purification system, such as reverse osmosis, at the RWQCP. The second would update the 1992 Recycled Water Master Plan by studying groundwater recharge potential for indirect potable reuse, further utilization of recycled water by more RWQCP Partners, connections with the Sunnyvale distribution system, and other potential recycled water activities. The Santa Clara Valley Water District would provide much of the funding for this work and help manage the various tasks.

Background

The RWQCP produces high quality recycled water which is a drought-proof, locally controlled, non-potable water supply. Recycled water will help reduce Palo Alto's reliance on imported water supplies. The RWQCP currently produces recycled water in excess of the current demand; therefore staff is working to expand the recycled water demand and distribution system. As such, the City of Palo Alto certified an Environmental Impact Report on September 28, 2015, to expand recycled water through South Palo Alto to Stanford Research Park (CMR# 5962). This proposed expansion project is phase III of the 1992 Recycled Water Master Plan. Additionally, the Santa Clara Valley Water District is seeking alternative water supplies from local wastewater treatment plants. There are three wastewater treatment plants that discharge into San Francisco Bay within Santa Clara County: (1) San Jose/Santa Clara Regional Wastewater Facility (San Jose RWF), (2) City of Sunnyvale and (3) the RWQCP. The Water District already has partner agreements with San Jose RWF and the City of Sunnyvale. Recently the Water District approved a partner arrangement with the City of Palo Alto to fund eighty percent of the Advanced Water Purification System Feasibility Study Contract. The Feasibility Study will evaluate alternatives including treatment to reduce improve recycled water quality.

As part of the effort to expand uses of recycled water, the City and Water District are developing a further understanding of the northwest county groundwater system to identify opportunities for enhanced groundwater recharge.

Discussion

For the past year staff have been working with the Santa Clara Valley Water District and the RWQCP partner agencies to research expanding recycled water use opportunities in Northwest Santa Clara County. The City is working on updating the Recycled Water Master Plan to produce a strategic plan that will include the following information:

- Advanced Water Purification System Feasibility Study
- White paper on initial description of all water sources
- White paper on satellite and onsite treatment and reuse of black water, grey water, and stormwater
- Ongoing Palo Alto Potable Water Supply Resource Planning
- Mountain View Recycled Water Distribution Expansion and potential Sunnyvale Tie-In
- Palo Alto Recycled Water Phase III Expansion Project business plan development, preliminary design, and securing of outside funding
- Northwest Santa Clara County Groundwater Study for Indirect Potable Reuse (IPR) Potential
- Palo Alto RWQCP Partner Agencies Recycled Water Expansion

In addition to the upcoming Recycled Water Strategic Plan, staff has been working on the following Recycled Water planning projects.

<u>Advanced Water Purification System Feasibility Study (contract in process)</u>
To expand the use of recycled water to include cooling towers and the irrigation of salt-sensitive landscaping, staff is working to reduce the total dissolved solids (TDS) concentration. Consequently, the City has partnered with the City of Mountain View and the Santa Clara Valley Water District to jointly fund a feasibility study for installation of an advanced water purification system (AWPS) at the RWQCP (CMR #6458). The AWPS would produce virtually TDS-free water which could be blended with the current recycled water to achieve a TDS concentration of 450 ± 50 parts per million (ppm).

<u>White Paper on Initial Description of all Water Sources</u>
At the 2015 Council Meeting approving of the Environmental Impact Report (EIR) for the Phase III Recycled Water Expansion, Council requested further information on water sources as they pertain to the City of Palo Alto. Attached is an initial description of all water sources (potable and non-potable) potentially available to the City of Palo Alto (Attachment A). Potable water refers to water that meets drinking water standards and is considered safe to drink; while non-potable water refers to water that does not meet drinking water standards and is considered

unsafe to drink.

White Paper on Satellite and Onsite Treatment and Reuse

City staff has been tracking satellite and onsite treatment systems and reuse. Staff will be collecting information on similar efforts regionally and nationally, including the development of standardized design criteria and regulations. Currently, in the RWQCP service area, there are a few facilities that have reused gray water and stormwater for irrigation purposes. Stanford is currently researching an onsite treatment system.

Ongoing Palo Alto Potable Water Supply Resource Planning

City staff is currently working on the Water Integrated Resources Plan (WIRP) that will discuss the variety of potable water supply resources and planning. The WIRP will include an assessment of alternative potable water supplies including the City's current water supply source from the San Francisco Public Utilities Commission's Region Water Supply System, groundwater, and treated water from the Santa Clara Valley Water District as well as demand-side management. Recycled water will be assessed both as a tool to reduce potable water demand and as a potential potable water supply through IPR and Direct Potable Reuse (DPR). The results of the groundwater study discussed below will be an important part of this analysis. All of these resources will be evaluated based on availability, cost, water quality, environmental impact and robustness in water emergencies and with respect to potential state regulations.

Mountain View Recycled Water Distribution Expansion and Sunnyvale Tie-in

Mountain View currently receives the majority of the recycled water produced at the RWQCP. Mountain View has hired a consultant to research expanding the recycled water distribution system within its city limits and is working with Sunnyvale for a potential recycled water intertie. The City of Sunnyvale is rebuilding their wastewater treatment plant and plans on treating the majority of their flow to purified water for future IPR. Therefore, their existing recycled water customers will need a new source of recycled water which will potentially be provided by the RWQCP via the Mountain View—Sunnyvale intertie.

Palo Alto Recycled Water Phase III Expansion (RFP in process)

The City is seeking a consultant to develop a business plan, preliminary design, and aid in securing funding for the Phase III Expansion project. This evaluation will help Council decide on pursuing Phase III Expansion of the recycled water pipeline. The City has drafted interim Recycled Water Guidelines to help facilitate new recycled water customers who are on the existing recycled water line near the RWQCP.

Northwest Santa Clara County Groundwater Study for Potential Indirect Potable Reuse (RFP in process)

The purpose of the groundwater study is to compile baseline information on the current condition of aquifers in northwestern Santa Clara County and adjacent areas, including sources and quantities of recharge, groundwater pumping, and water quality. This information will be used to evaluate the feasibility of IPR of advanced treated recycled water and identify opportunities for increased groundwater utilization of recycled water. This study will also evaluate impacts to groundwater resources from potential pumping or recharge projects to ensure continued sustainable groundwater management.

Palo Alto RWQCP Partner Agencies Recycled Water Expansion (RFP in process)

City staff is seeking opportunities to expand recycled water within the RWQCP service area: East Palo Alto, Los Altos, Los Altos Hills, Mountain View, Stanford, and Palo Alto. The RWQCP's NPDES permit requires the treatment plant to have a recycled water program. Current recycled water demands and distribution systems were identified in the Recycled Water Master Plan that was completed in 1992. Since 1992, prolonged drought and increased economic activity has opened up new potential demand for recycled water in partner cities, including potential groundwater recharge opportunities. Consequently, staff is pursuing a consultant to re-evaluate the current and projected recycled water demand in the RWQCP service area.

Timeline

Below is a tentative timeline for the recycled water projects:

- Cost sharing agreements with the Santa Clara Valley Water District and City of Mountain View for the Advanced Water Purification System Feasibility Study – April 2016
- Recycled waterpipeline expansion within East Palo Alto, Palo Alto and Mountain View – Construction expected to begin in 2016
- Advanced Water Purification System Feasibility Study expected to be

completed by end of 2016

- Recycled Water Strategic Planning and Groundwater Assessment contract expected to be approved in summer 2016; the following deliverables will be completed by December 2018:
    - Phase III Recycled Water Expansion Business Plan, Preliminary Design & Secured Funding Effort Report
    - IPR Feasibility Evaluation
    - Conceptual Groundwater Model
    - Northwest Santa Clara County Groundwater Study for Potential IPR Report
    - Recycled Water Strategic Plan Report
    - Funding Identification & Application(s)
    - Public Outreach

Resource Impact

The current recycled water program consists of five hard-piped City facilities and more than 60 permitted users of the recycled water truck fill station. The RWQCP is the wholesaler of recycled water within its service area. The City is currently negotiating private hard-piped recycled water customers along the existing distribution line,expanding recycled water into East Palo Alto and in South Palo Alto including Stanford Research Park.. City staff anticipate construction of the East Palo Alto recycled water expansion to commence in 2016; therefore, staff is needed to help manage future contractors. As mentioned previously the City is planning on managing larger recycled water planning contracts to improve the water quality, update recycled water strategic plan, and investigate the possibilty of indirect potable reuse to recharge groundwater. The City is currently negotiating with the Santa Clara Valley Water District that they will fund eighty percent of the Advanced Water Feasibilty Contract and the City is still negotiating how much the SCVWD will fund of the second contract that will update the recycled water strategic plan. The City currently does not have a dedicated staff person who works on recycled water. In order to expand the City's Recycled Water Program, a new Senior Engineer is required for future tasks including:

- Initiate and manage recycled water and water re-use consultant contracts
- Prepare a new Strategic Recycled Water Plan to complement the 1992 Recycled Water Master Plan

- Determine the need and timing for appropriate groundwater recharge and storage of purified water, based on modelling of the San Francisquito Creek cone
- Determine best method of brine disposal and management to allow for the addition of advanced recycled water treatment processes to the RWQCP's current treatment plant
- Develop RWQCP regulations and guidelines for the use and management of recycled water and purified water
- Serve as the principal point-of-contact for Partner Agencies to secure new or modified Recyled Water Service and determine amounts and timing of needs
- Serve as Public Health and Water Board Compliance Officer for water re-use programs, including inspection programs and cross-connection prevention programs
- Develop and manage Infrastrucutre Management System (IMS) for the Recycled Water wholesale water treatment and distribution system; track and manage system repairs and upgrades
- Develop Nutrient Credits and Offsets for Recycled Water Program
- Coordinate expanded water use and water quality reporting and monitoring with regulatory agencies, partner agencies, users, site supervisors, and customers.

Manage expanded recycled water system maintenance and utility locating services.The new Senior Engineer position would be funded partially by the partner agences to the RWQCP, since it is a requirement in our discharge permit to have a recycled water program. Therefore Palo Alto will only fund one third of the Senior Engineer Position which costs approximately $220,000. The projects that the Senior Engineer will manage will also be funded through cost-sharing agreements with the SCVWD, grants and state revolving funds.

Policy Implications

Continuing the exploration of expanding recycled water is consistent with Council policy. The Recycled Water Program is consistent with the Council-adopted Water Integrated Resource Plan Guideline 3: "Actively participate in development of cost effective regional recycled water plans." The project is consistent with Council direction to reduce imported water supplies and limit or reduce diversions from the Tuolomne River.

Council's Sustainability Policy supports the development of recycled water, specifically in the Policy's statement to "reduce resource use and pollution in a cost-effective manner while striving to protect and enhance the quality of the air, water, land and other natural resources."

The City's Comprehensive Plan contains Natural Environment Goal N-4: Water resources are prudently managed to sustain plant and animal life, support urban activities and protect public health and safety. Specifically, Program N-26 addresses the use of recycled water: implement incentives for the use of drought-tolerant landscaping and recycled water for landscape irrigation.

Environmental Review

Environmental Impact Report for Phase III of the recycled water pipeline project was approved in September 2015. Future Environmental Review will be required if the expanded recycled water pipeline is constructed.

Brettle, Jessica

From: Daniel Garber <dan@fgy-arch.com>
Sent: Friday, February 17, 2017 6:42 PM
To: Council, City
Cc: Keith Bennett; Rita Vrhel; Esther Nigenda
Subject: Broad Area v Localized Dewatering
Attachments: 170306 Broad Area v Localized Dewatering (6).pdf; Secant Wall .mp4

Dear Council Members-

Attached is a pdf showing the conceptual differences between Broad Area Dewatering and Localized Dewatering strategies that utilize cutoff walls.

Although there are several ways to create a cutoff wall, the mostly like one to be utilized in Palo Alto are cutoff walls made using the secant shoring technique. (Shoring is the term used to describe the holding back of the earth.) In this solution the cutoff wall is created by drilling a sequential series of holes to form a below grade wall. In this process, the earth isn't removed in the drilling process, rather the earth is mixed with a weak cement or expansive clay to create the wall.

I've recently had conversations with American Drilling's subcontractor Daedalus Engineering who designs the secant walls they build. I have learned that the only data that they need to design a secant wall that allows the dewatering of a localized area, is the same analysis of the soil borings that is contained in the standard geotech report that the City currently requires (not the "enhanced" geotech report the City is considering requiring for projects that use broad area dewatering methods).

While the engineer is happy to receive as much information as they can get, they don't need, for example, additional CPTesting to design the secant wall. This is good news in that it returns the cost for doing a Geotech Report to support a localized dewatering strategy to what it is today.

If monitoring the level of the groundwater is done, two additional costs are required. The first is for acquiring a permit from the County for a well (~400 $/well). The borings that the geotech does routinely do not require permits because they are capped right after the borings have been completed. The second cost is for measuring the level of the groundwater. This is done by hand (dropping a weighted measuring tape) or by sliding a piezometer into the well, either accomplishes the same thing.

I'm expecting to do two projects this year that will utilize a secant cutoff wall. And I'll be measuring the groundwater level to establish how effective localized dewatering strategies are in reducing groundwater extraction and what, if any, impacts cutoff walls have on groundwater flow. Depending on the outcomes of these learnings, the need to monitor the groundwater of future projects that utilize cutoff walls may not be necessary.

As I reported at the PSC Meeting in December, I'm expecting that the additional cost to build a secant wall to be about 25 to 35% more than utilizing Broad Area Dewatering solutions. However, utilizing a secant wall strategy reduces this added cost by 1) being built in approximately half the time that building the shoring for Broad Area Dewatering requires, 2) it requires fewer trades to be involved in the excavation and shoring compared to what Broad Area Dewatering requires, and although it doesn't directly relate to cost it allows the homeowner to build a basement anytime during the year. The homeowner isn't restricted to just the non-rainy season to build because the

City's storm drain system isn't burdened by the large amounts of water that results from a project that utilizes Broad Area dewatering methods.

Thus, localized dewatering strategies adds flexibility to a homeowner's construction schedule, adds only a very small percent to the overall cost of any new house and importantly avoids removing millions of gallons of water from our underground aquifer.

In addition to the attached pdf document, there is also a link to a small video of the actual soil mixing that is done to create a secant wall.

FYI, I have shared this information with Public Works, in addition to you.

best,

-dan

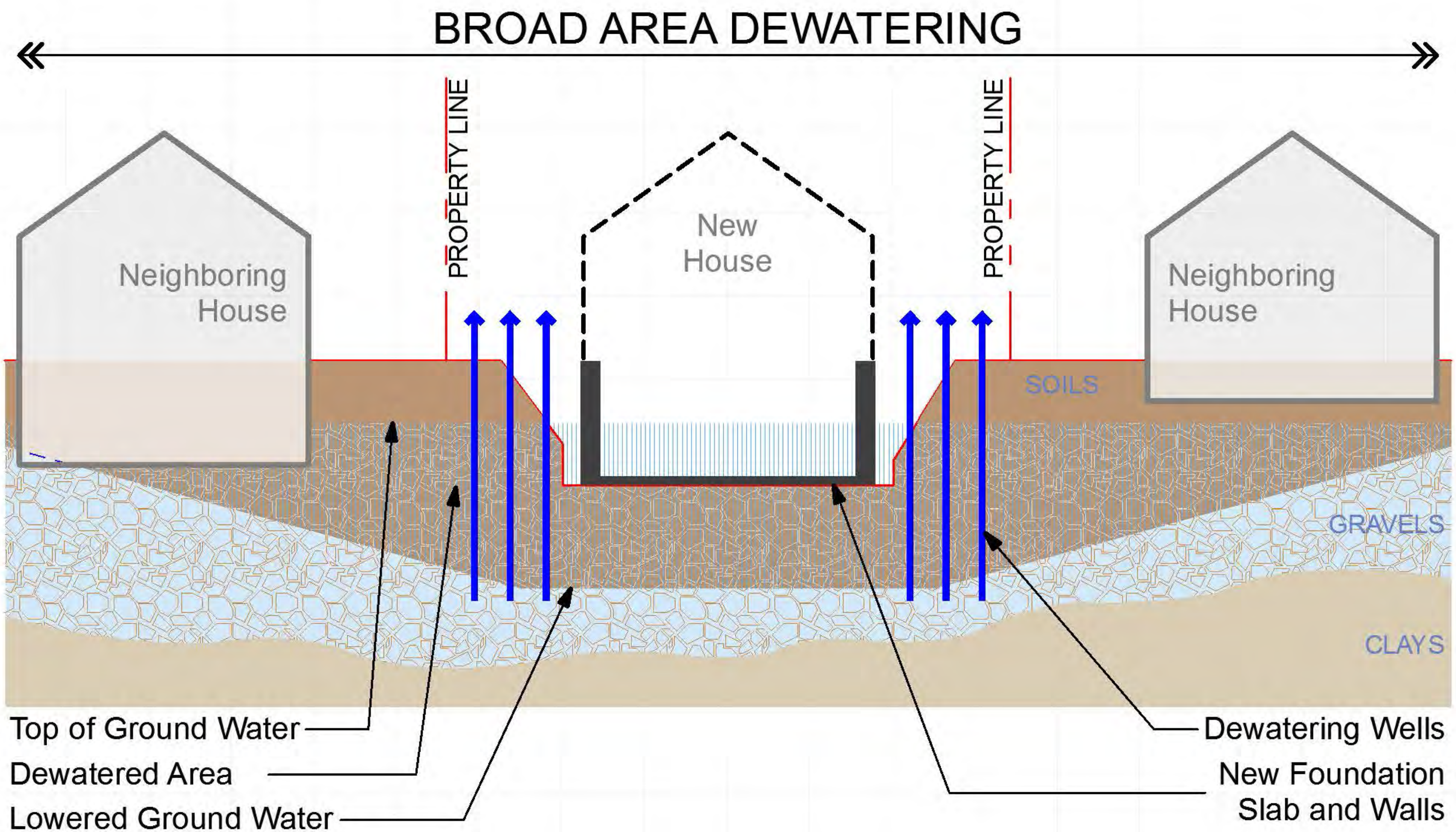
Daniel Garber, FAIA
Fergus Garber Young Architects

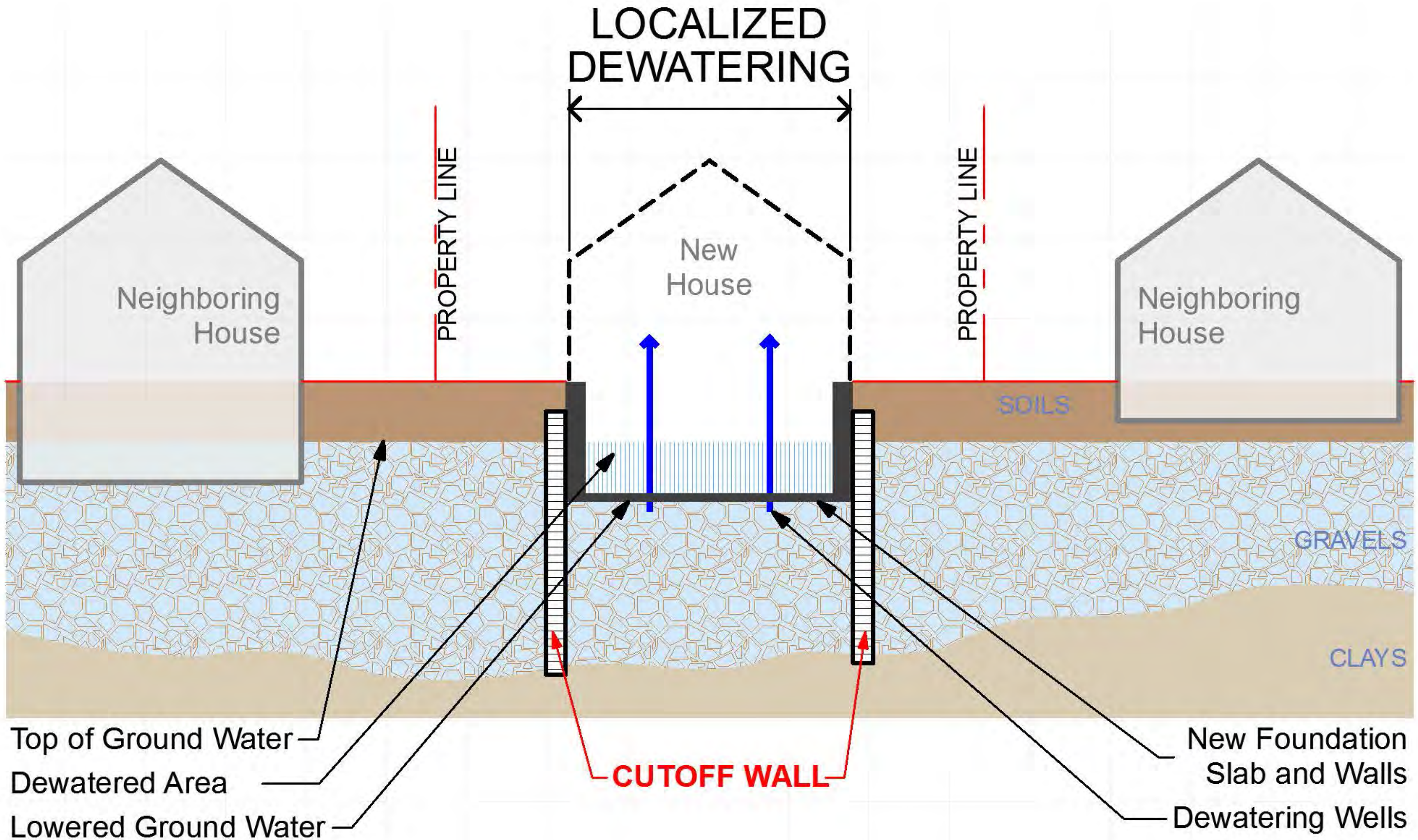
Conserving Palo Alto's Ground Water

Broad Area versus Localized Dewatering Strategies

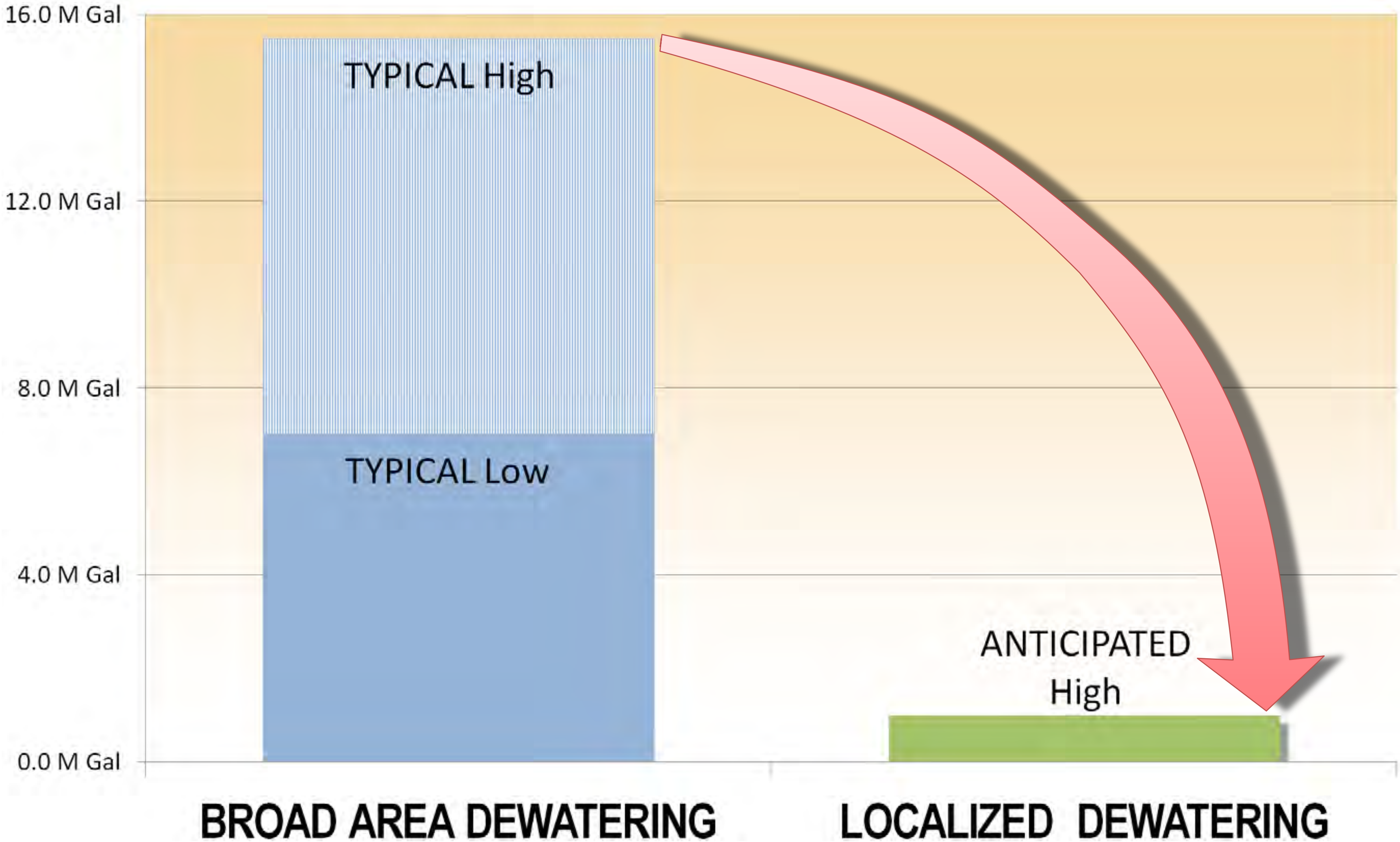
March 6, 2017

Daniel Garber
Save Palo Alto's Ground Water


BROAD AREA DEWATERING
PROPERTY LINE
PROPERTY LINE
Neighboring House
New House
Neighboring House
SOILS
GRAVELS
CLAYS
Top of Ground Water
Dewatered Area
Lowered Ground Water
Dewatering Wells
New Foundation Slab and Walls

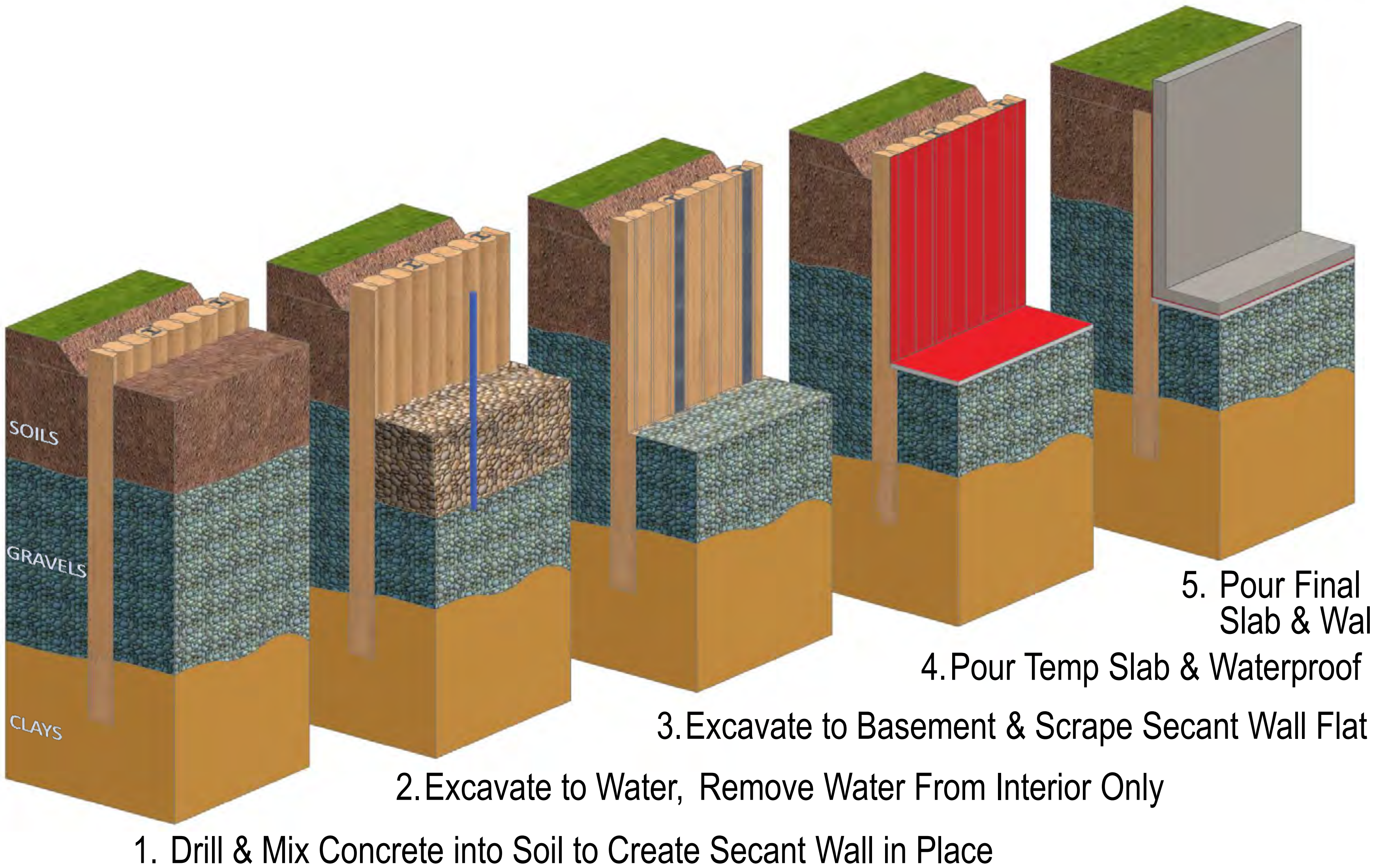

LOCALIZED
DEWATERING
PROPERTY LINE
PROPERTY LINE
Neighboring
House
New
House
Neighboring
House
SOILS
GRAVELS
CLAYS
Top of Ground Water
Dewatered Area
Lowered Ground Water
CUTOFF WALL
New Foundation
Slab and Walls
Dewatering Wells

The Potential Amount of Water that can be kept from going down the City Storm Drain System



No discharge may be needed with percolation, trucking and other use

Secant Cutoff Wall Concept



Photos of Secant Cutoff Wall Construction

Brettle, Jessica

From:	Rita Vrhel <ritavrhel@sbcglobal.net>
Sent:	Saturday, February 18, 2017 8:32 AM
To:	Keith Bennett; Daniel Garber; Council, City
Cc:	Esther Nigenda
Subject:	Re: Broad Area v Localized Dewatering

Hi All.... thank you Dan... yes Keith please send as we want everyone to read the document.

Rita C. Vrhel, RN, BSN, CCM
Medical Case Management
Phone: 650-325-2298
Fax: 650-326-9451

On Friday, February 17, 2017 8:26 PM, Keith Bennett <pagroundwater@luxsci.net> wrote:

Dan,
Thank you for this and sending it to Public Works as well.
Should I forward it to Council Members' "personal" e-mail addresses. I recall that at least some Council members preferred using their personal addresses for "important" stuff.

Keith

On 2/17/2017 6:42 PM, Daniel Garber wrote:

> Dear Council Members-
> Attached is a pdf showing the conceptual differences between Broad Area Dewatering and Localized Dewatering strategies that utilize cutoff walls.
>
> Although there are several ways to create a cutoff wall, the mostly like one to be utilized in Palo Alto are cutoff walls made using the secant shoring technique. (Shoring is the term used to describe the holding back of the earth.) In this solution the cutoff wall is created by drilling a sequential series of holes to form a below grade wall. In this process, the earth isn't removed in the drilling process, rather the earth is mixed with a weak cement or expansive clay to create the wall.

--
Keith Bennett
http://savepaloaltosgroundwater.org