

TASSAJARA HILLS, TRACTS 8102, 8260, AND 8325
DUBLIN, CALIFORNIA

FALLON CROSSING
GEOLOGIC HAZARD ABATEMENT DISTRICT (GHAD)
PLAN OF CONTROL
TASSAJARA HILLS DEVELOPMENT ANNEXATION

Submitted to
Toll Brothers, Inc.
8259 South Monarch Road
San Ramon, CA 94583

Prepared by
ENGEO Incorporated

May 30, 2017

Project No.
5661.002.000

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Project No.
5661.002.000

May 30, 2017

Mr. Steve Savage
Toll Brothers, Inc.
8259 South Monarch Road
San Ramon, CA 94583

Subject: Tassajara Hills, Tracts 8102, 8260, and 8325
Dublin, California

FALLON CROSSING GHAD PLAN OF CONTROL
TASSAJARA HILLS DEVELOPMENT ANNEXATION

Dear Mr. Savage:

Attached is the proposed Plan of Control to support annexation of the Tassajara Hills development Tracts 8102, 8260, and 8325 (formerly Moller Ranch Tract 8102) into the Fallon Crossing Geologic Hazard Abatement District (GHAD). This annexation satisfies portions of Condition of Approval No. 27 – Ownership and Maintenance of Improvements, No. 38 – Storm Drain Treatment Measures, and No. 48 - GHAD Formation.

If you have any questions or would like any additional information, please do not hesitate to contact us.

Sincerely,

ENGEO Incorporated

Prepared by:

Phil Stuecheli, CEG

Josef J. Tootle, GE



pjs/jjt/dt

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1.0 INTRODUCTION

Under the Conditions of Approval No. 48 for the Tassajara Hills Tracts 8102, 8260, and 8325, the City of Dublin has required that the Tassajara Hills development be annexed into the Fallon Crossing GHAD prior to filing of the first final map for the project. To satisfy this requirement, the developer of the Tassajara Hills Development has petitioned the Board of Directors of the Fallon Crossing GHAD to annex the Tassajara Hills development into the existing Fallon Crossing GHAD ("GHAD" or "District"). Grading for the project began in October 2015; at this time, the grading has not been completed.

1.1 PROPERTY IDENTIFICATION, OWNERSHIP AND MAINTENANCE RESPONSIBILITIES

A written description of the properties to be annexed into the existing Fallon Crossing GHAD is provided in Exhibit A and shown graphically on Exhibit B. The GHAD annexation area includes Assessor's Parcel Numbers (APN) 985-0001-001-01. Ownership and maintenance responsibilities for the individual parcels within the annexation area (Tracts 8102, 8260, and 8325) are shown on Figures 1 and 2.

2.0 TASSAJARA HILLS PLAN OF CONTROL

2.1 GEOLOGIC HAZARDS

Geologic hazards identified for the site in the ENGEO Geotechnical Exploration report (Reference 1) dated November 12, 2012, include the following items.

- Slope instability
- Creek bank instability
- Surface erosion
- Seismically induced ground shaking
- Swell/settlement related to deep fills
- Compressible soils
- Expansive soils
- Alkali Soils

These geologic hazards are not expected to be eliminated entirely by site grading. Slope instability or potential slope instability is not unique to this project but is of importance for hillside projects throughout the San Francisco Bay Area, such as Tassajara Hills. Future stability depends on various factors, including any introduction of natural or artificial groundwater, future grading and earthquake ground shaking.

2.1.1 Slope Instability – Tassajara Hills

During mapping for the Tassajara Hills geotechnical exploration, areas of slope instability were identified throughout the planned development area and within the future open space areas. The geologic map showing the location of each of the debris flows and landslides is included in Figure 5. The table below identifies each of the landslide areas within the development area and the proposed corrective measures. Potential District monitoring or maintenance activities for the specific areas listed in the table below are discussed in Section 2.3.

TABLE 2.1.1-1 Mapped Landslides and Completed or Proposed Corrective Measures

AREA DESIGNATION	TYPE OF FEATURE	COMPLETED OR PLANNED MITIGATION METHOD
1	Earthflow	Upslope portion removed by design cut, keyway and removal to support proposed entrance road
2	Deep-seated Rotational Slump	Upslope portion removed and replaced, keyway along downslope side of entrance road
3	Deep-seated Earthflow Complex	Upslope portion removed and replaced, keyway along downslope side of entrance road
4	Deep-seated Earthflow Complex	Upslope portion removed and replaced, keyway along downslope side of entrance road
5	Earthflow	Removed and replaced
6	Deep-seated Earthflow Complex	Removed and replaced portion within development area, buttressed remaining upslope portion with geogrid reinforcement
7	Slump/Earthflow	Outside development area, no proposed mitigation
8	Deep-seated Complex	Removed and replaced, buttressed remaining upslope
9	Deep-seated Complex	Removed and replaced within development are, keyway along downslope side of road
10	Shallow Earthflow	Removed and replaced upslope portion that is within development area
11	Deep-seated Earthflow Complex	Removed and replaced surficial portions of landslide, buttressed deep-seated portion of landslide with design fill.
12	Earthflow Complex	Removed and replaced
13	Earthflow Complex	Removed and replaced
14	Earthflow Complex	Removed and replaced
15	Earthflow Complex	Removed and replaced portion within development area, construct buttress/catchment area for remaining upslope portion
16	Deep-seated Earthflow Debris Lobe	Buttressed with deep engineered fill keyway, remove and replace upper portions within and adjacent to development area buttressed remaining upslope portions
17	Deep-seated Earthflow Complex	Removed and replaced within development area and upslope and buttressed by a deep engineered fill keyway
18	Earthflow Complex	Removed and replaced within development area
C1	Earthflow Complex	Removed and replaced within development area
C2	Earthflow Complex	Removed and replaced within development area
C3	Earthflow Complex	Removed and replaced within development area

A landslide is defined as a mass of rock, soil and other debris that has been displaced downslope by sliding, flowing or falling. Landslides include cohesive block slides and disrupted slumps that have formed by displacement along a planar slip surface or rotation (displacement along a curved slip surface). Undercutting and erosion of hillside slopes can trigger slope failures.

Slope failures are also triggered by increased pore water pressure due to the infiltration of rainwater. The resulting decrease of shear resistance (internal resistance to deformation by shearing) can cause a slope to move. The level of the groundwater table varies with the amount of rainfall for the area. If rainfall is higher than average during the winter season, the water table

may be higher than average on a hillslope and groundwater pressures may become high. Under these conditions, hillside movement can be activated.

Areas of thickened soil cover on the hillslopes are known as colluvium (Qc). Colluvial deposits are typically the result of soil creep and may be in a weak, unconsolidated state, making them susceptible to landsliding if undercut. Colluvial deposits located within open-space areas are natural landforms that do not require mitigation, except where they affect manmade improvements. Potential mitigation and repair measures for District areas near improvements are discussed in Section 2.3.

2.1.2 Creek Bank Instability

As identified in the referenced Geotechnical Exploration report, creek banks along Moller Creek are subject to erosion and localized slumping. The banks have been oversteepened by erosion and consist of relatively weak materials. Creek bank erosion has locally been exacerbated by extensive burrowing by ground squirrels and formation of sinkholes associated with concentrated burrow networks. To mitigate the potential for adverse impacts from creek bank instability, it has been recommended that all improvements be set back beyond a 3:1 projection from the toe of the creek bank or where closer, special mitigation measures will be needed. These measures could include use of geogrid-reinforced fills or buried rip-rap. Creek bank areas, especially areas with existing vertical banks and concentrations of gullies or sinkholes, should be periodically monitored by the GHAD so that appropriate maintenance can be completed in a timely manner.

2.1.3 Surface Erosion

Graded slopes will be subject to localized erosion and surface sloughing, especially during peak rainfall events. Areas of erosion could also occur along created mitigation swales (shown on Figure 3) and in existing natural drainage channels on open space slopes. Erosion gullies, if left un-mitigated, and allowed to enlarge, can lead to undermining of slopes and development of surface landslides. Potential erosion hazards can be mitigated by erosion control measures recommended in the Geotechnical Exploration report, such as covering graded slopes with a topsoil veneer, and by installation of typical erosion control measures and monitoring as described in the Erosion Control Plans and the SWPPP. Slopes should be periodically monitored by the GHAD so that appropriate maintenance can be completed in a timely manner if areas of erosion develop in project graded slopes, or on an adjacent native slope areas area that could impact improvements.

2.1.4 Seismically Induced Ground Shaking

As identified in the Geotechnical Exploration report, an earthquake of moderate to high magnitude generated within the San Francisco Bay Region could cause considerable ground shaking at the site, similar to that which has occurred in the past. Seismic slope stability has been considered in the geotechnical reports completed for the site; however, seismically generated slope failures could occur outside the grading limits within the Tassajara Hills Development.

2.1.5 Swell/Settlement Related to Deep Fills

According to the preliminary grading plans, fills up to about 120 feet thick will be placed in the swales and low-lying areas. Studies have shown that engineered fills in residential development

sites typically experience increases in moisture content after building construction due to increases in irrigation or natural conditions and to alteration of drainage patterns. This process may take about 10 to 15 years after irrigation commences, or even more, before the fill becomes fully wetted. The wetting process can cause settlement or swell (hydrocompression due to wetting) depending on soil type, compaction, moisture content, and the overburden pressures (fill thickness).

2.1.6 Compressible Soils

As identified in the Geotechnical Exploration report, settlement of soft soils may be significant if not properly mitigated. Differential movement under structures is a primary geotechnical concern. Settlement at the site could be generated from: (1) consolidation of the alluvial and colluvial deposits in the swale areas where fills will be placed, (2) compression of the deep fills due to their own weight, and (3) compression of soils beneath foundation systems due to building loads. As recommended, compressible alluvial and colluvial soil materials should be removed within the area of development during corrective grading.

2.1.7 Expansive Soils

Near-surface soils, in addition to claystone and siltstone at the site, could exhibit a high potential for expansion. These potentially expansive soils could impact the planned site development. Expansive soils shrink and swell as a result of moisture change. This can cause heaving and cracking of slabs-on-grade, pavements and structures founded on shallow foundations. The potential for expansive soils has been identified in previous reports for the property. Shrink and swell of expansive soils on slopes is a portion of the mechanism of creep movement, which can result in shallow slope instability.

2.1.8 Alkali Soils

The site geologic map presented as Figure 2 in the Geotechnical Exploration report for the Tassajara Hills development and on Exhibit D of this document, depicts areas of existing alkali soils on the surface of the creek alluvium. These soils were identified as potentially corrosive in the Geotechnical Report. The corrective Grading Plans recommended removing alkali soil within the grading envelope and placing them in deep fills below pad grade. This recommendation was implemented. If future improvements are proposed in the alkali soils remaining in the open space areas they should be designed with appropriate corrosivity considerations.

2.2 SLOPE STABILITY MITIGATION CONSIDERATIONS DURING MASS GRADING

As recommended in the Geotechnical Exploration report for the Tassajara Hills development, existing non-documented artificial fills within the graded area will be removed prior to engineered fill placement. In addition, unsuitable materials, which could include colluvium and other unsuitable material, will be overexcavated to firm undisturbed materials below the unsuitable material as determined by the project Geotechnical Engineer or Engineering Geologist (ENGEO) at the time of grading. Subdrains will be installed to collect subsurface waters. The configuration of the subdrainage system will be tailored to the subsurface conditions at the time of grading. The locations of subdrain outfalls will be shown on the Field-Verified Geology and Subdrain Plan, that will be included with the mas grading testing and observation report. Each subexcavation area will be reconstructed to final grade by keying and benching below the landslide plane with compacted, drained engineered fill.

Cuts were mapped by a geologist during grading to provide mitigation schemes for unsuspected slope conditions, which could decrease the slope stability. Such conditions include unfavorable bedrock attitudes, weak or highly sheared bedrock materials, and seepage conditions. Testing and observation reports shall be made available to the GHAD for its use following completion of the project development.

2.3 GHAD-MAINTAINED IMPROVEMENTS AND OPEN SPACE AREAS

Conditions of Approval (COA) Numbers 27, 38, and 48 address parcel ownership and GHAD maintenance responsibilities.

> COA No. 27 – *Ownership and Maintenance of Improvements: Ownership, dedications on final map, and maintenance of street right-of-ways, common areas parcels, and open space areas shall be by the City of Dublin, the Homeowner's Association, and the Geologic Hazard Abatement District, as shown on the Ownership and Maintenance responsibility Exhibit, Stage II submittal, Tract Map 8102, prepared by MacKay and Somps, dated August 2012.*
>
> COA No. 38 – *Storm Drain Treatment Measures: The developer shall install storm drain treatment measures as shown on the Vesting Tentative Map, Sheet 11-13. The stormwater ponds shall include a screen or filter at each storm drain pipe outfall into the pond that comply with Section C.10 of the Municipal Regional Permit for Stormwater with regards to trash capture. Water quality measures located within the GHAD parcels shall be maintained by the Fallon Crossing GHAD. New impervious surface area on Tassajara Road shall also be provided with treatment measures; water quality measures serving the road will be maintained by the City unless directed into the GHAD treatment ponds.*
>
> COA No. 48 – *Geologic Hazard Abatement District: Prior to filing the first final map, the annexation of the entire project into the Fallon Crossing Geologic Hazard Abatement District (GHAD) covering the entire project shall be completed. The GHAD Board of Directors for the GHAD shall be the City Council of the City of Dublin. The GHAD shall be responsible for the ongoing maintenance of the open space areas (including benches and brow ditches, maintenance roads or trails or fencing) and water quality control ponds, and shall include a reserve for unforeseen repair of future slope instability. Ownership of GHAD-maintained parcels shall be by the GHAD in fee as shown on the Vesting Tentative Map.*

The District will have authority and responsibility to manage erosion and other geologic hazards within the boundary shown in Exhibit B subject to the exclusions listed in Section 2.5 – Criteria for GHAD Responsibility. The GHAD shall be responsible for monitoring and maintenance of the following site improvements located within the GHAD-owned parcels shown on the Open Space and Improvement Ownership/Maintenance Plan (Figures 1 and 2).

- Developer or GHAD-constructed retaining walls, including repair if structural integrity of a wall or adjacent structure(s) is threatened.
- Water detention, bioretention cells, and vegetated bio-swales facility maintenance, including access road.
- Slopes.

- Debris benches.
- Emergency vehicle access (EVA) and maintenance roads.
- Lined and unlined drainage ditches in developed areas and open space.
- Vegetation control within open space.
- Storm drain system improvements.
- Subdrains and subdrain outlets.
- Fuel management for fire suppression.
- Fencing.
- Mitigation swales.
- Slope and subdrain maintenance within GHAD easements. Although these areas are outside the GHAD boundary, the maintenance of these items is necessary to reduce the potential of geologic hazards that could affect properties and improvements within the GHAD boundary, and therefore, it will be protective of facilities within the GHAD. Prior to providing monitoring and maintenance for the facilities, the GHAD must be granted an access and maintenance easement by the property owner, Moller RE Investors, LLC. The GHAD is not responsible for other maintenance items related to open space.

The GHAD intends to mitigate, prevent, abate or repair landslide or erosion hazards that could directly affect property within the GHAD boundary, as necessary to implement this Plan of Control. As a responsible landowner, the GHAD will also assume open-space management responsibilities that are required for the Tassajara Hills project. These responsibilities will include vegetation management, vegetation removal (fire suppression), and selected other maintenance associated with open space.

2.3.1 Agency Notice

Long-term management, monitoring, and maintenance of habitat features and values within the Riparian Restoration Area and the mitigation swales and channels located uphill and adjacent to the development envelope will be done in accordance with the *Riparian Mitigation & Monitoring Plan for the Moller Ranch Residential Development and Tassajara Culvert Replacement Projects*, Alameda and Contra Costa Counties, California (H. T. Harvey & Associates, 2014) (Riparian MMP) by the Riparian Land Manager. An endowment will provide the funding for the long-term management, monitoring and maintenance activities described in the Riparian MMP, including mitigation channels/swales A through P, which are not included in the GHAD operations or budget estimates.

Management of the Riparian Restoration Area, and mitigation channels/swales A through P, including general maintenance, will be conducted by the Land Manager identified in the Riparian MMP and approved by the State and Federal Agencies. Activities not specifically described in the Riparian MMP are not included in the State and Federal permits. The GHAD will comply with the Riparian MMP and will obtain all necessary State and Federal permits for any activity not

described in the Riparian MMP, that is regulated pursuant to State law (Porter Cologne Act, Fish & Game code, and Section 401 of the Clean Water Act), and Federal law (Clean Water Act and Endangered Species Act).

2.3.2 General Landslide Mitigation

The techniques the District may employ to prevent, mitigate or abate landsliding or adverse erosion damage might include, but are not necessarily limited to:

- Removal of the unstable earth mass.
- Stabilization (either partial or total) of the landslide by removal and replacement with compacted drained fill.
- Construction of structures to retain or divert landslide material or sediment.
- Construction of erosion-control devices such as gabions, rip rap, geotextiles or lined ditches.
- Placement of drained (e.g., underdrains or horizontal drains) engineered buttress fill.
- Placement of subsurface drainage devices (e.g., underdrains or horizontal drains).
- Slope correction (e.g., gradient change, biotechnical stabilization, and slope trimming or contouring).
- Construction of additional surface ditches and/or detention basins, silt fences, sediment traps, or backfill or erosion channels.

Potential landslide and erosion hazards can often best be mitigated by controlling soil saturation and water runoff and by maintaining the surface and subsurface drainage system. Maintenance shall be provided for lined surface drainage ditches and drainage terraces.

2.4 BIOTECHNICAL RECOMMENDATIONS FOR PREVENTION AND MITIGATION OF EXISTING OR POTENTIAL EROSION HAZARDS

Fill slopes within the boundaries of the District are expected to be erodible as will cut slopes in bedrock; therefore, the maintenance of vegetative cover is especially important. Vegetation provides a layer of protection on soil and exposed rock. It absorbs the impact of raindrops, reduces the velocity of runoff and retards erosion.

In many instances, adequate erosion protection for slopes can be accomplished with carefully selected and placed biological elements (plants) without the use of structures (e.g., brush layering and willow waddling).

In other areas, biotechnical slope protection may involve the use of mechanical elements or structures in combination with biological elements to provide erosion control and help prevent small-scale slope failures. Locally, walls, welded-wire walls, gabion walls, rock walls, riprap and reinforced earth walls used in combination with carefully selected and planted vegetation can provide high-quality slope protection. The vegetation may be planted on the slope above a low retaining structure or toe wall, or the interstices of the structure can be planted.

2.5 CRITERIA FOR GHAD RESPONSIBILITY

To establish an appropriate GHAD assessment level for the Tassajara Hills portion of the Fallon Crossing GHAD, it is important to clearly define the limits of the GHAD's responsibilities. The GHAD will accept responsibility for property as described in Exhibit A. However, the intent of this Plan of Control is not to extend the GHAD's responsibilities to every potential situation of slope instability; as such, the following are exclusions from GHAD responsibility.

2.5.1 Isolated or Remote Slope Instability

The GHAD shall not have responsibility to monitor, abate, mitigate or control slope instability that does not involve damage to, or pose a significant threat to damage, site improvements or flood control capacity. As used herein, the term "site improvements" means buildings, roads, sidewalks, utilities, retaining walls, improved trails, swimming pools, geologic stabilization features and drainage features or similar improvements.

2.5.2 Single Property

The GHAD will not prevent, mitigate, abate or control geologic hazards which are limited in area to a single residential parcel of property unless the geologic hazard has damaged or poses a significant threat of damage to site improvements located on other property within the GHAD boundaries.

2.5.3 Geologic Hazards Resulting from Negligence of Property Owner

The GHAD may, in the general manager's sole discretion, decline to prevent, mitigate, abate or control geologic hazards which occur or result from any negligence of a homeowner and/or the homeowner's contractors, agents or employees in developing, investigating, grading, constructing, maintaining or performing or not performing any post-development work on the subject property.

2.5.4 Property Not Accepted

The GHAD shall not have responsibility to repair damage that is situated on a parcel of real property, which the GHAD has not accepted in accordance with Exhibit E. The GHAD, however, may monitor, abate, mitigate or control slope instability on a parcel of real property, which the GHAD has not accepted in accordance with Exhibit E, provided that the GHAD responsibility on such parcel shall be limited to the extent necessary to address damage or a significant threat to damage site improvements on a GHAD-accepted parcel.

2.5.5 Geologic Hazard Which Requires Expenditure in Amount Exceeding the Value of the Threatened or Damaged Improvement

The GHAD may elect not to prevent, mitigate, abate or control a geologic hazard where, in the general manager's sole discretion, the anticipated expenditure required to be funded by the GHAD to prevent, mitigate, abate or control the geologic hazard will exceed the value of the structure(s) and site improvement(s) threatened with damage or loss.

2.5.6 GHAD Funding or Reimbursement for Damaged or Destroyed Structures or Site Improvements

In the event a residence or any other private structure, site improvement or landscape feature is damaged or destroyed as a result of a geologic hazard, the District may fund or reimburse the property owner for the expenses necessary to repair or replace the damaged or destroyed structure, site improvement or landscaping. Unless otherwise authorized by the Board of Directors, the total dollar amount of the District funding or reimbursement paid to all property owners whose property is damaged by a geologic hazard may not exceed ten percent (10%) of the total costs incurred by the District in actually mitigating, abating or controlling the geologic hazard that causes the damage[1]. In the event the geologic hazard damages or destroys a structure, site improvement or landscaping which violates any provisions of the City Building Code or City Code at the time of its installation or improvement, the District may decline to provide any funding, or reimbursement to the property owner for repair or replacement of the damaged structure, improvement or landscaping.

2.5.7 No Reimbursement of Expenses Incurred by Property Owners

The GHAD will not be obligated to reimburse a property owner for expenses incurred for the prevention, mitigation, abatement, or control of a geologic hazard absent a written agreement between the property owner and the GHAD to that effect, which agreement has been executed prior to the property owner incurring said expenses, and following an investigation conducted by the GHAD.

2.6 PRIORITY FOR DISTRICT-FUNDED REPAIRS

Emergency response and scheduled monitoring, maintenance or repair expenditures are to be prioritized by the General Manager, utilizing its discretion, based upon available funds, a prudent reserve and the approved operating budget. In addition, the GHAD shall support the priorities of the Resource Manager (as defined in the RMP), and the protection of biotic resources, in compliance with the RMP.

Should available funds not be sufficient to undertake all of the identified remedial and preventive stabilization measures, the expenditures shall be prioritized as follows in descending order of priority:

A. The prevention, mitigation, abatement or control of geologic hazards that have either damaged or pose a significant threat of damage to residences, critical lifeline utilities or emergency vehicle access corridors.

B. The prevention, mitigation, abatement or control of geologic hazards that have either damaged or pose a significant threat of damage to water quality basin improvements, wetlands, riparian features, portions of mitigation channels/swales A through D and F through N within limits of GHAD, vegetated swales, restored and unaltered creek channels including annual funding so that the facilities are maintained in accordance with the requirements of the Stormwater and Hydromodification Management Plan, Operations and Maintenance Manual (Exhibit G).

[1] For example, if a landslide causes $10,000 in structural damage to each one of four neighboring homes for a total of $40,000 in structural damage and it costs the District $100,000 to design and install a new retaining wall to abate the slide, the District may only reimburse each property owner $2,500 of their $10,000 in structural damage.

C. The prevention, mitigation, abatement or control of geologic hazards that have either damaged or pose a significant threat of damage to private recreation facilities (e.g., pools, spas, etc.).

D. The prevention, mitigation, abatement or control of geologic hazards that have either damaged or pose a significant threat of damage limited to loss of landscaping or other similar non-essential amenities.

E. The prevention, mitigation, abatement or control of geologic hazards existing entirely on open-space property and which have neither damaged nor pose a significant threat of damage to any site improvements.

If sufficient funds are not available to undertake the listed activities, the GHAD may investigate obtaining funding as allowed in Section 26505(e) of the Public Resources Code through the issuance of bonds, notes, or debentures such as a line of credit.

2.7 MAINTENANCE AND MONITORING SCHEDULE

Geologic features and District-maintained facilities should be inspected on a regular basis. Budget permitting, inspections should generally be scheduled to occur two times per year in normal years and three or more times per year in years of heavy rainfall. The inspections should be scheduled to take place in the fall, prior to the first significant rainfall; mid-winter as necessary during heavy rainfall years; and in spring at the end of the rainy season. It is anticipated that the monitoring events for the Tassajara Hills development and the Fallon Crossing development within the Fallon Crossing GHAD would be completed on the same schedule.

- A District Engineer and/or Geologist should inspect the lined surface of concrete-lined drainage ditches within the District boundaries on a regular schedule. Repairs and maintenance should be performed as needed. Excess silt or sediment in ditches should be removed and cracked or broken ditches should be patched or repaired as required before the beginning of the next rainy season.

- Subsurface drain outlets and horizontal drain outlets, if any, should be inspected on a regular schedule. Water flowing from these outlets should be measured and recorded during each inspection. Any suspicious interruption in flow should signal a need to unplug or clean by flushing the affected drain.

- If installed, piezometers used to measure groundwater levels, or other instruments such as inclinometers, tiltmeters, and/or settlement-monitoring devices, should be monitored on a regular schedule. In the event of anomalous readings, the monitoring frequency should be increased.

- Inlets, outfalls or trash racks, if used, must be kept free of debris, and spillways must be maintained. Attention should be given to plantings or other obstructions, which may interfere with access by power equipment.

- The water-quality basin and bioretention cells shall be monitored and maintained in accordance with the Operations and Maintenance Manual for Tassajara Hills (Exhibit G).

The District should review its inspection schedule annually and assess the effectiveness of its preventive maintenance program on a regular basis. District staff should prepare an annual report to the Board of Directors with recommendations for maintenance and/or repair projects. Consultants, as necessary, may be retained to undertake the needed studies. The District Engineer and/or Engineering Geologist retained by the District shall prepare an annual inspection report for presentation to the District Board of Directors.

3.0 GLOSSARY

Engineer's Report – The document that establishes the individual property owners' GHAD assessment based on the projected expenses (budget) of the GHAD.

Geological Hazard Abatement District (GHAD) Manager – An entity employing a licensed Geotechnical Engineer who will oversee the operations of the GHAD including preparation of GHAD budgets. The GHAD Manager is hired by and reports to the GHAD Board of Directors.

Mitigation Channels/Swales A through P – Swales are shown on the Mitigation Grading Plan, Tassajara Hills (Formerly Moller Ranch), Dublin, CA, August 2016, and included in Exhibit I.

Riparian Land Manager – The Riparian Land Manager refers to the entities that are responsible for implementing the Riparian MMP.

Riparian MMP – The Riparian MMP refers to the *Riparian Mitigation & Monitoring Plan for the Moller Ranch Residential Development and Tassajara Culvert Replacement Projects*, Alameda and Contra Costa Counties, California prepared by H. T. Harvey & Associates (June 11, 2014) (Exhibit I) and any amendments thereto approved by the San Francisco Bay Regional Water Quality Control Board and California Department of Fish and Wildlife.

Riparian Restoration Area – The portion of the Riparian Restoration Area, as defined in the Riparian MMP, that is owned by the GHAD.

Trust – The Agricultural-Natural Resources Trust of Contra Costa County.

4.0 OWNERSHIP AND MANAGEMENT

Ownership, funding sources and maintenance responsibilities shall be as shown on the following table and Figures 1 and 2.

TABLE 4.0-1: TASSAJARA HILLS RESIDENTIAL DEVELOPMENT/FALLON CROSSING GHAD Long-Term Ownership and Management Matrix

FACILITY/FUNCTION	MAINTENANCE ENTITY	FUNDING	TENTATIVE ACCEPTANCE DATE OR MINIMUM INITIAL MONITORING TERM	OWNERSHIP
1. Development Area				
a. Single-Family Residential Parcels (370 units)	Private	Private	Not Applicable	Private
b. Park	City of Dublin	City of Dublin	Not Applicable	City of Dublin
c. Neighborhood Common Areas	Master HOA	HOA Fees	Not Applicable	Master HOA

FACILITY/FUNCTION	MAINTENANCE ENTITY	FUNDING	TENTATIVE ACCEPTANCE DATE OR MINIMUM INITIAL MONITORING TERM	OWNERSHIP
d. Public Road Areas				
i. Roadway	City of Dublin	City of Dublin	Not Applicable	City of Dublin
ii. Median Landscape Maintenance and Replacement	City of Dublin	City of Dublin	Not Applicable	City of Dublin
iii. Parkway Strip Landscape/Trees Maintenance and Replacement	Master HOA	HOA Fees	Not Applicable	City of Dublin
iv. Sidewalk	HOA or Homeowner	HOA Fees or Private	Not Applicable	City of Dublin
v. Bridge	City of Dublin	City of Dublin	Not Applicable	City of Dublin
e. Private Clubhouse	Master HOA	HOA Fees	Not Applicable	City of Dublin
f. Emergency Vehicle Access Roads	GHAD	Assessment	Perpetual	GHAD
g. Storm Drain System	City of Dublin	City of Dublin	Not Applicable	City of Dublin
h. Vegetated Bioswales				
i. Landscape Maintenance and Replacement	HOA	HOA	Not Applicable	HOA
ii. Functional Maintenance, Repair, and Replacement	GHAD	Assessment	Perpetual	HOA
2. GHAD-Owned Open Space Areas Outside of Conservation Easement				
Plan of Control Defined Activities (2-Year Minimum Initial Monitoring Period)				
a. Bioretention cells	Developer	Private Funding	2 years	Developer
b. Detention Basin	Developer	Private Funding	2 years	Developer
c. Storm Drain System	Developer	Private Funding	2 years	Developer
d. Vegetation Management for Fire Suppression	Developer	Private Funding	2 years	Developer
e. Slopes, maintenance benches, and Surface Drainage Improvements	Developer	Private Funding	2 years	Developer
f. Fire/Emergency Vehicle Access Roads	Developer	Private Funding	2 years	Developer
g. Gates and Fencing	Developer	Private Funding	2 years	Developer
h. Trail	Developer	Private Funding	2 years	Developer
Plan of Control Defined Activities (Post Initial Monitoring Period)				
a. Bioretention cells	GHAD	Assessment	Perpetual	GHAD
b. Detention Basin	GHAD	Assessment	Perpetual	GHAD
c. Storm Drain System	GHAD	Assessment	Perpetual	GHAD
d. Vegetation Management for Fire Suppression	GHAD	Assessment	Perpetual	GHAD
e. Slopes, maintenance benches, and Surface Drainage Improvements	GHAD	Assessment	Perpetual	GHAD
f. Fire/Emergency Vehicle Access Roads	GHAD	Assessment	Perpetual	GHAD

FACILITY/FUNCTION	MAINTENANCE ENTITY	FUNDING	TENTATIVE ACCEPTANCE DATE OR MINIMUM INITIAL MONITORING TERM	OWNERSHIP
g. Gates and Fencing	GHAD	Assessment	Perpetual	GHAD
h. Trail	Master HOA	HOA Fees		GHAD
3. Riparian Restoration Area within Conservation Easement				
a. Mitigation and Monitoring Plan Activities (Pre Final Success Criteria Achievement)	Developer	Private Funding	10 years following installation of riparian mitigation	Developer
b. Mitigation and Monitoring Plan Activities (Post Final Success Criteria Achievement)	Lands Manager	Endowment	Perpetual	USFWS and CDFW Approved and Accredited Entity (to be determined)
4. Riparian Restoration Area GHAD-Owned Lands				
a. Mitigation and Monitoring Plan Activities Along Moller Creek and Portions of Mitigation Channels/Swales A through P (Pre Final Success Criteria Achievement)	Developer	Private Funding	10 years following installation of riparian mitigation	Developer
b. Mitigation and Monitoring Plan Activities (Post Final Success Criteria Achievement)	Lands Manager	Endowment	Perpetual	GHAD

5.0 RIGHT-OF-ENTRY

District officers, employees, consultants, contractors, agents, and representatives shall have the right to enter upon all lands within the District boundary, as shown on Exhibit B, for the purpose of performing the activities described in the Tassajara Hills GHAD Plan of Control. Should the District need to access parcels owned by the Homeowner's Association or private residential lots to fulfill its duties under the Plan of Control, the District shall provide the affected landowner and/or resident with 72 hours advanced notice unless, in the reasonable judgment of the GHAD Manager, an emergency situation exists which makes immediate access necessary to protect the public health and safety, in which case no advanced notice is required, but the District shall inform the landowner and/or resident as soon as reasonably possible.

The owner or owners of property within the Tassajara Hills development shall record a Declaration of Restrictive Covenants, Right of Entry and Disclosures Regarding Geologic Hazard Abatement District ("Declaration") after recordation of the Parcel Map, in the form attached as Appendix F. The Declaration creates covenants that run with the land and will be binding upon all future owners of property within the Tassajara Hills development, their successors and assigns.

REFERENCES

1. ENGEO, Geotechnical Exploration, Moller Ranch, Tassajara Road, Dublin, California, Project Number 5661.000.001, November 12, 2012.

2. MacKay and Somps; Open Space and Improvements Ownership/Maintenance Plan, Moller Ranch, Tract 8102, Dublin, California; Project Number 19569.0, November 2012.

3. Berlogar Geotechnical Consultants, Plan of Control, Fallon Crossing GHAD, Tassajara Road, Dublin California, Job Number 3058.000, February 17, 2011.

4. Dublin City of, Resolution No. 147-11, Formation of the Fallon Crossing Geologic Hazard Abatement District, August 16, 2011.

5. Dublin City of, Resolution No. 12-45, Approving Vesting Tentative Tract Map 8102 for the Project Known as Moller Ranch (APNs 985-0001-001 and 985-0001-001-02).

6. MacKay and Somps; Final Storm Water Quality/Hydromodification Report, Moller Ranch, Dublin, California; Project Number 19569.010, June 26, 2015.

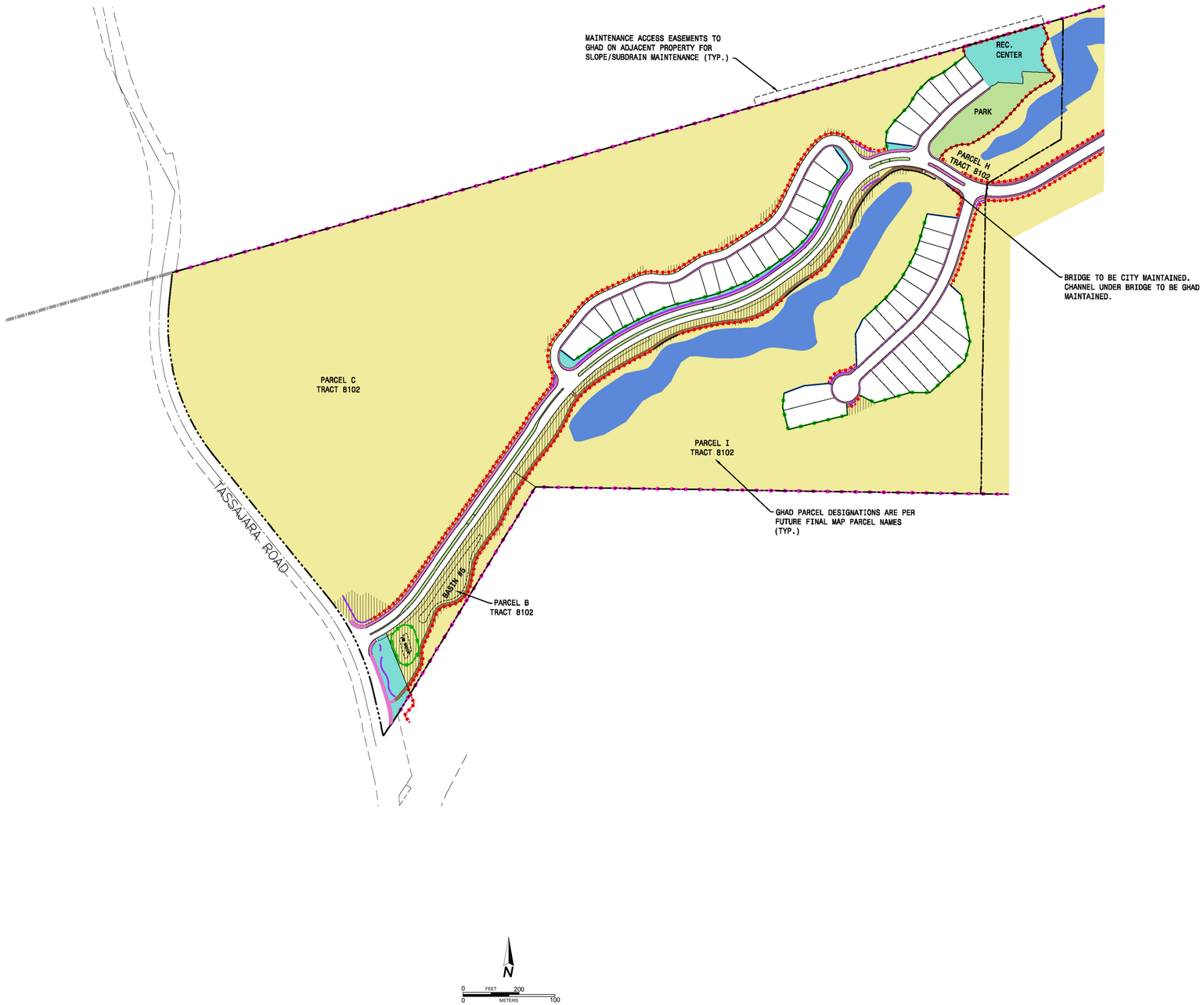
7. MacKay and Somps; Land Plan, Moller Ranch, Dublin, California; Project Number 19569.000, July 15, 2011.

8. H. T. Harvey & Associates; Riparian Mitigation & Monitoring Plan for the Moller Ranch Residential Development and Tassajara Culvert Replacement Projects, Alameda and Contra Costa Counties, California; May 12, 2014.



FIGURES

FIGURES 1 AND 2: Ownership Maintenance Plan
FIGURE 3: Drainage System Ownership Map ï Phase 1
FIGURE 4: Drainage System Ownership Map ï Phase 2
FIGURE 5: Geologic Map



LEGEND:

- LANDS AND IMPROVEMENTS TO BE OWNED BY CITY OF DUBLIN WITH MASTER HOMEOWNERS ASSOCIATION MAINTAINING PARKWAY STRIP LANDSCAPING AND TREE PLANTING AND HOMEOWNER OR MASTER HOMEOWNERS ASSOCIATION MAINTAINING SIDEWALK/HARDSCAPE IN MEDIAN.
- LANDS AND IMPROVEMENTS TO BE OWNED AND MAINTAINED BY THE CITY OF DUBLIN. (BRIDGE AT CREEK CROSSING, STREET MEDIAN AND PARK)
- LANDS AND IMPROVEMENTS TO BE OWNED AND MAINTAINED BY MASTER HOMEOWNERS ASSOCIATION, WITH EXCEPTION OF PUBLIC UTILITIES.
- LANDS AND IMPROVEMENTS TO BE OWNED AND MAINTAINED BY A GEOLOGIC HAZARDS ABATEMENT DISTRICT (GHAD).
- LANDS OWNED BY GHAD WITH LANDSCAPE AND IRRIGATION MAINTAINED BY MASTER HOMEOWNERS ASSOCIATION. DRAINAGE FEATURES WITHIN THESE AREAS TO BE GHAD MAINTAINED.
- LANDS TO BE OWNED BY GEOLOGIC HAZARDS ABATEMENT DISTRICT (GHAD), AND MAINTAINED BY A LAND TRUST.
- TRAIL: LANDS OWNED BY GHAD AND MAINTAINED BY MASTER HOMEOWNERS ASSOCIATION.
- LANDS AND IMPROVEMENTS WITHIN MAINTENANCE ACCESS EASEMENT ON ADJACENT PROPERTY TO BE MAINTAINED BY GHAD.
- LOW STONE WALL (WITH SPECIES BARRIER WHERE REQUIRED - SEE NOTE) (HOA OWNED AND MAINTAINED WHEN IN HOA PARCELS; HOA MAINTAINED WHEN DECORATIVE AND LOCATED IN GHAD PARCELS; GHAD MAINTAINED WHEN STRUCTURAL AND LOCATED IN GHAD PARCEL)
- THEME WALL (WITH SPECIES BARRIER WHERE REQUIRED - SEE NOTE) (HOMEOWNER OWNED WHEN LOCATED ON LOT PROPERTY LINE. HOMEOWNER SHALL MAINTAIN INSIDE FACE OF WALL; HOA TO MAINTAIN STRUCTURE AND OUTSIDE FACE OF WALL.)
- VIEW FENCE (WITH SPECIES BARRIER WHERE REQUIRED - SEE NOTE) (HOMEOWNER OWNED AND MAINTAINED, EXCEPT SPECIES BARRIER FENCE WHICH SHALL BE GHAD MAINTAINED)
- COVERED SPECIES BARRIER FENCE (GHAD OWNED AND MAINTAINED)
- ORNAMENTAL METAL FENCE (WITH SPECIES BARRIER ADDED) (HOA MAINTAINED)
- CATTLE GRAZING FENCE (BARBED WIRE) (GHAD OWNED AND MAINTAINED)

NOTE: ALL SPECIES BARRIER FENCE TO BE MAINTAINED BY GHAD (BOTH STAND ALONE FENCE AND SPECIES BARRIER FENCE ATTACHED TO OTHER FENCING.)

BASE MAP SOURCE: MACKAY & SOMPS, 2017

ENGEO Expect Excellence	OWNERSHIP MAINTENANCE PLAN TASSAJARA HILLS DUBLIN, CALIFORNIA	PROJECT NO.: 5661.002.000 SCALE: AS SHOWN DRAWN BY: SRP CHECKED BY: PJS	FIGURE NO. 1

ORIGINAL FIGURE PRINTED IN COLOR

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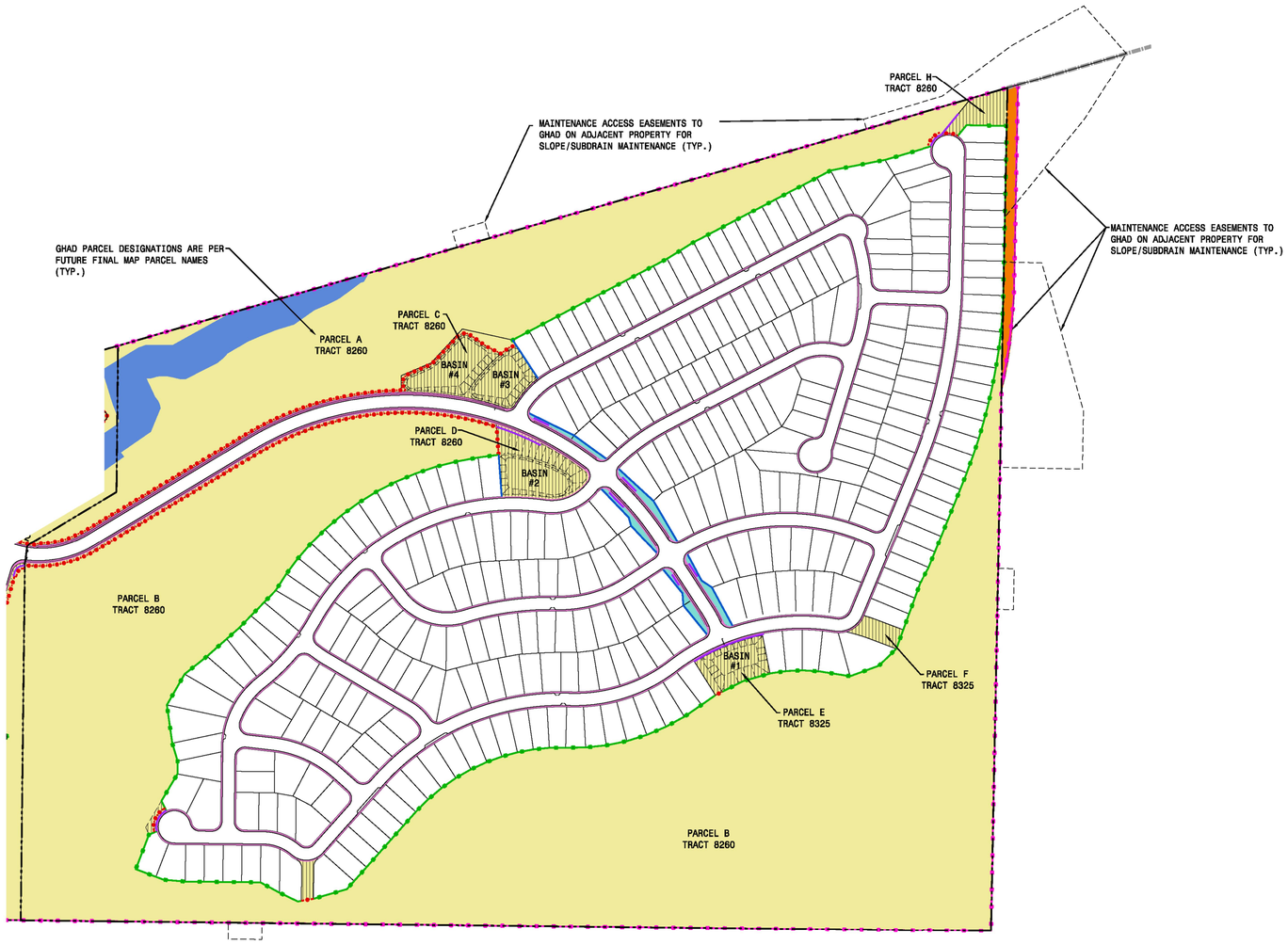

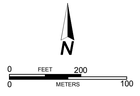

LEGEND:

- LANDS AND IMPROVEMENTS TO BE OWNED BY CITY OF DUBLIN WITH MASTER HOMEOWNERS ASSOCIATION MAINTAINING PARKWAY STRIP LANDSCAPING AND TREE PLANTING AND HOMEOWNER OR MASTER HOMEOWNERS ASSOCIATION MAINTAINING SIDEWALK/HARDSCAPE IN MEDIAN.
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NOTE: ALL SPECIES BARRIER FENCE TO BE MAINTAINED BY GHAD (BOTH STAND ALONE FENCE AND SPECIES BARRIER FENCE ATTACHED TO OTHER FENCING.)

BASE MAP SOURCE: MACKAY & SOMPS, 2017

ENGEO Expect Excellence	OWNERSHIP MAINTENANCE PLAN TASSAJARA HILLS DUBLIN, CALIFORNIA	PROJECT NO.: 5661.002.000 SCALE: AS SHOWN DRAWN BY: SRP CHECKED BY: PJS	FIGURE NO. 2

ORIGINAL FIGURE PRINTED IN COLOR

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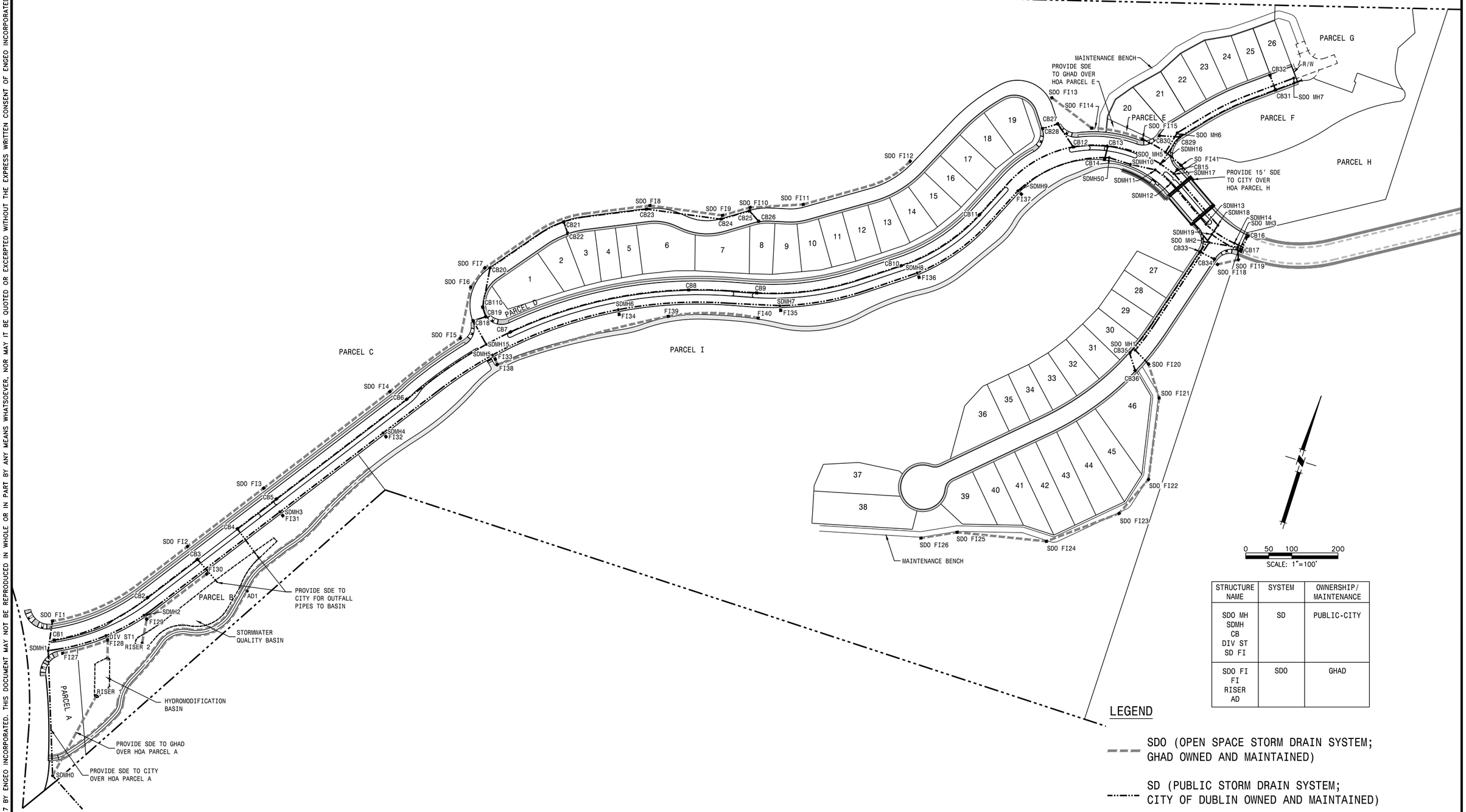

STRUCTURE NAME	SYSTEM	OWNERSHIP/ MAINTENANCE
SDO MH SDMH CB DIV ST SD FI	SD	PUBLIC-CITY
SDO FI FI RISER AD	SDO	GHAD

LEGEND

SDO (OPEN SPACE STORM DRAIN SYSTEM; GHAD OWNED AND MAINTAINED)

SD (PUBLIC STORM DRAIN SYSTEM; CITY OF DUBLIN OWNED AND MAINTAINED)

SDE STORM DRAIN EASEMENT

BASEMAP SOURCE: MACKAY AND SOMPS, JUNE 1, 2017

ENGEO Expect Excellence

DRAINAGE SYSTEM OWNERSHIP PLAN - PHASE 1

TASSAJARA HILLS

DUBLIN, CALIFORNIA

PROJECT NO.: 5661.002.000

SCALE: AS SHOWN

DRAWN BY: M&S CHECKED BY: PJS

FIGURE NO. 3

P:\19569\e-files-out\ENGEO\2017-06-01 GHAD POC EXH\GHAD POC-Drainage System Ownership Map-PH 1.dwg Plot Date:6-01-17 kreed

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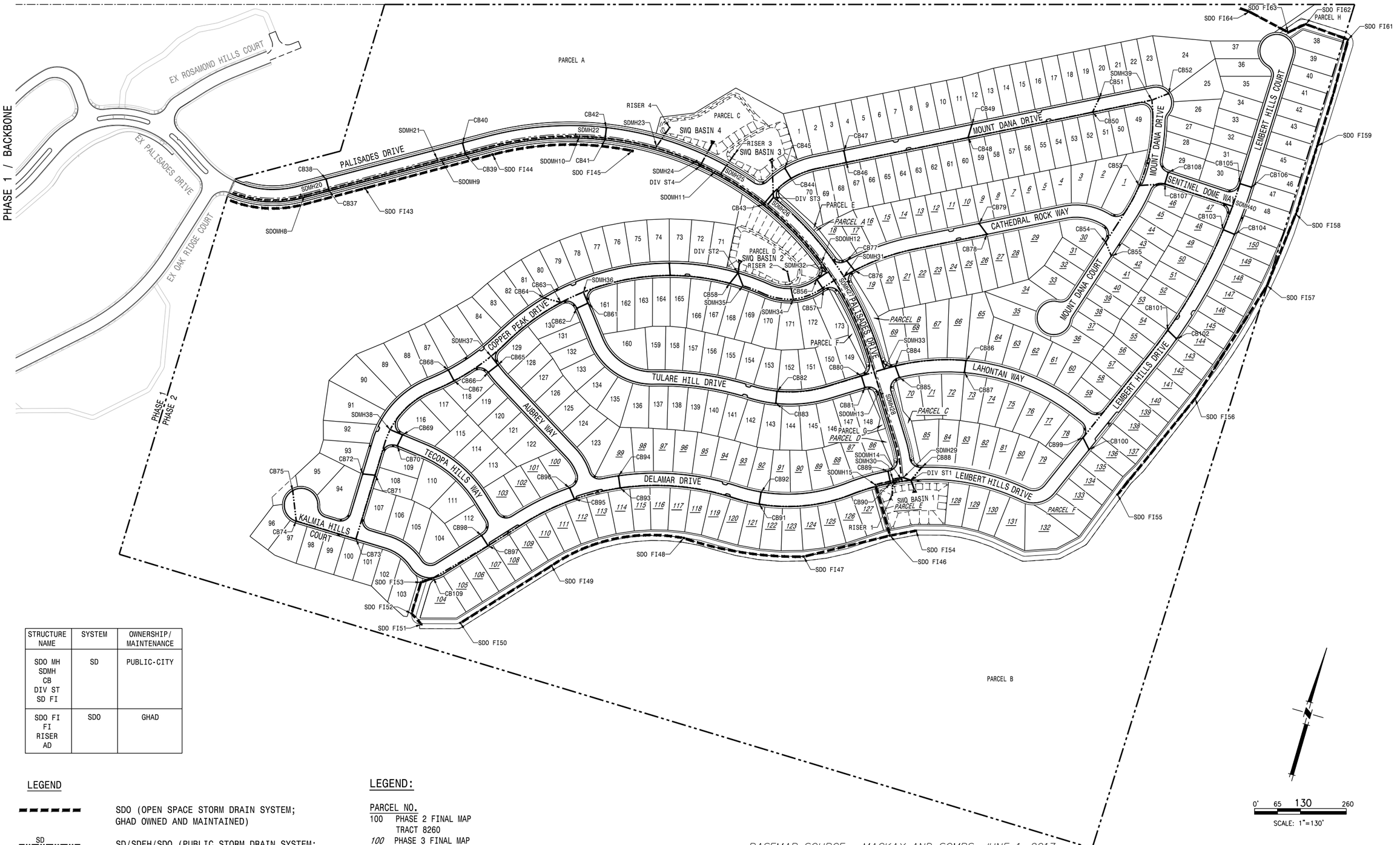
TRACT 8102-TASSAJARA HILLS
PHASE 1 / BACKBONE



STRUCTURE NAME	SYSTEM	OWNERSHIP/ MAINTENANCE
SDO MH SDMH CB DIV ST SD FI	SD	PUBLIC-CITY
SDO FI FI RISER AD	SDO	GHAD

LEGEND

SDO (OPEN SPACE STORM DRAIN SYSTEM; GHAD OWNED AND MAINTAINED)

SD / SDHF / SDO — SD/SDFH/SDO (PUBLIC STORM DRAIN SYSTEM; CITY OF DUBLIN OWNED AND MAINTAINED)

SDE — STORM DRAIN EASEMENT

LEGEND:

PARCEL NO.

100 PHASE 2 FINAL MAP TRACT 8260

100 PHASE 3 FINAL MAP TRACT 8350

0' 65 130 260

SCALE: 1"=130'

BASEMAP SOURCE: MACKAY AND SOMPS, JUNE 1, 2017

ENGEO Expect Excellence

DRAINAGE SYSTEM OWNERSHIP PLAN - PHASE 2

TASSAJARA HILLS

DUBLIN, CALIFORNIA

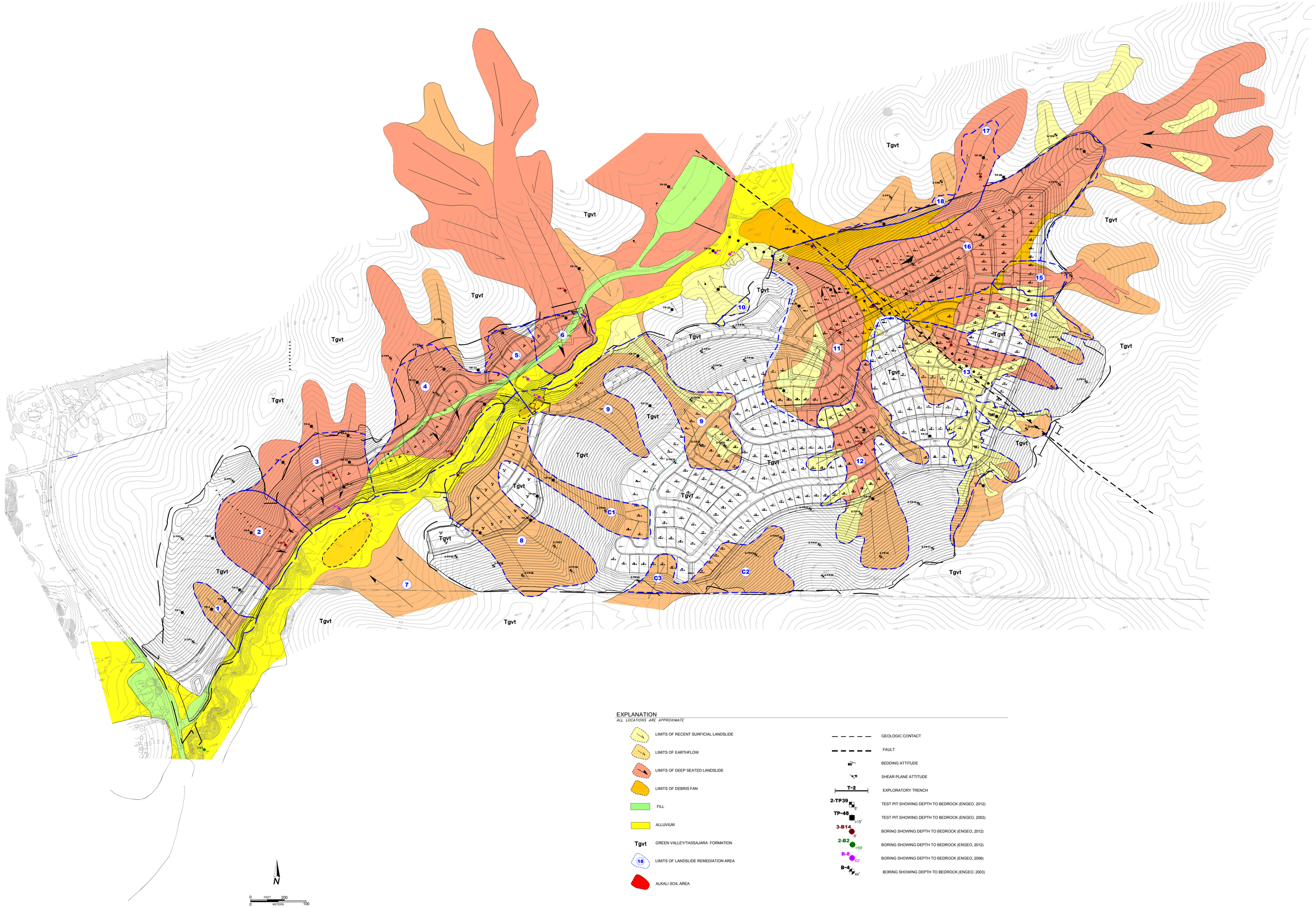
PROJECT NO.: 5661.002.000

SCALE: AS SHOWN

DRAWN BY: M&S CHECKED BY: PJS

FIGURE NO. 4

P:\19569\e-files-out\ENGEO\2017-06-01 GHAD POC EXH\GHAD POC-Drainage System Ownership Map-PH 2.dwg Plot Date:6-01-17 kreed



EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

- LIMITS OF RECENT SURFICIAL LANDSLIDE
- LIMITS OF EARTHFLOW
- LIMITS OF DEEP SEATED LANDSLIDE
- LIMITS OF DEBRIS FAN
- FILL
- ALLUVIUM
- Tgvt — GREEN VALLEY/TASSAJARA FORMATION
- 18 — LIMITS OF LANDSLIDE REMEDIATION AREA
- ALKALI SOIL AREA
- GEOLOGIC CONTACT
- FAULT
- 80 — BEDDING ATTITUDE
- 11 — SHEAR PLANE ATTITUDE
- T-2 — EXPLORATORY TRENCH
- 2-TP39 — 8' — TEST PIT SHOWING DEPTH TO BEDROCK (ENGEO, 2012)
- TP-46 — >15' — TEST PIT SHOWING DEPTH TO BEDROCK (ENGEO, 2003)
- 3-B14 — 6' — BORING SHOWING DEPTH TO BEDROCK (ENGEO, 2012)
- 2-B2 — >50' — BORING SHOWING DEPTH TO BEDROCK (ENGEO, 2012)
- B-5 — 82' — BORING SHOWING DEPTH TO BEDROCK (ENGEO, 2006)
- B-4 — 44' — BORING SHOWING DEPTH TO BEDROCK (ENGEO, 2003)

BASE MAP SOURCE: MACKAY & SOMPS, 2012

ENGEO Expect Excellence

GEOLOGIC MAP
TASSAJARA HILLS
DUBLIN, CALIFORNIA

PROJECT NO.: 5661.002.000 | FIGURE NO. 5
SCALE: AS SHOWN
DRAWN BY: JCS | CHECKED BY: PJS

ORIGINAL FIGURE PRINTED IN COLOR

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EXHIBIT A

LEGAL DESCRIPTION FOR TRACTS 8102, 8260, AND 8325

EXHIBIT "A"
LEGAL DESCRIPTION

ALL THAT CERTAIN REAL PROPERTY SITUATED IN THE CITY OF DUBLIN, COUNTY OF ALAMEDA, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

BEING A PORTION OF THE LAND AS DESCRIBED IN THE DEED TO RICHEY TRUST, ET AL, RECORDED ON NOVEMBER 09, 2001 IN DOCUMENT NUMBER 2001440482, OFFICIAL RECORDS OF ALAMEDA COUNTY, LYING SOUTH OF THE ALAMEDA AND CONTRA COSTA COUNTY LINE, DESCRIBED AS FOLLOWS:

BEGINNING AT THE SOUTHEAST CORNER OF SECTION 21, TOWNSHIP 2 SOUTH, RANGE 1 EAST, MOUNT DIABLO BASE AND MERIDIAN; THENCE ALONG THE SOUTHERN LINE OF SAID SECTION 21, NORTH 89°20'13" WEST, 1866.14 FEET TO THE MOST EASTERN CORNER OF SAID PARCEL 2; THENCE LEAVING SAID SOUTHERN LINE AND ALONG THE SOUTHEASTERN LINE OF SAID PARCEL 2, SOUTH 31°01'01" WEST, 953.28 FEET; THENCE SOUTH 33°22'51" WEST, 92.98 FEET TO THE EASTERLY LINE OF COUNTY ROAD NO. 2568 (TASSAJARA ROAD); THENCE LEAVING SAID SOUTHEASTERN LINE, ALONG SAID CENTER LINE NORTH 13°02'45" WEST, 165.79 FEET TO A CURVE TO THE LEFT HAVING A RADIUS OF 833.00 FEET, A DELTA OF 26°03'30"; THENCE ALONG SAID CURVE AN ARC LENGTH OF 378.85 FEET; THENCE NORTH 39°06'15" WEST, 637.44 FEET TO A CURVE TO THE RIGHT HAVING A RADIUS OF 767.00 FEET, A DELTA OF 45°10'30"; THENCE ALONG SAID CURVE AN ARC LENGTH OF 604.74 FEET; THENCE NORTH 06°04'15" EAST, 99.53 FEET TO THE ALAMEDA/CONTRA COSTA COUNTY LINE; THENCE ALONG SAID COUNTY LINE, NORTH 73°50'31" EAST, 6067.92 FEET; THENCE LEAVING SAID COUNTY LINE, SOUTH 01°07'46" WEST, 2503.12 FEET TO THE SOUTHERN LINE OF SECTION 22, TOWNSHIP 2 SOUTH, RANGE 1 EAST, MOUNT DIABLO BASE AND MERIDIAN; THENCE ALONG LAST SAID LINE, NORTH 89°20'57" WEST, 2609.11 FEET TO THE POINT OF BEGINNING.

APN.: 985-0001-001-01

END OF DESCRIPTION

PREPARED BY:

IAN MACDONALD
LICENSED LAND SURVEYOR NO. 8817
(EXP. 12/31/17)
STATE OF CALIFORNIA

LICENSED LAND SURVEYOR
IAN BRUCE MACDONALD
No.8817
STATE OF CALIFORNIA

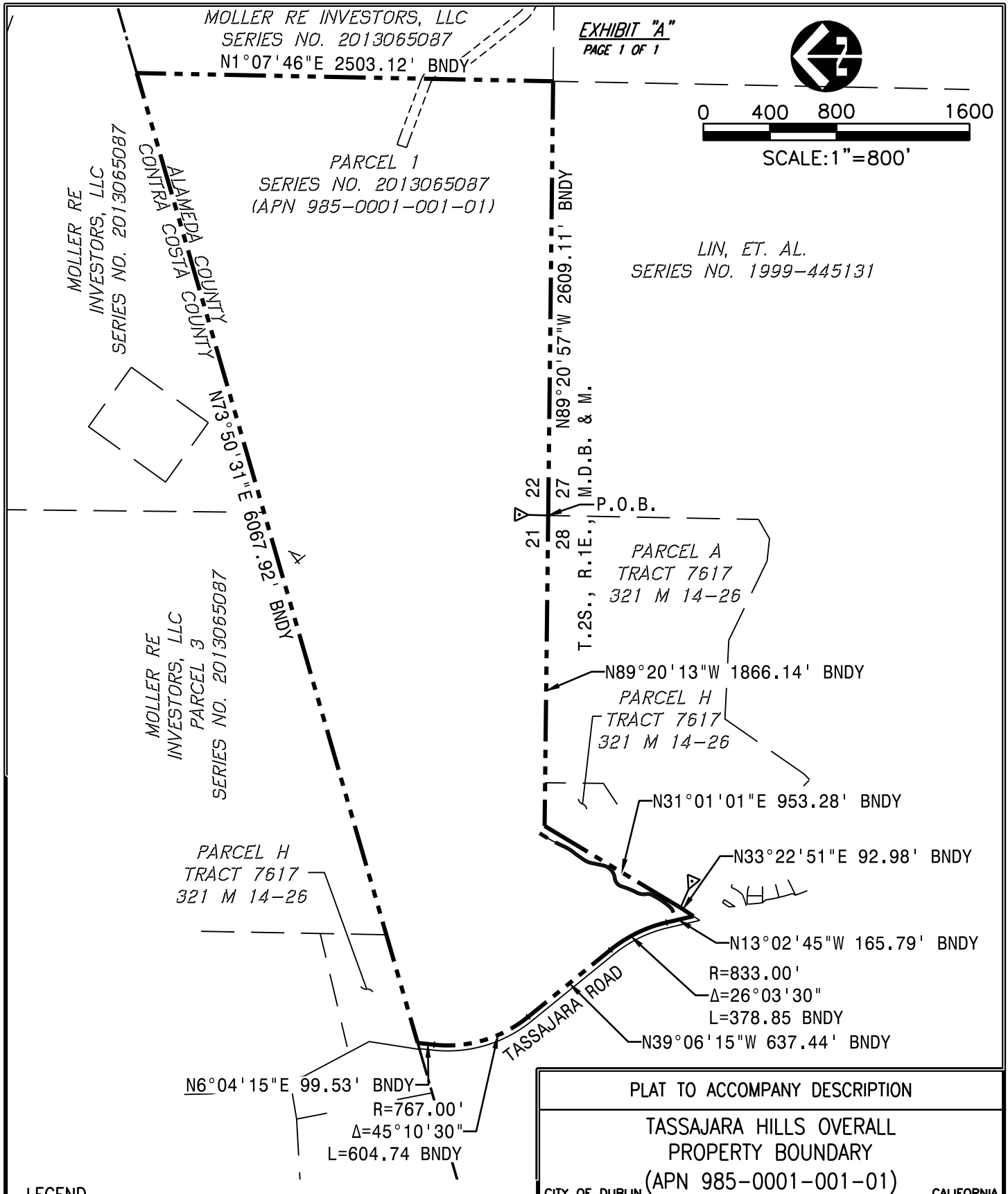
4/19/17
DATE

MACKAY & SOMPS
CIVIL ENGINEERING • LAND PLANNING • LAND SURVEYING
5142 Franklin Drive Suite B, Pleasanton, CA. 94588-3355
(925) 225-0690



EXHIBIT B

Plat to Accompany Legal Description for Tracts 8102, 8260, and 8325 Boundary Exhibit



PLAT TO ACCOMPANY DESCRIPTION

TASSAJARA HILLS OVERALL
PROPERTY BOUNDARY
(APN 985-0001-001-01)

CITY OF DUBLIN CALIFORNIA

MACKAY & SOMPS
ENGINEERS PLANNERS SURVEYORS
5142B FRANKLIN DR, PLEASANTON, CA 94588 (925)225-0690

DRAWN	DATE	SCALE	JOB NO.
TDM	AUGUST, 2016	1"=800'	19569.01AX



EXHIBIT C

TASSAJARA HILLS ANNEXATION
Background

AUTHORITY

The Dublin City Council formed the Fallon Crossing Geologic Hazard Abatement District ("GHAD" or "District") on August 16, 2011, with approval of Resolution 147-11, under authority of the California Public Resources Code (Division 17, commencing with Section 26500). Included within the District were 106 single-family residences and adjacent open spaces within the Fallon Crossing development (Tract 7617). The Dublin City Council members act as the Board of Directors of the Fallon Crossing GHAD.

Section 26509 of the Public Resources Code requires a Plan of Control, prepared by a State-Certified Engineering Geologist, as a prerequisite to formation of a GHAD. An Engineering Geologist, certified pursuant to Section 7822 of the Business and Professions Code, prepared the original Plan of Control for the Fallon Crossing GHAD. The Business and Professions Code requires a Plan of Control to describe in detail geologic hazards, their location, who is affected by them, and most significantly, a plan for the prevention, mitigation, abatement, or control thereof. In accordance with the requirements of the Public Resources Code, a proposed amendment to the original Fallon Crossing GHAD Plan of Control is to accompany the petition to annex the Tassajara Hills Property into the Fallon Crossing GHAD. This Plan of Control applies GHAD operations within the area described in Exhibit A and shown graphically on Exhibit B.

BACKGROUND

ENGEO conducted a preliminary geotechnical exploration of the site in 2003 that consisted of drilling four exploratory borings ranging from approximately 55 to 80 feet deep, excavation of 46 test pits ranging from about 4 to 17 feet deep, and excavation of two exploratory trenches.

In 2006, ENGEO performed preliminary geotechnical explorations for three previously proposed bridges within the development area as well as a bridge where Tassajara Road crosses Moller Creek, near the southwest corner of the site. These explorations included eight borings ranging in depth from about 37 to 101 feet. In July 2012, two exploratory borings were drilled to evaluate subsurface conditions near the southwest corner of the site, where culvert improvements are planned at the existing Tassajara Road crossing over Moller Creek. These borings were drilled to depths of about 51 feet.

PROPOSED DEVELOPMENT

A Vesting Tentative Map for the project has been prepared by MacKay & Somps that is dated July 2012. The plans indicate that the 225.2-acre property will be developed with approximately 370 single-family residential lots within a development area of approximately 76.5 acres. The majority of the lots will be situated in a bowl-shaped valley in the central portion of the site.

Grading for the project site involves cuts up to about 135 feet and fills up to about 90 feet thick. Proposed graded slope gradients vary from 2:1 to 3:1. Low retaining walls are planned between numerous lot side yards.

The project design includes five stormwater quality bio-cells and one stormwater detention basin. One crossing over Moller Creek is planned using either a bridge or a partially buried culvert with headwalls at both ends.



EXHIBIT D

TASSAJARA HILLS ANNEXATION
Geology

REGIONAL GEOLOGY AND GEOLOGIC MAPS

The site is located within the Coast Ranges geologic province of California, a series of northwest-trending ridges and valleys. Regional geologic maps were reviewed as part of the Geotechnical Exploration Report for the Tassajara Hills site. A published geologic map of the site vicinity (Graymer, 1996) indicates that the site is underlain by Plio-Pleistocene Livermore gravels (QTl) and the Green Valley/Tassajara group (Tgvt). Both of these formations consist of poorly indurated, non-marine sedimentary rock. Graymer maps bedrock structure striking to the northwest and dipping to the southwest at inclinations of 40 to 75 degrees.

SITE GEOLOGY

The geologic units mapped on the site include bedrock and surficial deposits consisting of fill, alluvium and colluvium. The geologic units described below are adapted from a geotechnical exploration report completed by ENGEO for the site in 2012 and are shown on Figures 2 and 3.

GEOLOGIC UNITS

Existing Fill. Artificial fill was identified as small fills made for existing ranch roads, building pads, and two material stockpiles located in the western portion of the site. The stockpile locations are approximately shown on the Corrective Grading Plan, Figures 2 and 3.

Landslides. The onsite landslides have been classified as either recent or dormant, and as surficial or deep-seated (Figures 2 and 3). Recent landslides were identified based on bare, near-vertical head scarps and fairly obvious toe bulges and lateral margins. Dormant landslides are older landslides that have been modified by erosion. Dormant landslides generally have vegetated scarps and subtle toe or lateral margins.

Surficial landslides involve primarily soil but may include some highly weathered bedrock material. Test pit exploration indicates that the surficial landslides range from about 5 to 20 feet thick. The surficial landslides in the study area appear to include slumps and earthflow type slides. Slumps move relatively slowly as a somewhat coherent mass. With continued movement and saturation, slumps sometimes become earthflows, which are a more rapidly moving viscous-flow type of landslide.

Many of the identified landslide areas are landslide complexes that contain coalescing slide segments. The larger, deep-seated landslides generally have displaced blocks of bedrock in the downslope portions of the landslide area and surficial slumps and earthflow segments in the steeper upslope portions of the landslide area.

Residual Soil. Residual soils develop essentially in place from weathering of the underlying parent material. Residual soils were encountered on ridge lines and the flanks of ridges and were found to range from about 2 to 4 feet thick. The residual soils encountered consist of dark brown and dark grayish brown silty clay. Laboratory test results indicated that the residual soils have a high plasticity (with Plasticity Index ranging from 31 to 39) and a high expansion potential.

Colluvium. Areas of thicker soil cover in swales are shown as colluvium (Qc) on Figures 2 and 3. Colluvial soils encountered in test pits consist of dark brown and dark grayish brown silty clay that has a high plasticity and a high expansion potential. The colluvial deposits encountered were stiff to hard and range up to about 15 feet thick.

Alluvium. Younger Alluvium (Qal) and Older Alluvium (Qoa) were encountered along the Moller Creek valley and extending into the large topographic bowl in the central portion of the site. The alluvial deposits range up to at least 65 feet thick in some areas.

The younger alluvium encountered consisted of soft to medium stiff silty clay, sandy clay and clayey sand. Laboratory testing indicated that the near-surface younger alluvium has a high plasticity (Plasticity Index of 32) and a high expansion potential.

Older alluvium encountered in borings consisted of stiff to hard, silty and sandy clay. Laboratory testing indicates that the older alluvium varies from low to high plasticity and low to high expansion potential. The older alluvium appears to be sufficiently stiff or dense that it would not be susceptible to liquefaction.

Livermore Gravels. The Livermore Gravels (QTl) are a poorly indurated, non-marine sedimentary rock. Where encountered onsite, the Livermore Gravels were found to include interbedded claystone, siltstone and sandstone. The formation is generally friable, poorly indurated and varies from thinly to thickly bedded. The claystone units appeared to have a high plasticity and a high expansion potential. Some sandstone units exposed in the test pits were uncemented and appeared to be a material that would be easily erodable on cut slopes.

Bedrock structure was poorly developed in some of the test pit exposures. Bedrock in the western portion of the site was observed striking to the west/northwest and dipping at inclinations of 12 to 15 degrees to the south/southwest. In Trench T-1, in the central portion of the site, bedding was mapped striking to the northwest and dipping 40 to 80 degrees to the northeast.

Green Valley/Tassajara Formation. The Green Valley/Tassajara Formation is mapped by Graymer (1996) in the eastern portion of the site. Bedrock characteristics encountered in the area mapped as Green Valley/Tassajara Formation were similar to those encountered in the Livermore Gravels.

GROUNDWATER

During the site explorations conducted between 2003 and 2012, groundwater was encountered in several exploratory soil borings. Groundwater levels ranged between 27 and 68 feet below the original ground surface. As noted in the Geotechnical Exploration, groundwater conditions are expected to vary depending on factors such as weather conditions, time of year and future irrigation practices.

SEISMIC SOURCES

No faults are mapped on the site by Graymer (1996) or Dibblee (1980). Crane (1988) maps three thrust faults on the eastern portion of the site. The westerly thrust fault mapped by Crane crosses the area of planned development. Maps showing recency of faulting prepared by Jennings (1994) and Bortugno (1991) do not show the faults mapped by Crane as active or potentially active. Based on the finding of the previous exploration (ENGEO, 2003), no indications of faulting were found from exploratory trenching where Crane (1988) maps a thrust fault in the central portion of the site. The site is not located within a State of California Earthquake Fault Zone for known active faults.



EXHIBIT E

TASSAJARA HILLS ANNEXATION
Funding and Acceptance

FUNDING AND ACCEPTANCE OF RESPONSIBILITY BY THE DISTRICT

An annual assessment is already being levied for properties in the Fallon Crossing GHAD under the provisions of the existing Plan of Control and Engineer's Report. Ultimately, an annual assessment shall be levied on all annexed residential parcels within the Tassajara Hills development.

1. Activation of Assessment

The assessment shall be levied by the GHAD on each individual parcel beginning the first fiscal year following issuance of a building permit for that parcel.

2. Responsibility for GHAD Activities

The party that, on the date each Final Map is recorded within the GHAD annexation boundaries owns the developable parcels shown on that Final Map, shall have the responsibility to perform all the activities of the GHAD on property within that Final Map. Such responsibility shall be eligible to transfer to the GHAD at 9:00 a.m. on the day exactly two (2) years after the first residential building permit within the annexation area is issued by the City of Dublin provided that the items listed under item No. 4 in this section have been completed. This turn-over date may be extended at the sole discretion of the project developer provided that the assessments shall continue to be levied during the extension period and that notice of such extension is delivered to the GHAD Manager at least 30 days prior to the turnover date.

3. Ownership of the Open Space

Ownership of the open space parcels will pass from the owner/developers to the District. GHAD-owned parcels shall include Parcels B, C, H, I, and H in Tract 8102, Parcels A, B, C, D, and H in Tract 8260, and Parcels E and F in Tract 8325.

4. Process for Transferring Responsibility for GHAD Activities

After the Transfer Eligibility Date for parcel(s), the process for transferring responsibility for performing GHAD activities on such parcel(s) shall be as follows:

(a) Up to one year in advance of the Transfer Eligibility Date or in any subsequent year, at its discretion, the developer may apply to the GHAD ("Transfer Application") to transfer the responsibility for performing GHAD Activities for parcel(s) to the District. Actual transfer date is limited as stated in Section 2 above and does not allow the GHAD transfer prior to the required transfer period.

(b) Within 45 days of receiving such notice, a representative of the GHAD shall verify that all the facilities for which the GHAD will have maintenance responsibility have been constructed and maintained according to the City-approved plans and specifications for the individual improvements, and that such facilities are operational and in good working order.

(c) Within 15 days of such inspection, the GHAD will send the developer a list ("Punch list") of all of the items that need to be constructed, repaired or otherwise modified.

(d) The developer may notify the GHAD when it has completed the items identified on the Punch list.

(e) Within 30 days of receipt of such notice, the GHAD shall verify whether all Punch List items have been completed. If such items have been completed, the GHAD shall notify the developer that the District accepts responsibility for performing all future GHAD Activities on the parcel(s).

(f) The GHAD Manager shall confirm that the reserve requirement and minimum number of residential parcels subject to the levy of the assessment, as defined in the approved Engineer's Report, have been met.

(g) Ownership of the open space shall be transferred from the owner/developers to the District.

(h) The GHAD must review, approve, and the developer or HOA must record an access and maintenance easement for HOA activities on GHAD owned parcels.

(i) The owner or owners of property within the Site shall record a Declaration of Restrictive Covenants, Right of Entry and Disclosures Regarding Geologic Hazard Abatement District ("Declaration") previously approved by the GHAD.

As part of the transfer, the developer of parcel(s) to be transferred will provide the GHAD, for its use, copies of the applicable geotechnical exploration reports, grading plans, corrective grading plans, improvement plans, field-verified geologic maps, as-built subdrain plans or other pertinent documents as requested by the GHAD.



EXHIBIT F

FALLON CROSSING GEOLOGIC HAZARD ABATEMENT DISTRICT
Tassajara Hills Development
GHAD Disclosure and Right of Access

**DECLARATION OF RESTRICTIVE COVENANTS,
RIGHT OF ENTRY AND DISCLOSURES REGARDING
GEOLOGIC HAZARD ABATEMENT DISTRICT**

This Declaration of Restrictive Covenants, Right of Entry and Disclosures Regarding Geologic Hazard Abatement District (the "Declaration") is made this _____ day of _____, 2016 (the "Effective Date"), by Tassajara Hills RE Investors, LLC, ("Declarant").

RECITALS

A. Property. The following "Right of Entry and Disclosures" regarding a Geologic Hazard Abatement District shall be recorded against all land within Tracts 8102, 8260, and 8325 as filed on _____ in Book ____of Maps at Pages _____, Official Records of Alameda County in the City of Dublin, County of Alameda, State of California ("Property").

B. The City of Dublin has approved a subdivision on the Property. A condition of approval of the tentative map for Tract 8102 was that the Property be annexed into the Fallon Crossing Geologic Hazard Abatement District ("GHAD").

C. Under the authority of California Public Resources Code section 26500, et seq., the Dublin City Council on August 16, 2011 formed and established the Fallon Crossing Geologic Hazard Abatement District ("Fallon Crossing GHAD" or "District") to prevent, mitigate, abate or control potential geologic hazards within the boundaries of the GHAD. On _____, 2016, the Fallon Crossing GHAD Board of Directors adopted Resolution _____, upon the application of Declarant, annexing the Property into the Fallon Crossing GHAD.

NOW, THEREFORE, Declarant, as the owner of the Property, for itself, its successors and assigns does hereby declare as follows:

1. Notification and Disclosure of Geologic Hazard Abatement District: The Declarant hereby gives notice and discloses that the Property is a part of the Fallon Crossing GHAD, a Geologic Hazard Abatement District formed pursuant to the laws of the State of California. The Board of Directors of the Fallon Crossing GHAD are the members of the Dublin City Council. Pursuant to the Plan of Control for Annexation of Tassajara Hills Development to Fallon Crossing Geologic Hazard Abatement District as it may be amended from time to time (the "Plan of Control"), the Declarant and the Fallon Crossing GHAD are afforded certain responsibilities and rights relating to the prevention, mitigation, abatement and control of potential geologic hazards on the Property. The powers of the Fallon Crossing GHAD include the power to assess lot owners within the Property for the purposes set out in the Plan of Control.

2. Property Access; Right of Entry: The Declarant hereby grants the Fallon Crossing GHAD, its officials, employees, contractors and agents a non-exclusive, perpetual easement (the "GHAD Easement"), for continuing and perpetual access to and across the Property for the purposes and responsibilities set out in the Plan of Control. The GHAD Easement shall become effective upon the conveyance of the various lots within the subdivision by grant deeds including the Deed Statement set out in Section 5 below. Until such conveyance and the effectiveness of the GHAD Easement, the Declarant by executing and recording this Declaration, hereby contractually affords the Fallon Crossing GHAD an irrevocable right of entry over and upon the Property for the purposes of the GHAD Easement as set out above.

3. Binding on Successors and Assigns: The covenants and provisions of this Declaration shall be binding upon any and all owners of the Property, their successors and assigns.

4. Deed Statement: Any conveyance of all or a portion of the Property shall include in the deed conveying such property interest the following statement:

   "This conveyance is made subject to the Declaration of Restrictive Covenant, Right of Entry and Disclosures regarding a Geologic Hazard Abatement District, recorded in the Official Records of Alameda County as Instrument No. _____ on _____, 2016."

5. Enforcement: The Fallon Crossing GHAD shall have the right but not the obligation to enforce the provisions of this Declaration.

6. Modification or Termination: This Declaration shall not be modified, amended or terminated without the written consent of the Fallon Crossing GHAD.

Executed as of the Effective Date.

Declarant: Tassajara Hills Investors, LLC

By: _____

Its: _____



EXHIBIT G

TASSAJARA HILLS DEVELOPMENT
Final Stormwater Quality and Hydromodification Report June 26, 2015

M&S Job# 19569.010

Final Stormwater Quality and Hydromodification Management Plan (SWMP)

prepared for:

Braddock & Logan Services, Inc.
4155 Blackhawk Plaza Circle
Suite 201
Danville, CA 94506

For the project entitled:

Moller Ranch
Dublin, CA

Prepared by:

MACKAY & SOMPS

Mark D. McClellan, PE
RCE 60467

Dated: June 26, 2015

MacKay and Somps Civil Engineers Inc.
5142 Franklin Drive, Suite B
Pleasanton, CA 94588

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INTRODUCTION

This Final Stormwater Quality / Hydromodification Management Plan (SWMP) was prepared in conjunction with the final design of the proposed Moller Ranch project. This SWMP is intended to provide the final stormwater quality and hydromodification calculations to confirm project compliance with the requirements of the Municipal Regional Permit (MRP) adopted by the Regional Water Quality Control Board (RWQCB) under the National Pollution Discharge Elimination System (NPDES) program and administered by the Alameda County Clean Water Program (ACCWP) and City of Dublin as a permittees under the MRP. This Final SWMP has been prepared in compliance with the latest "C.3 Stormwater Technical Guidance" document from the Alameda County Clean Water Program, dated January 1, 2015 (Version 4.1).

The proposed Moller Ranch development site is a 225± acre property located on the east side of Tassajara Road just north of the intersection of Tassajara Rd. and Fallon Rd. in the far northeastern corner of the City of Dublin city limits, adjacent to the Alameda Co. / Contra Costa Co. line. The current use of the site is agricultural / ranch land with an existing paved access road to an existing PG&E substation located just north of the 225-acre property in Contra Costa Co. The proposed Moller Ranch development consists of approximately 90-acres and includes up to 381 single family residential homes with associated utility and roadway improvements to serve the homes. In addition to the proposed residential uses, the project would also include a 1.1-acre public park and 1.2-acres of public trails and a regional trail Staging Area, as well as approximately 135-acres of open space / rural agricultural uses surrounding the development. Below is a graphic showing the proposed Moller Ranch development and surrounding open space:



The existing hydrology of the property is focused around the existing creek, referred to as Moller Creek, which runs through the property from northeast to southwest and is tributary to Tassajara Creek to the southwest. The Moller Creek watershed contains approximately 2.4 square miles lying in Alameda County and Contra Costa County with the watershed being nearly all undeveloped agricultural ranch land except for the PG&E substation uses and the existing rural ranch homes and out buildings. Published hydrologic mapping of the watershed by

Alameda County and Contra Costa County indicates approximately 16 -17 inches mean annual precipitation. The watershed is comprised of mostly rolling, grassland hills and some steeper slopes that surface drain to Moller Creek. FEMA Flood Insurance Rate Mapping for the project area (Map No. 06001C0326G, Panel 326, dated 2009) shows that Moller Creek is not a designated floodway and the area immediately surrounding the creek is considered to be "Zone X" or an area of minimal flood hazard and outside of the 100-year floodplain.

The existing soil types of the watershed and more specifically the soils of the Moller Ranch project area are indicated to all fall within the hydrologic soil group "D", per soil mapping by the National Resource Conservation Service. Group "D" soils are defined as being high clay materials having a very slow infiltration rate and as a result, the existing watershed is characterized by rapid storm water runoff after saturation has occurred.

This SWMP is divided into four sections:

- STORM WATER QUALITY PLAN – identifies overall storm water quality strategy, describes Best Management Practices (BMP's) of source and treatment controls and provides C.3 Bio-Retention Basin sizing calculations for the proposed Bio-Retention treatment basins.
- HYDROMODIFCATION – describes compliance strategy for hydromodification detention requirements and presents final BAHM calculations (Bay Area Hydrology Model) for sizing of the proposed hydromodification detention facility.
- OPEN SPACE DRAINAGE – describes the proposed strategy for collecting and conveying open space runoff from the undeveloped hillsides surrounding the project, directing these existing "clean" flows back to the preserved creek.
- OWNERSHIP/MAINTENANCE – describes the proposed ownership and maintenance entity and funding mechanism for long term maintenance of the water quality and hydromodification treatment facilities.

The goal of this document is to address post-construction changes in runoff flow quality and quantity from the Project site through the implementation of control measures along with post-construction treatment measures that minimize impacts to receiving waters to the maximum extent practicable.

STORM WATER QUALITY PLAN

The overall stormwater management strategy is based on a hierarchical approach advocated by local agencies and particularly by the Alameda Countywide Clean Water Program in their C.3 Stormwater Technical Guidance handbook (Version 4.1, January 1, 2015). The hierarchical approach has the following categories or levels:

- Level I – Site Design

  One key element of the SWMP for the Moller Ranch project is to incorporate appropriate site design elements that enhance efforts to limit water quality impacts. Properly implemented features in essence "set the stage" for an effective plan by establishing a land use pattern that limits the amount of directly connected impervious areas (DCIAs), clusters buildings/pavement areas, encourages infiltration and runoff reduction to the greatest extent practicable and complements other BMPs that may be used.

- Level II – Source Control

  Another primary focus of this SWMP is a strong source control program. This approach capitalizes on the fact that it is generally more effective, in terms of both impact and cost; to prevent or limit constituents of concern from being released than it is to remove them from the environment once they have been mobilized (BASMAA, 1999).

- Level III – Treatment Measures

  The term "treatment measures" refers to those BMPs that are designed to reduce constituents of concern once they have been mobilized in stormwater runoff. They should properly be seen as a "last line of defense" in the overall suite of BMPs that are employed. Treatment measures are generally considered necessary BMPs since even the most aggressive site design and source control programs cannot guarantee that constituents of concern will not be mobilized from the site.

LEVEL I – SITE DESIGN ELEMENTS

The primary goal of the Alameda County Clean Water program is to incorporate water quality elements into the project design and limit the amount of DCIA within the development envelope. Limiting DCIA promotes infiltration, increases times of concentration and reduces runoff volumes. Additionally, lower impervious area generally leads to increased amounts of space that can be dedicated to landscaping and open space uses that limit the introduction of pollutants to the environment and can filter out pollutants that already have been mobilized.

The site design for Moller Ranch includes many stormwater friendly site design elements including:

- Reduced Street Widths (reducing impervious area)
- Sidewalks on only one side of the street where possible, separated sidewalks with landscape strip and separated multi-purpose trail (reducing impervious area and increasing landscape areas)
- Eliminating direct connections to stormwater systems.
- Flow from all impervious area of the development has been directed towards multiple bio-retention cells spread throughout the development and roadways draining directly to bio-retention swales.
- Preservation of open space area (135-acres out of 225-acre site), including setbacks from the existing creek to provided vegetated open space buffers.

LEVEL II – SOURCE CONTROL ELEMENTS

Control of pollutant sources limits the release of pollutants into the stormwater system and serves an important early role in reducing urban pollutants. In addition to maintenance activities such as regular street sweeping and storm drain inlet cleaning, storm drain inlets will be stenciled with appropriate warnings indicating that the runoff flows to the San Francisco Bay. The open space hillsides surrounding the project will be actively managed by the Geologic Hazard Abatement District (GHAD) which will monitor slopes, soil conditions and manage native vegetation to prevent erosion. The site will comply with the Water Efficient Landscape Ordinance, minimizing irrigation needs and nuisance runoff. Additionally, educational materials (provided through existing City Programs) will assist homeowners in reducing the introduction of pollutants to the stormwater system.

LEVEL III – TREATMENT MEASURES

Treatment measures are generally considered necessary as a final element in water quality protection even when the use of approved site planning and source control BMPs is maximized. The C.3 Provisions of the MRP set minimum standards for the use of treatment measures and Low Impact Development (LID) methods to assure that an appropriate portion of the annual runoff is treated. Pollutants typically found in urban runoff at similar sites include chemicals used in landscape maintenance (insecticides, herbicides, fungicides and pesticides), heavy metals (such as copper, zinc and cadmium), oils and greases, and nutrients (nitrogen and phosphorus). The project will construct several selected treatment controls designed to assure that all runoff from the site is treated before being conveyed to existing Moller Creek. This primarily includes the use of bio-retention cells and vegetated bio-swales, but also includes vegetated buffer strips as self treating areas.

Additionally, the MRP and C.3 Technical Guidelines require that stormwater treatment requirements be met using the following LID methods:

- Rainwater harvesting and reuse
- Evapotranspiration
- Infiltration
- Bio-filtration treatment (when the first three methods above are not feasible)

Rainwater harvesting and reuse: Attached as **Appendix A** is the completed "Form D – Rainwater Harvesting and Use Feasibility Worksheet" confirming harvesting and reuse is not feasible for the Moller Ranch project.

Evapotranspiration: Evapotranspiration will be incorporated with the project treatment methods as part of the proposed bio-retention cells and vegetated bio-swales. The bio-retention cells and vegetated bio-swales will comprise landscaped surface area of approximately 80,600-sft (or approximately 1.9-acres) with plant materials specifically selected per Chapter 5 and "Appendix B" of the C.3 Stormwater Technical Guidance handbook (ACCWP) to promote evapotranspiration and biological treatment of stormwater. Ponding within the bio-retention cells will also provide for evapotranspiration through the air. Full treatment of the C.3.d runoff amount will not be feasible through evapotranspiration alone due to the sloped, hillside nature of the site, significant geotechnical slide constraints and limited flat areas to pond runoff. However, use of bio-retention cells and vegetated bio-swales spread throughout the development will implement evapotranspiration to the maximum extent practicable.

Infiltration: Per the Screening Worksheet Guidance (Section J.2) in "Appendix J" of the C.3 Stormwater Technical Guidance handbook (ACCWP), if the soils at the project site consist of Type C or Type D soils, then infiltration is not a feasible LID treatment method. Attached as **Appendix B** is the soil conservation service soils map for the project site area showing that all of the soils on the property are Type D soils. Thus infiltration is not feasible.

Bio-Filtration treatment: The project incorporates bio-retention cells and vegetated bio-swales located throughout the proposed development in a stair-step or treatment train fashion to capture and treat stormwater runoff at numerous locations close to the source.

A Storm Water Quality Exhibit is included in this report as **Appendix C**. This color-coded exhibit shows the developed watershed areas or Drainage Management Areas (DMA's) tributary to each proposed bio-retention cell and bio-swale, and presents the calculation of pervious and impervious areas for each DMA. This exhibit is the basis for the sizing of the bio-retention cells and vegetated bio-swales discussed below:

Bio-Retention Cells

Bio-retention cells function through a combination of soil and plant based filtration devices and remove pollutants through physical, biological and chemical treatment processes. These cells normally consist of an upper layer of mulch followed by a layer of filtration media (sandy loam) with a high infiltration rate (5 in/hr), permeable material is placed beneath with an underdrain to convey treated stormwater to the underground gravity system. Underdrains are particularly necessary with the Moller Ranch site given the poor draining Type D soils. Typical design sections for each of the bio-retention cells and for the bio-swales are shown on the exhibit in **Appendix C – Sheet 2**.

The Bio-retention Cells #1 through #5 for DMA 1 through 5 have now been sized per the Combined Flow and Volume Based approach presented in Chapter 5 of the C.3 Stormwater Technical Guidance handbook (ACCWP). The calculations for the sizing of Bio-retention Cells 1 – 5 are presented in **Appendix D-1** of this report. **Appendix D-2** provides a color coded summary of the Bio-retention Cell sizing and Bio-swale sizing that correlates the colored DMA areas on Appendix C to the calculations.

Vegetated Bio-Swales

Vegetated bio-swales function similarly to bio-retention cells in that they function through a combination of soil and plant based filtration devices and remove pollutants through physical, biological and chemical treatment processes. The swales normally consist of an upper layer of mulch followed by a layer of filtration media (sandy loam) with a high infiltration rate (5 in/hr), permeable material is placed beneath with an underdrain to convey treated stormwater to the underground gravity system.

The vegetated bio-swale designed to treat DMA #6, or stormwater drainage shed K, is shown on the attached Appendix C exhibit. This bio-swale was designed using the combined flow and volume basedsizing method outlined in Chapter 5 of the C.3 Stormwater Technical Guidance handbook (ACCWP). These calculations for sizing of the bio-swale are also shown in **Appendix D-1** of this report. Note that the square footage of treatment area provided by the proposed bio-swale is actually about 47% larger than the minimum required. The primary collector roadway has been designed to sheet flow into the adjacent bio-swale providing treatment at the source and providing for disconnection of impervious areas --- treating the roadway runoff before it enters the underground storm drain system.

Self Treating Areas (Vegetated Buffer Strips)

Self treating areas are portions of the drainage shed in which infiltration and natural processes remove pollutants in stormwater. These self treating areas only treat the stormwater runoff that they create and are not designed to treat other impervious areas.

Only two types of self treating areas are identified for this project. The first are the landscape strips along Street A and along the south side of the primary collector roadway, between the roadway and the meandering trail. The second type of areas are the individual bio-retention cells.

The landscape strips will be planted with long grasses and shrubs as identified in the Alameda County C.3 Manual. The bio-retention cells will function as self treating by passing through stormwater to the gravity system prior to any untreated water entering the BMP device.

Bio-Retention Cell / Bio-Swale – Soil Specifications

The proposed Bio-retention cells and Bio-swale construction will incorporate biotreatment soil specifications that comply with Appendix L of the Municipal Regional Stormwater Permit. These specifications have been incorporated into this report as **Appendix "L".** The specifications also allow for use of alternative bioretention soil mixes that are in accordance with the "Verification of Alternative Bioretention Soil Mixes", as included in **Appendix "L"**.

HYDROMODIFICATION

BACKGROUND

The City of Dublin is covered under the Municipal Regional Permit (MRP) which includes a provision requiring hydromodification management.

Hydromodification management (HM) is a concern when development alters site hydrology to an extent that peak flow rates and/or durations of flow are increased significantly and if the receiving waters are susceptible to erosive impacts related to the increased flow. These potential impacts are often referred to as hydrograph modification impacts and may include erosion or degradation of downstream channels, alteration of sediment transport characteristics and changes in flood frequency, among other issues.

Within Alameda County, projects meeting the following applicability criteria are required to comply with the HM requirements in the MRP:

- The project creates and/or replaces one (1) acre or more of impervious area. *[Moller Ranch – YES]*
- The project will increase impervious surface over the pre-project conditions. *[Moller Ranch – YES]*
- The project is located in a susceptible area, as shown on the susceptibility map. *[Moller Ranch – YES]*

Hydromodification management measures that mitigate for potential impacts are grouped into three types:

- Site design and hydrologic source control measures
- On-site structural HM measures
- In-stream or restorative measures

The Moller Ranch project will address HM impacts through the first two methods above as described in more detail below. The project does not propose to alter or impact the existing Moller Creek other than at the one localized area surrounding the proposed creek crossing, so in-stream measures are not proposed.

Site Design & Hydrologic Source Control Measures

These types of measures help to minimize hydrological changes caused by development and are generally distributed throughout the project. Moller Ranch will minimize impervious area (as described in Level I – Site Design Elements above) and will disconnect roof leaders as feasible per the geotechnical engineer. Additionally, the bio-retention cells distributed throughout the project in a treatment train fashion provide localized detention and reduction of runoff (in addition to water quality treatment) as the stormwater flows travel through the system. The BAHM calculations, attached as **Appendix E-1,** confirm that the multiple bio-retention cells distributed throughout the project provide significant mitigation of hydromodification impacts, substantially attenuating the storm water flowrates being discharged from the project.

On-site Structural HM Measures

These “end-of-pipe” measures mitigate the effects of hydrograph changes through the temporary detention of stormwater runoff and metered discharge of outflow at rates calculated to mimic pre-development runoff (rates calculated to avoid adverse impacts). The structural HM measures are sized for Flow Duration Control which detains and meters the outflow for storm event flows ranging from 10% of the 2-year storm up to the 10-year storm, through continuous hydrologic simulation modeling based on long-term precipitation records. Thus reducing post-development discharge to levels below the critical flow rate that would cause erosion in the receiving waters.

To facilitate the simulation modeling the Alameda County Clean Water Program (and other agencies) have developed the Bay Area Hydrology Model (BAHM) software to provide analysis of the existing and developed watershed, to determine facility sizing for structural HM measures and to size orifice outlet controls that adequately mimic the pre-development runoff flows and show compliance for post-development flows being less than the critical flow rate.

For the Moller Ranch design and for this SWMP, the current BAHM model was utilized to determine required HM detention volumes and to confirm orifice / outflow controls that meet pre-development runoff rate requirements. **Appendix E-1** of this report presents the BAHM model input data and the model results for the required HM detention sizing.

As noted in the "Site Design Measures" paragraph above, the final BAHM calculations presented in **Appendix E-1** conclude that only a minor detention volume of 0.0054 acre-ft is required to meet the HM detention requirements of the C.3 Guidelines, due to the significant flow attenuation provided by the treatment train of multiple Bio-retention cells.

Despite the very minor volume of storage required by the BAHM modeling, we have designed the Moller Ranch project to include an oversized HM detention facility with an actual detention volume of 0.46 acre-ft, which far exceeds what is required. **Appendix E-2** presents the BAHM modeling and results for the actual HM detention being proposed with the project. We have provided this additional detention in recognition of the City's desire to be proactive about hydromodification impacts along all of Tassajara Creek, which is the downstream receiving water body for the project runoff.

Functionally, the oversized HM detention basin will detain approximately 0.37 acre-ft by use of a diversion weir structure in the downstream end of the project storm drain system, which forces all critical flows into the HM detention basin, based on the BAHM modeling of the critical storm event flowrates. The HM basin will utilize an orifice control device to release flows at pre-development rates. Discharge from the HM basin to Moller Creek will be through an outfall structure located at the upstream end of the proposed new Tassajara Road culvert, per the approved plans and permits for this culvert improvement. Above the 10-year storm event flows for HM treatment, high-flows will spill over the diversion weir and be allowed to discharge directly to Moller Creek at the same outfall location described above.

Appendix F presents the Hydromodification Management Plan Exhibit and details that illustrate the HM system described above.

OPEN SPACE DRAINAGE

The proposed Moller Ranch project consists of a development area of approximately 90-acres out of the total 225-acre property. The remaining 135-acres of the property will remain as open space / rural agricultural uses. A significant portion of this 135-acres of open space is comprised of hillsides that are situated above the proposed development and drain downhill toward the development. Portions of these open space hillsides will be disturbed by project grading, however, the graded hillside slopes will be naturally contoured to blend with adjacent existing slopes and the graded areas will be treated with topsoil and re-vegetated with native grasses. Stormwater runoff from these open space hillsides will be undeveloped, "clean" runoff and therefore the project proposes to keep this open space runoff separate from the development runoff through the use of a separate "open space" storm drainage (SDO) system.

The SDO drainage system consists of a series of vegetated earth swales and storm drain lines constructed along a flat graded bench that will be situated at the toe of slope where the surrounding open space hillsides meet the proposed development. The earth swales and storm drain lines will collect open space runoff and a separate storm drain system within the proposed streets will convey open space stormwater through the development, separate from the in-tract storm drain conveyance system. The SDO system will ultimately discharge the open space stormwater runoff back to existing Moller Creek at controlled points of discharge.

Separating open space stormwater runoff from the developed runoff provides two primary advantages:

- The stormwater quality treatment and HM management facilities will be limited to treating only developed runoff and won't have to be "oversized" to include open space flows with developed flows.
- Routing the open space runoff through the project and back to the existing creek will help maintain the existing hydrologic conditions of the creek.

Appendix G is an exhibit that depicts the proposed open space storm drainage system and illustrates the limits of the open space watersheds and which SDO systems will be conveying which watersheds, and where each system will discharge to the existing creek.

OWNERSHIP / MAINTENANCE - GHAD

As noted in the previous section, the proposed Moller Ranch project includes approximately 135-acres of open space area. A majority of this 135-acres of open space are the hillsides surrounding the development and the creek area running through the development. To ensure long term maintenance and monitoring of the open space area, hillside and creek stability, the Project proposes that the 135-acres of open space be included in a Geologic Hazard Abatement District (GHAD). This GHAD will also take ownership and maintenance responsibility for the storm water quality / hydromodification treatment facilities.

The GHAD would be funded through property tax assessments and governed by a GHAD Plan of Control written by a California Certified Engineering Geologist and Geotechnical Engineer, adopted by the GHAD Board of Supervisors. The GHAD Plan of Control would specifically provide for monitoring and maintenance of the proposed water quality bio-retention facilities, the hydromodification facility and all Project surface drainage facilities. The GHAD Plan of Control would also provide monitoring and maintenance for potential creek erosion, creek bank stability and hillside/slope stability. The assessment would be levied by the GHAD on each individual residential parcel beginning the first fiscal year following issuance of a building permit for that parcel.

APPENDIX A – FORM D "RAINWATER HARVESTING AND USE FEASIBILITY WORKSHEET"

FORM D

Rainwater Harvesting and Use Feasibility Worksheet
Municipal Regional Stormwater Permit (MRP)
Stormwater Controls for Development Projects

Complete this worksheet for all **C.3 Regulated Projects*** for which the project density exceeds the **screening density***. Use this worksheet to determine the feasibility of treating the **C.3.d amount of runoff*** with rainwater harvesting and use for indoor, non-potable water uses. Where it is infeasible to treat the C.3d amount of runoff with either harvesting and use or infiltration, stormwater may be treated with **biotreatment*** measures. See Glossary (Attachment 1) for definitions of terms marked with an asterisk (*).

Complete this worksheet for the entire project area. If rainwater harvesting and use is infeasible for the entire project, and the project includes one or more buildings that each individually has a roof area of 10,000 square feet, then complete a separate copy of this form for each of these buildings (in this case, complete only the sections of the form that make sense for the roof area evaluation).

1. Enter Project Data.

1.1	Project Name:	Moller Ranch
1.2	Project Address:	Tassajara Rd., Dublin, CA (APN 985-0001-001)
1.3	Applicant/Agent Name:	MacKay & Somps Civil Engineers / Mark McClellan
1.4	Applicant/Agent Address:	5142 Franklin Dr., Ste. B, Pleasanton, CA 94588

(For projects with a potential non-potable water use other than toilet flushing, skip to Question 5.1)

1.5	Project Type: Residential	If residential or mixed use, enter # of dwelling units:	381
1.6		Enter square footage of non-residential interior floor area.:	NA

1.7	Total area being evaluated (entire project or individual roof with an area > 10,000 sq.ft.):	1,344,934	sq.ft.
1.8	If it is a **Special Project***, indicate the percentage of **LID treatment*** reduction: *(Item 1.8 applies only to entire project evaluations, not individual roof area evaluations.)*	NA	percent
1.9	Total area being evaluated, adjusted for Special Project LID treatment reduction credit: *(This is the total area being evaluated that requires LID treatment.)*	1,344,9	sq.ft.

2. Calculate Area of Self-Treating Areas, Self-Retaining Areas, and Areas Contributing to Self-Retaining Areas.

2.1	Enter square footage of any **self-treating areas*** in the area that is being evaluated:	93,910	sq.ft.
2.2	Enter square footage of any **self-retaining areas*** in the area that is being evaluated:	0	sq.ft.
2.3	Enter the square footage of areas contributing runoff to **self-retaining area***:	0	sq.ft.
2.4	TOTAL of Items 2.1, 2.2, and 2.3:	93,910	sq.ft.

3. Subtract credit for self-treating/self-retaining areas from area requiring treatment.

3.1	Subtract the TOTAL in Item 2.4 from the adjusted area being evaluated (Item 1.9). This is the **potential rainwater capture area***:	1,251,024	sq.ft.
3.3	Convert the potential rainwater capture area (Item 3.1) from square feet to acres	28.7	acres

4. Determine feasibility of use for toilet flushing based on demand

4.1	Project's dwelling units per acre of potential rain capture area (Divide the number in 1.5 by the number in 3.3)	13.3	dwelling units/acre
4.2	Non-residential interior floor area per acre of potential rain capture area (Divide the number in 1.6 by the number in 3.3)	NA	Int. non-res. floor area/acre

* See definitions in Glossary (Attachment 1)

*Note: formulas in Items 4.1 and 4.2 are set up, respectively, for a residential or a non-residential project. Do not use these pre-set formulas for mixed use projects. **For mixed use projects**, evaluate the residential toilet flushing demand based on the dwelling units per acre for the residential portion of the project (use a prorated acreage, based on the percentage of the project dedicated to residential use). Then evaluate the commercial toilet flushing demand per acre for the commercial portion of the project (use a prorated acreage, based on the percentage of the project dedicated to commercial use).*

Rainwater Harvesting and Use Feasibility Worksheet

4.3	Refer to the applicable countywide table in Attachment 2. Identify the number of dwelling units per impervious acre needed in your Rain Gauge Area to provide the toilet flushing demand required for rainwater harvest feasibility.	177	dwelling units/acre
4.4	Refer to the applicable countywide table in Attachment 2. Identify the square feet of non-residential interior floor area per impervious acre needed in your Rain Gauge Area to provide the toilet flushing demand required for rainwater harvest feasibility.	NA	int. non-res. floor area/acre

Check "Yes" or "No" to indicate whether the following conditions apply. If "Yes" is checked for any question, then rainwater harvesting and use is infeasible. As soon as you answer "Yes", you can skip to Item 6.1. If "No" is checked for all items, then rainwater harvesting and use is feasible and you must harvest and use the C.3.d amount of stormwater, unless you infiltrate the C.3.d amount of stormwater.*

4.5	Is the project's number of dwelling units per acre of potential rainwater capture area (listed in Item 4.1) LESS than the number identified in Item 4.3?	☑ Yes	☐ No
4.6	Is the project's square footage of non-residential interior floor area per acre of potential rainwater capture area (listed in Item 4.2) LESS than the number identified in Item 4.4?	☐ Yes	☐ No

5. Determine feasibility of rainwater harvesting and use based on factors other than demand.

5.1	Does the requirement for rainwater harvesting and use at the project conflict with local, state, or federal ordinances or building codes?	☐ Yes	☐ No
5.2	Would the technical requirements cause the harvesting system to exceed 2% of the **Total Project Cost***, or has the applicant documented economic hardship in relation to maintenance costs? (If so, attach an explanation.)	☐ Yes	☐ No
5.3	Do constraints, such as a slope above 10% or lack of available space at the site, make it infeasible to locate on the site a cistern of adequate size to harvest and use the C.3.d amount of water? (If so, attach an explanation.)	☐ Yes	☐ No
5.4	Are there geotechnical/stability concerns related to the surface (roof or ground) where a cistern would be located that make the use of rainwater harvesting infeasible? (If so, attach an explanation.)	☐ Yes	☐ No
5.5	Does the location of utilities, a septic system and/or **heritage trees*** limit the placement of a cistern on the site to the extent that rainwater harvesting is infeasible? (If so, attach an	☐ Yes	☐ No

Note: It is assumed that projects with significant amounts of landscaping will either treat runoff with landscape dispersal (self-treating and self-retaining areas) or will evaluate the feasibility of harvesting and using rainwater for irrigation using the curves in Appendix F of the LID Feasibility Report.

* See definitions in Glossary (Attachment 1)

6. Results of Feasibility Determination

		Infeasible	Feasible
6.1	Based on the results of the feasibility analysis in Item 4.4 and Section 5, rainwater harvesting/use is (check one):	☑	☐

→ If "FEASIBLE" is indicated for Item 6.1 the amount of stormwater requiring treatment must be treated with harvesting/use, unless it is infiltrated into the soil.

→ If "INFEASIBLE" is checked for Item 6.1, then the applicant may use appropriately designed ***bioretention*** **[1] facilities for compliance with C.3 treatment requirements. If Ksat > 1.6 in./hr., and infiltration is unimpeded by subsurface conditions, then the bioretention facilities are predicted to infiltrate 80% or more average annual runoff. If Ksat < 1.6, maximize infiltration of stormwater by using bioretention if site conditions allow, and remaining runoff will be discharged to storm drains via facility underdrains. If site conditions preclude infiltration, a lined bioretention area or flow-through planter may be used.*

10/8/12

Signature (and Print Name) — Date

Circle one: (licensed Soils Engineer/Licensed Civil Engineer/Licensed Architect/ Licensed Landscape

MacKay & Somps, 5142 Franklin Dr., Ste. B, Pleasanton, CA 94588 (925)225-0690

Name, address and telephone number of Consultant's Office

* See definitions in Glossary (Attachment 1)

LID Feasibility Worksheet
Attachment 1: Glossary

Bioinfiltration Area

A type of low development treatment measure designed to have a surface ponding area that allows for evapotranspiration, and to filter water through 18 inches of engineered biotreatment soil. After the water filters through the engineered soil, it encounters a 12-inch layer of rock in which an underdrain is typically installed. If the underlying soils have a saturated hydraulic conductivity rate of 1.6" per hour or greater, then the C.3.d amount of runoff is treated by evapotranspiration and infiltration. If the soils have a lower hydraulic conductivity rate, then the bioinfiltration area treats stormwater with evapotranspiration, some infiltration, and the remaining amount of the C.3.d amount of runoff is filtered and released into the underdrain. The difference between a bioinfiltration area and a bioretention area is that the bioinfiltration area is never lined with an impermeable layer; whereas, a bioretention area may be lined or unlined.

Bioretention Area

A type of low development treatment measure designed to have a surface ponding area that allows for evapotranspiration, and to filter water through 18 inches of engineered biotreatment soil. After the water filters through the engineered soil, it encounters a 12-inch layer of rock in which an underdrain is typically installed. If the underlying soils have a saturated hydraulic conductivity rate of 1.6" per hour or greater, then the C.3.d amount of runoff is treated by evapotranspiration and infiltration. If the soils have a lower hydraulic conductivity rate, or if infiltration is prohibited and the bioretention area is lined with an impermeable layer, then the bioretention area treats stormwater with evapotranspiration, some or no infiltration, and the remaining amount of the C.3.d amount of runoff is filtered and released into the underdrain. The difference between a bioinfiltration area and a bioretention area is that the bioinfiltration area is never lined with an impermeable layer; whereas, a bioretention area may be lined or unlined.

Biotreatment

A type of low impact development treatment allowed under Provision C.3.c of the ***MRP****, if infiltration, evapotranspiration and rainwater harvesting and use are infeasible. As required by Provision C.3.c.i(2)(vi), biotreatment systems shall be designed to have a surface area no smaller than what is required to accommodate a 5 inches/hour stormwater runoff surface loading rate and shall use biotreatment soil as specified in the biotreatment soil specifications approved by the Regional Water Board, or equivalent.

C.3 Regulated Projects:

Development projects as defined by Provision C.3.b.ii of the ***MRP****. This includes public and private projects that create and/or replace 10,000 square feet or more of impervious surface, and restaurants, retail gasoline outlets, auto service facilities, and uncovered parking lots (stand-alone or part of another use) that create and/or replace 5,000 square feet or more of impervious surface. Single family homes that are not part of a larger plan of development are specifically excluded.

C.3.d Amount of Runoff

The amount of stormwater runoff from C.3 Regulated Projects that must receive stormwater treatment, as described by hydraulic sizing criteria in Provision C.3.d of the ***MRP****.

Heritage Tree

An individual tree of any size or species given the 'heritage tree' designation as defined by the municipality's tree ordinance or other section of the municipal code.

Infiltration Devices

Infiltration facilities that are deeper that they are wide and designed to infiltrate stormwater runoff into the subsurface and, as designed, bypass the natural groundwater protection afforded by surface soil. These devices include dry wells, injection wells and infiltration trenches (includes French drains).

Infiltration Facilities

A term that refers to both infiltration devices and measures.

Infiltration Measures

Infiltration facilities that are wider than they are deep (e.g., bioinfiltration, infiltration basins and shallow wide infiltration trenches and dry wells).

Low Impact Development (LID) Treatment

Removal of pollutants from stormwater runoff using the following types of stormwater treatment measures: rainwater harvesting and use, infiltration, evapotranspiration, or, where these are infeasible, biotreatment.

Municipal Regional Stormwater Permit (MRP)

The municipal stormwater NPDES permit under which discharges are permitted from municipal separate storm sewer systems throughout Alameda County and the other NPDES Phase I jurisdictions within the San Francisco Bay Region.

Potential Rainwater Capture Area

The impervious area from which rainwater may be potentially be captured, if rainwater harvesting and use were implemented for a project. If the entire site is evaluated for rainwater harvesting and use feasibility, this consists of the impervious area of the proposed project; for redevelopment projects that replace 50% or more of the existing impervious surface, it also includes the areas of existing impervious surface that are not modified by the project. If only a roof area is evaluated for rainwater harvesting and use feasibility, the potential rainwater capture area consists only of the applicable roof area.

Screening Density

A threshold of density (e.g., number of units or interior floor area) per acre of impervious surface, associated with a certain potential demand for non-potable water, for C.3 regulated projects. The screening density varies according to location (see Attachment 2.) If the screening density is met or exceeded, the Rainwater Harvesting and Use Feasibility Worksheet must be completed for the project.

Self-Retaining Area

A portion of a development site designed to retain the first one inch of rainfall (by ponding and infiltration and/or evapotranspiration) without producing stormwater runoff. Self-retaining areas must have at least a 2:1 ratio of contributing area to a self-retaining area and a 3" ponding depth. Self-retaining areas may include graded depressions with landscaping or pervious pavement. **Areas that Contribute Runoff to Self-Retaining Areas** are impervious or partially pervious areas that drain to self-retaining areas.

Self-Treating Area

A portion of a development site in which infiltration, evapotranspiration and other natural processes remove pollutants from stormwater. Self-treating areas may include conserved natural open areas, areas of landscaping, green roofs and pervious pavement. Self-treating areas treat only the rain falling on them and do not receive stormwater runoff from other areas.

Special Projects

Certain types of smart growth, high density and transit oriented development projects that are allowed, under Provision C.3.e.ii of the MRP, to receive LID treatment reductions. The specific development project types will be described in an amendment to the MRP, anticipated in Fall 2011.

Total Project Cost

Total project cost includes the construction (labor) and materials cost of the physical improvements proposed; however, it does not include land, transactions, financing, permitting, demolition, or off-site mitigation costs.

LID Feasibility Worksheet
Attachment 2: Toilet-Flushing Demand Required for Rainwater Harvesting Feasibility per Impervious Acre (IA) [1,2]

Table 1 - Alameda County:

Rain Gauge[3]	Required Demand (gal/day/IA)[4]	Residential		Office/Retail[5]		Schools[6]	
		No. of residents per IA[7]	Dwelling Units per IA[8]	Employees per IA[9]	Interior Floor Area (sq.ft./IA)[10]	Employees[11] per IA	Interior Floor Area (sq.ft./IA)[12]
Berkeley	5,900	690	255	860	172,000	170	51,000
Dublin	4,100	480	177	590	118,000	120	36,000
Hayward	4,800	560	207	700	140,000	140	42,000
Palo Alto	2,900	340	125	420	84,000	90	27,000
San Jose	2,400	280	103	350	70,000	70	21,000

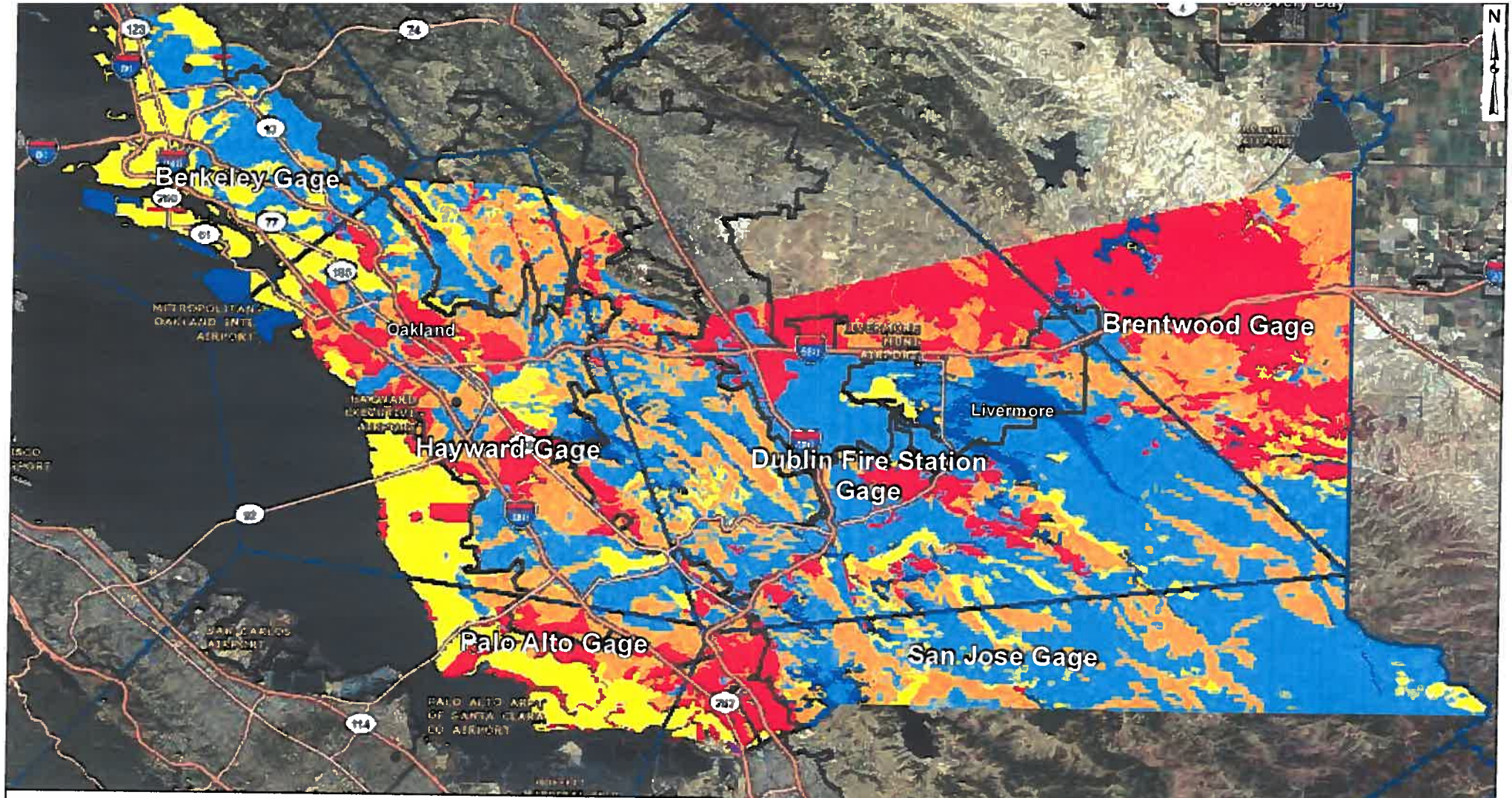
Notes:

1. Demand thresholds obtained from the "Harvest and Use, Infiltration and Evapotranspiration Feasibility/Infeasibility Criteria Report" (LID Feasibility Report) submitted to the Regional Water Board on May 1, 2011.
2. Toilet flushing demands assume use of low flow toilets per the California Green Building Code.
3. See Attachment 3 to identify the rain gauge that corresponds to the project site.
4. Required demand per acre of impervious area to achieve 80% capture of the C.3.d runoff volume with the maximum allowable drawdown time for cistern of 50,000 gallons or less, from Table 9 of the LID Feasibility Report.
5. "Office/Retail" includes the following land uses: office or public buildings, hospitals, health care facilities, retail or wholesale stores, and congregate residences.
6. "Schools" includes day care, elementary and secondary schools, colleges, universities, and adult centers.
7. Residential toilet flushing demand identified in Table 10 of the LID Feasibility Report.
8. Residential toilet flushing demand divided by the countywide average number of persons per household (US Census data reported on www.abag.org), as follows: Alameda County: 2.71 persons per household.
9. Office/retail employee toilet flushing demand identified in Table 10 of the LID Feasibility Report.
10. Interior floor area required for rainwater harvest and use feasibility per acre of impervious area is based on the number of employees in Column 5 multiplied by an occupant load factor of 200 square feet per employee (reference: 2010 California Plumbing Code, Chapter 4, Plumbing Fixtures and Fitting Fixtures, Table A, page 62.)
11. School employee toilet flushing demand identified in Table 10 of the LID Feasibility Report. Each school employee represents 1 employee and 5 "visitors" (students and others).
12. Interior floor area required for rainwater harvest and use feasibility per acre of impervious area is based on the number of employees in Column 7 multiplied by 6 to account for visitors, then multiplied by an occupant load factor of 50 square feet per employee (reference: 2010 California Plumbing Code).

LID Feasibility Worksheet

Attachment 3:

Countywide Map with
Rain Gauge Areas
And
Soil Hydraulic Conductivity (Ksat)



Legend

- Precipitation Gage
- Precipitation Gage Polygon
- Urban Areas

Saturated Hydraulic Conductivity (in/hr)

0.0 - 0.1	0.5 - 0.7
0.1 - 0.2	0.7 - 0.9
0.2 - 0.3	0.9 - 1.1
0.3 - 0.4	1.1 - 1.3
0.4 - 0.5	1.3 - 1.5
	> 1.5

Note: Saturated hydraulic conductivities (Ksat) presented are NRCS "representative" values in the absence of complete coverage of "low" value.

8 4 0 8 Miles

Saturated Hydraulic Conductivity (Ksat) and Precipitation Polygons
Alameda County, CA

Geosyntec consultants

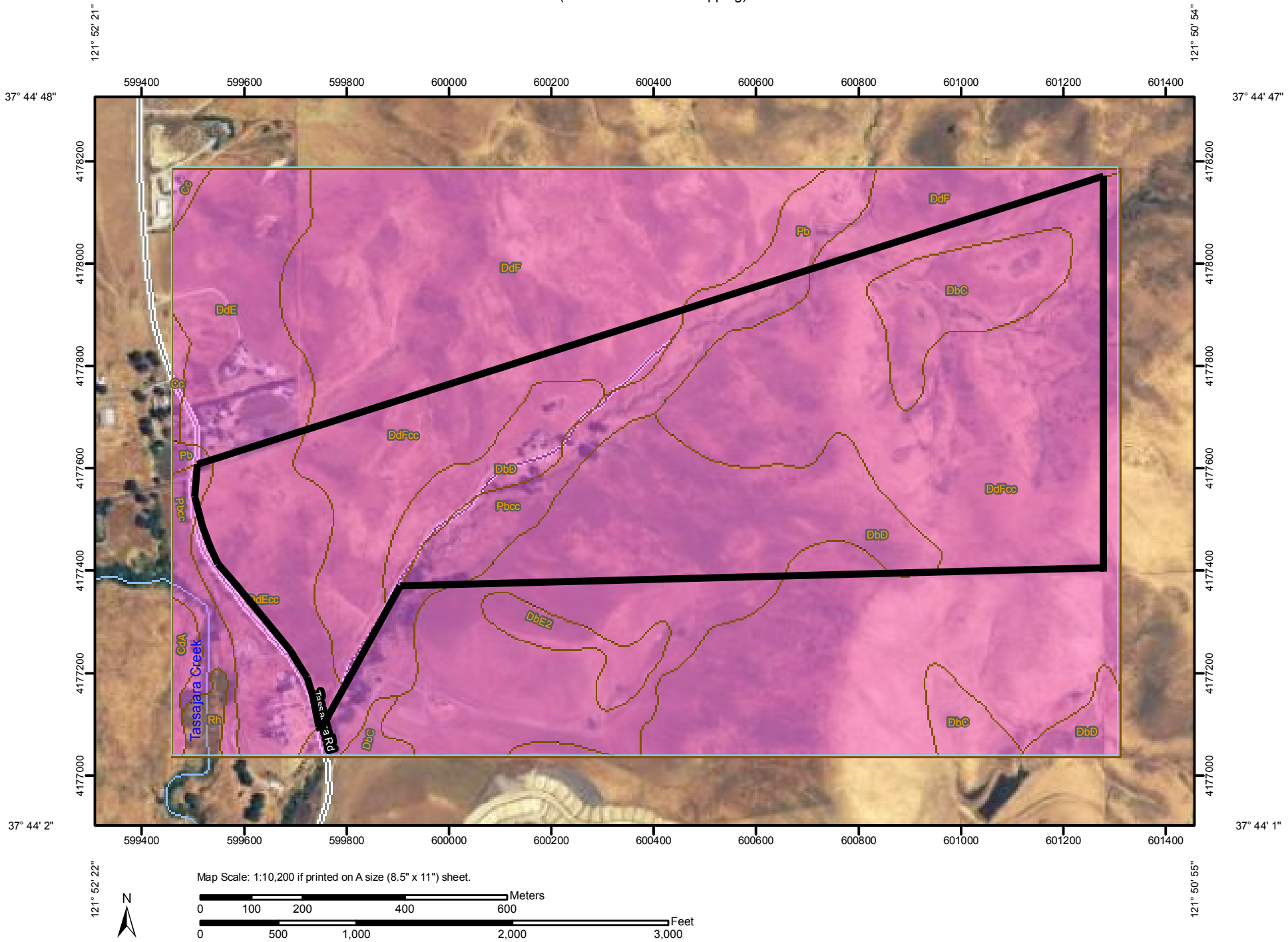
Oakland Office | February 2011

Figure **A-6**

P:\GIS\BASMAA_LID\Projects\MRP_Soils_Alameda.mxd, WHL, February 28, 2011

APPENDIX B – NATURAL RESOURCE CONSERVATION SERVICES – SOIL MAPPING

Hydrologic Soil Group—Alameda Area, California, and Contra Costa County, California
(Moller Ranch - Soil Mapping)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:10,200 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Alameda Area, California
Survey Area Data: Version 6, Jul 26, 2010

Soil Survey Area: Contra Costa County, California
Survey Area Data: Version 8, Jul 22, 2008

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 6/13/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Alameda Area, California (CA609)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
CdA	Clear Lake clay, drained, 0 to 3 percent slopes	D	2.6	0.5%
DbC	Diablo clay, 7 to 15 percent slopes	D	23.0	4.4%
DbD	Diablo clay, 15 to 30 percent slopes	D	96.7	18.4%
DbE2	Diablo clay, 30 to 45 percent slopes, eroded	D	6.9	1.3%
DdEcc	Diablo clay, 15 to 30 percent slopes	D	30.6	5.8%
DdFcc	Diablo clay, 30 to 50 percent slopes	D	192.7	36.7%
Pbcc	Pescadero clay loam	D	32.8	6.2%
Rh	Riverwash	A	2.6	0.5%
Subtotals for Soil Survey Area			**387.9**	**73.8%**
Totals for Area of Interest			**525.5**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Contra Costa County, California (CA013)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
Cc	CLEAR LAKE CLAY	D	2.5	0.5%
DdE	DIABLO CLAY, 15 TO 30 PERCENT SLOPES	D	30.9	5.9%
DdF	DIABLO CLAY, 30 TO 50 PERCENT SLOPES	D	95.5	18.2%
Pb	PESCADERO CLAY LOAM	D	8.6	1.6%
Subtotals for Soil Survey Area			**137.6**	**26.2%**
Totals for Area of Interest			**525.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX C – STORM WATER QUALITY EXHIBIT

AREA C
75,505 SFT.
1.73 AC.

AREA B
172,725 SFT.
3.97 AC.

SUM OF AREA A1-A5
113,960 SFT. 2.62 AC.

AREA L
(TREATED BY BIOSWALE L1 - L-4)
96,719 SFT. 2.22 AC.

DMA 6
BIOSWALE
AREA L1+L2+L3+L4
4,153 ± sq. ft.

AREA D
187,603 SFT.
4.31 AC.

DMA 5
BIO-CELL #5
AREA A+B+C+D+E SWQ
BASIN EL. 479.7 ±
15,145 ± sq. ft.

HM BASIN
0.46 AC. FT. VOL. @ 4.2' DEPTH
(3,640 SQ. FT. BASIN FLOOR AREA)

HM BASIN OUTFALL PIPE
TO CREEK

HIGH FLOW OUTFALL PIPE
TO CREEK

TASSAJARA ROAD

DMA 4
BIO-CELL #4
AREA F SWQ
BASIN EL. 630.0 ±
21,620 ± sq. ft.

DMA 3
BIO-CELL #3
SWQ FOR AREA G+H+J
BASIN EL. 650.0 ±
14,320 ± sq. ft.

AREA F
932,115 SFT.
21.40 AC.

AREA E
81,751 SFT.
1.88 AC.

DMA 2
BIO-CELL #2
AREA I SWQ
BASIN EL. 684.0 ±
17,890 ± sq. ft.

AREA G
226,724 SFT.
5.25 AC.

AREA I
771,151 SFT.
17.70 AC.

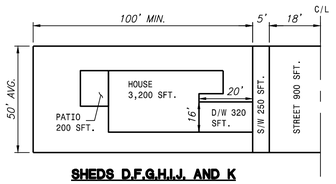
AREA J
190,888 SFT.
4.38 AC.

AREA H
197,551 SFT.
4.54 AC.

AREA K
415,130 SFT.
9.53 AC.

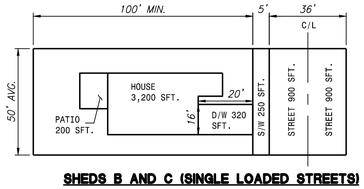
DMA 1
BIO-CELL #1
AREA K SWQ
BASIN EL. 705.0 ±
7,500 ± sq. ft.

ESTIMATED PERCENT IMPERVIOUS (IMPV.) FOR EACH DEVELOPED SHED



SHEDS D,F,G,H,I,J, AND K

TOTAL SFT. = 50'X 123' = 6,150 SFT.
TOTAL IMPV. SFT = 4,870 SFT.
EST. % IMPV. = 79.2% USE 79%

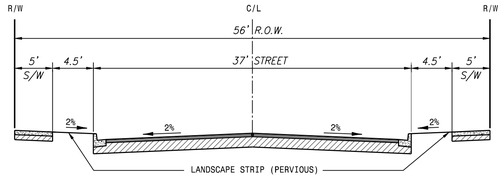


SHEDS B AND C (SINGLE LOADED STREETS)

TOTAL SFT. = 50'X 141' = 7,050 SFT.
TOTAL IMPV. SFT = 5,770 SFT.
EST. % IMPV. = 81.8% USE 82%

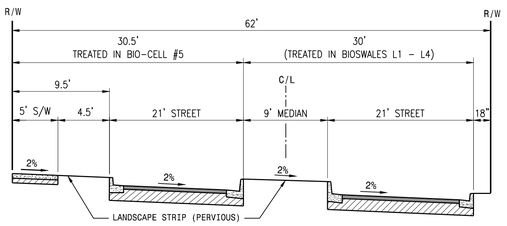
NOTE:

1. AVERAGE LOT SIZE OF 50'X100' IS CONSERVATIVE AS MOST LOTS HAVE SIDEYARD AND/OR REARYARD SLOPES BEYOND 50'X100' ENVELOPE, AND SLOPE AREA IS PERVIOUS AREA.
2. ASSUMED IMPERVIOUS HOUSE FOOTPRINT OF 3,200 SFT. (BASED ON CURRENT MAXIMUM HOUSE SIZE.)



SHED E
NTS

TOTAL FT. = 56' R.O.W.
TOTAL IMPV. FT = 47'
EST. % IMPV. = 83.9% USE 85%



SHED A
NTS

TOTAL FT. = 30.5'
TOTAL IMPV. FT = 26'
EST. % IMPV. = 85.2% USE 85%

SHED L
NTS

TOTAL FT. = 30'
TOTAL IMPV. FT = 21'
EST. % IMPV. = 70%

LEGEND:

- DMA 1 - BIO-CELL #1
- DMA 2 - BIO-CELL #2
- DMA 3 - BIO-CELL #3
- DMA 4 - BIO-CELL #4
- DMA 5 - BIO-CELL #5
- DMA 6 - BIOSWALE

0 100 200 400
SCALE:1"=200'

SHEET 1 OF 2

MOLLER RANCH
APPENDIX C
STORMWATER QUALITY EXHIBIT

DUBLIN CALIFORNIA

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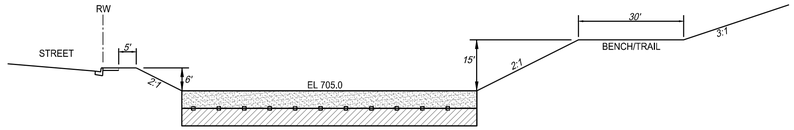
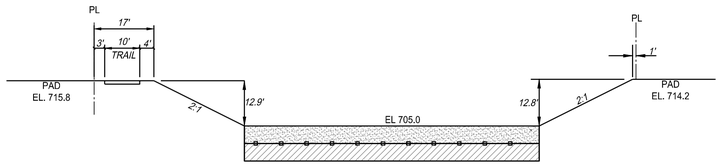
PLEASANTON	1" = 200'	6-26-2015	19569-010
OFFICE	SCALE	DATE	JOB NO.

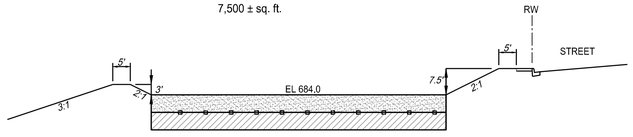
06-26-2015 5:02pm Kim Reed P:\19569\HYDRO\APP-C-SWQ-EXHPG1-2015-06-26.DWG



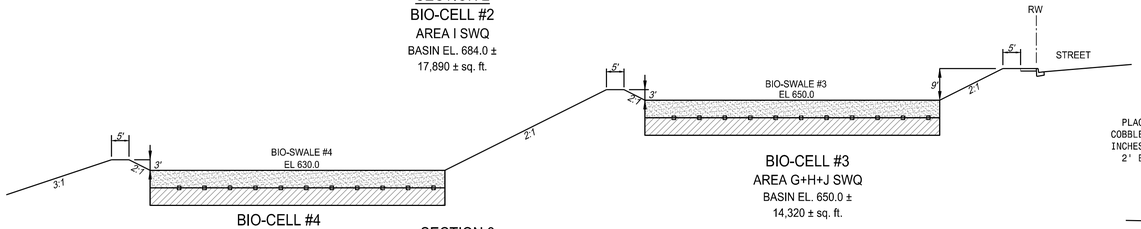
SECTION 1A
BIO-CELL #1
AREA K SWQ
BASIN EL. 705.0 ±
7,500 ± sq. ft.



SECTION 1B
BIO-CELL #1
AREA K SWQ
BASIN EL. 705.0 ±
7,500 ± sq. ft.



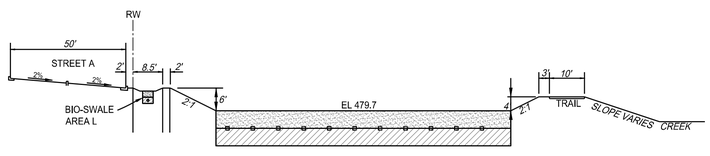
SECTION 2
BIO-CELL #2
AREA I SWQ
BASIN EL. 684.0 ±
17,890 ± sq. ft.



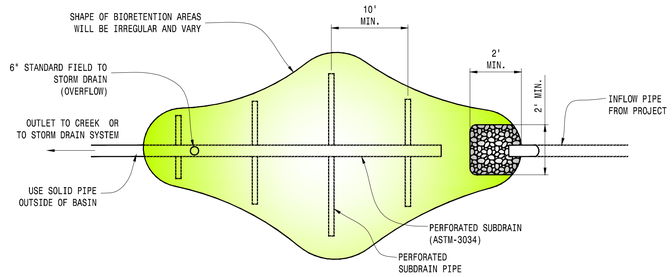
BIO-CELL #4
AREA F SWQ
BASIN EL. 630.0 ±
21,620 ± sq. ft.

SECTION 3

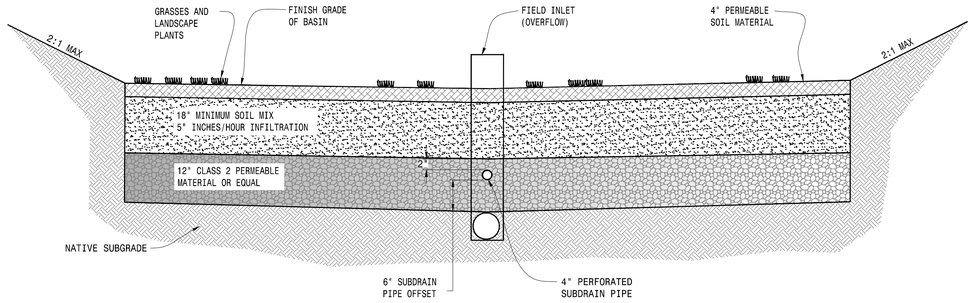
BIO-CELL #3
AREA G+H+J SWQ
BASIN EL. 650.0 ±
14,320 ± sq. ft.



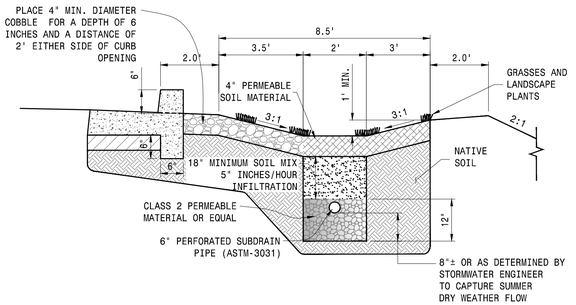
SECTION 4
BIO-CELL #5
AREA A+B+C+D+E SWQ
BASIN EL. 479.7 ±
15,145 ± sq. ft.



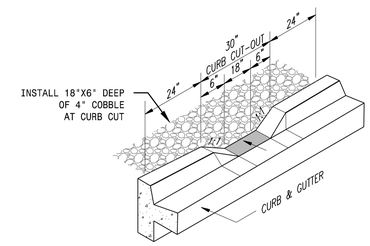
BIO-RETENTION CELL TYPICAL DETAIL
NTS



BIO-RETENTION CELL TYPICAL DETAIL
NTS



TYPICAL BIO-SWALE DETAIL
NTS



CURB OPENING DETAIL
NTS

BIO-RETENTION CELL NOTES:

SOIL MIX:
SHALL BE 50% IMPORTED SAND, 20- 30% MULCH/COMPOST, AND 20- 30% TOPSOIL WITH LESS THAN 5% CLAY. MAXIMUM CONTENT OF FINES SHOULD NOT EXCEED 25%. SOIL MIX MAY BE PRODUCED WITH ON-SITE SOILS OR WITH IMPORTED SOILS TO ACHIEVE THE NOTED MIXTURE SPECIFICATION. ANY NATIVE SOIL MATERIALS USED SHALL HAVE THE FOLLOWING SPECIFICATIONS: MATERIALS TO BE USED SHALL BE FREE FROM ORGANIC MATTER AND OTHER DELETERIOUS SUBSTANCES, AND OF SUCH QUALITY THAT IT WILL DRAIN THOROUGHLY WITHOUT EXCESSIVE VOIDS. EXCAVATED ON-SITE MATERIAL WILL BE CONSIDERED SUITABLE IF IT CONTAINS NO MORE THAN THREE PERCENT ORGANIC MATTER, IS FREE OF DEBRIS AND OTHER DELETERIOUS SUBSTANCES AND CONFORMS TO THE REQUIREMENTS SPECIFIED ABOVE. ROCKS SHALL BE REMOVED FROM ANY FILL MATERIAL TO THE SATISFACTION OF THE GEOTECHNICAL ENGINEER.

MULCH:
SHALL BE DOUBLE-GRIND CEDAR BARK OR APPROVED EQUAL, AVAILABLE AT SUN- UP FOREST PRODUCTS, INC., 3301 BUSINESS DRIVE, SACRAMENTO, CA 95820, 1 (800) 222 2551.
EXECUTION: INCORPORATE 2" LAYER OF MULCH INTO TOP 6" LAYER OF SOIL MIX. INCORPORATE WITH ROTOTILLER TO A HOMOGENOUS BLEND. SMOOTH OUT FINISH SURFACE PRIOR TO PLANTING.

CLASS 2 PERMEABLE MATERIAL:
AS DESCRIBED IN HEADING B UNDER SECTION 2.05, PART 2-PRODUCTS IN THE GEOTECHNICAL GUIDE CONTRACT SPECIFICATIONS PREPARED BY ENGEO.

GEOTEXTILE FILTER MAT:
SHALL BE SKAPS TN- 270 OR APPROVED EQUAL.

PERFORATED SUBDRAIN:
PERFORATED SUBDRAIN SHALL BE PERFORATED PVC SOLID WALL SDR 35 (ASTM D-3034). PLACE PERFORATIONS DOWN. ALL PIPE JOINTS SHALL BE GLUED, PER MANUFACTURER'S SPECIFICATIONS. PERFORATED PIPE SHALL HAVE A MINIMUM OF THREE 3/4" DIAMETER HOLES, EQUALLY SPACED ALONG THE CIRCUMFERENCE OF THE PIPE AND NOT LESS THAN THREE HOLES PER LINEAR FOOT OF PIPE. SUBDRAIN SHOULD BE PLACED AT A 1% SLOPE MINIMUM.

SOIL MIX TESTING AND REPORTING:
COLLECT ONE SAMPLE OF FILTER MIX. CONFIRM THAT ORGANIC CONTENT US 20- 30% OF FILTER MEDIA BY VOLUME (ASTM D2974). CONFORM THAT PERCENT PASSING #200 SIEVE (ASTM D422- 63) DOES NOT EXCEED 25%. CONFIRM USING HYDROMETER TEST (ASTM D422- 63) THAT CLAY CONTENT DOES NOT EXCEED 5%. A REPORT SHALL BE SUBMITTED TO THE WWQCB (REGIONAL WATER QUALITY CONTROL BOARD) WITH LABORATORY TESTING RESULTS PRIOR TO PLACEMENT OF THE TOP LAYER OF MULCH AND VEGETATION.

0 10 20 40
SCALE: 1"=20'

MOLLER RANCH
APPENDIX C
STORMWATER QUALITY EXHIBIT

DUBLIN CALIFORNIA

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PLEASANTON	AS NOTED	6-26-2015	19569-010
OFFICE	SCALE	DATE	JOB NO.

APPENDIX D-1 – BIO-RETENTION CELL SIZING CALCULATIONS

Moller Ranch

19569.01
6/26/2015
KMR

APPENDIX D-1

Bio-Retention Sizing Calculation

Combination Flow and Volume Approach
Per Alameda County C.3 Guidance Document dated May 2013

	DMA 1 - BIO-CELL #1		DMA 2 - BIO-CELL #2		DMA 3 - BIO-CELL #3		DMA 4 - BIO-CELL #4		DMA 5 - BIO-CELL #5		DMA 6 - BIOSWALE	
Inputs	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
Mean Annual Precipitation[1]	16.5	in	16.5	in	16.5	in	16.5	in	16.5	in	16.5	in
Gross Impervious Surfaces[2]	327,953	sq ft	609,209	sq ft	487,559	sq ft	736,371	sq ft	518,109	sq ft	67,703	sq ft
Interceptor Tree Impervious Area Reduction[3]	0	sq ft	0	sq ft	0	sq ft	0	sq ft	0	sq ft	0	sq ft
Pervious Surfaces[4]	87,177	sq ft	161,942	sq ft	129,604	sq ft	195,744	sq ft	113,435	sq ft	29,016	sq ft
Calculations												
Effective Impervious Area[5]	336,671	sq ft	625,403	sq ft	500,519	sq ft	755,945	sq ft	529,453	sq ft	70,605	sq ft
Adjusted Unit Basin Storage Volume[6]	0.60	in	0.60	in	0.60	in	0.60	in	0.60	in	0.60	in
Required Captured Volume[7]	16,902	cu ft	31,398	cu ft	25,128	cu ft	37,952	cu ft	26,581	cu ft	3,545	cu ft
Rain Event Duration[8]	3.01	hours	3.01	hours	3.01	hours	3.01	hours	3.01	hours	3.01	hours
Results												
Basin Area per 4% Approximate Sizing Factor[9]	13,467	sq ft	25,016	sq ft	20,021	sq ft	30,238	sq ft	21,178	sq ft	2,824	sq ft
Minimum Basin Area at Max 12" Ponding Depth[10]	7,500	sq ft	13,930	sq ft	11,150	sq ft	16,830	sq ft	11,790	sq ft	1,580	sq ft
Provided Bio-Filtration Area[11]	7,500	sq ft	17,890	sq ft	14,320	sq ft	21,620	sq ft	15,145	sq ft	4,153	sq ft
Depth of Ponding[12]	11.98	in	6.00	in	6.00	in	6.00	in	6.00	in	-4.82	in

Notes:

[1] Mean Annual Precipitation (MAP) determined using the map of Alameda County provided as Appendix D of the May 2013 Stormwater Technical Guidance document.
[2] Impervious Surfaces includes all impervious surfaces (Roof Areas, Paving, Sidewalks, etc)
[3] Per Section 4.5, the impervious area can be reduced for each existing tree that is preserved and each new evergreen or deciduous tree planted that meets the requirements of section 4.5.1 of the May 2013 C.3 Stormwater Technical Guidance document.
[4] Pervious surfaces (Landscaping, properly designed pervious paving)
[5] Effective impervious area includes the total Impervious Surfaces -Interceptor Tree credit+(0.1)*Pervious Surfaces
[6] For MAP> 16.4 inches the Oakland Airport Gauge is utilized (MAP = 18.35, Unit Basin Storage Volume = 0.67). For MAP< 16.4 inches the San Jose Airport Gauge is utilized (MAP= 14.4, Unit Basin Storage Volume= 0.56).
[7] Required Capture Volume is equal to the Adjusted Unit Basin Storage Volume x the Impervious Area.
[8] Rain Event Duration assumes an intensity of 0.2 in/hr, the Adjusted Unit Basin Volume is divided by the intensity.
[9] Calculated Basin Area using a flow based calculation only, no ponding. (4% method)
[10] The May 2013 Stormwater Technical Guidance document recommends ponding depths between 6 and 12 inches within a Bio-Retention Facility or Flow Thru Planter.
[11] The Bio-Retention Area provided on the site design
[12] The depth of ponding the provided Bio-Retention Area will have in the design event

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APPENDIX D-2 – BIO-RETENTION CELL SIZING SUMMARY

Storm Water Quality
Bio-Retention Sizing

APPENDIX D-2
MOLLER RANCH

19569.01
Rev. 6/26/15

SHED	AREA (AC.)	AREA (SFT.)	ESTIMATED % IMPERVIOUS	IMPERVIOUS AREA (SFT.)	SWQ BIO-CELL TREATMENT AREA (SFT.) ESTIMATED @ 4%	DMA # / BIO-CELL #	PERVIOS AREA
A	2.6	113,960	85%	96,866	3,875	5	17,094
B	4.0	172,725	82%	141,635	5,665	5	31,091
C	1.7	75,505	82%	61,914	2,477	5	13,591
D	4.3	187,603	79%	148,206	5,928	5	39,397
E	1.9	81,751	85%	69,488	2,780	5	12,263
F	21.4	932,115	79%	736,371	29,455	4	195,744
G	5.3	228,724	79%	180,692	7,228	3	48,032
H	4.5	197,551	79%	156,065	6,243	3	41,486
I	17.7	771,151	79%	609,209	24,368	2	161,942
J	4.4	190,888	79%	150,802	6,032	3	40,086
K	9.5	415,130	79%	327,953	13,118	1	87,177
L	2.2	96,719	70%	67,703	2,708	6 / Bioswale	29,016
							716,918
		CELL #3 Combined SWQ Area Req'd.:			19,502		
		CELL #5 Combined SWQ Area Req'd.:			20,724		
CELL #3 IMPERVIOUS AREA:				487,559	CELL #3 PERVIOUS AREA:	129,604	
CELL #5 IMPERVIOUS AREA:				518,109	CELL #5 PERVIOUS AREA:	113,435	

APPENDIX E-1 – BAHM CALCULATIONS FOR REQUIRED HYDROMODIFICATION DETENTION

BAHM2013

PROJECT REPORT

General Model Information

Project Name:	19569.04
Site Name:	Moller Ranch
Site Address:	
City:	Dublin
Report Date:	6/26/2015
Gage:	LIVERMORE
Data Start:	1959/10/01
Data End:	2004/09/30
Timestep:	Hourly
Precip Scale:	1.07
Version:	2014/02/10

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	79.4
Pervious Total	79.4

Impervious Land Use	Acres
Impervious Total	0
Basin Total	79.4

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	2.97
Pervious Total	2.97

Impervious Land Use	Acres
Roads,Flat(0-5%)	1.38
Roads,Steep(10-20%)	1.38
Roof Area	3.61
Driveways,Mod(5-10%)	0.49
Sidewalks,Flat(0-5%)	0.06
Impervious Total	6.92
Basin Total	9.89

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

Basin 2

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	4.68
Pervious Total	4.68

Impervious Land Use	Acres
Roads,Flat(0-5%)	2.18
Roads,Steep(10-20%)	2.18
Roof Area	5.69
Driveways,Mod(5-10%)	0.77
Sidewalks,Flat(0-5%)	0.1
Impervious Total	10.92
Basin Total	15.6

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 2	Surface retention 2	

Basin 3

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	4.29
Pervious Total	4.29

Impervious Land Use	Acres
Roads,Flat(0-5%)	2
Roads,Steep(10-20%)	2
Roof Area	5.22
Driveways,Mod(5-10%)	0.7
Sidewalks,Flat(0-5%)	0.09
Impervious Total	10.01
Basin Total	14.3

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 3	Surface retention 3	

Basin 4

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	6.63
Pervious Total	6.63

Impervious Land Use	Acres
Roads,Flat(0-5%)	3.09
Roads,Steep(10-20%)	3.09
Roof Area	8.06
Driveways,Mod(5-10%)	1.09
Sidewalks,Flat(0-5%)	0.14
Impervious Total	15.47
Basin Total	22.1

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 4	Surface retention 4	

Basin 5

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	5.25
Pervious Total	5.25

Impervious Land Use	Acres
Roads,Flat(0-5%)	2.45
Roads,Steep(10-20%)	2.45
Roof Area	6.38
Driveways,Mod(5-10%)	0.86
Sidewalks,Flat(0-5%)	0.11
Impervious Total	12.25
Basin Total	17.5

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 5	Surface retention 5	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length: 0.14 ft.
Bottom Width: 0.14 ft.
Depth: 4.5 ft.
Volume at riser head: 0.0054 acre-ft.
Side slope 1: 2 To 1
Side slope 2: 2 To 1
Side slope 3: 2 To 1
Side slope 4: 2 To 1
Discharge Structure
Riser Height: 3.5 ft.
Riser Diameter: 54 in.
Notch Type: Rectangular
Notch Width: 4.500 ft.
Notch Height: 0.853 ft.
Orifice 1 Diameter: 6.898 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000	0.000	0.000	0.000
0.0500	0.000	0.000	0.279	0.000
0.1000	0.000	0.000	0.395	0.000
0.1500	0.000	0.000	0.484	0.000
0.2000	0.000	0.000	0.558	0.000
0.2500	0.000	0.000	0.624	0.000
0.3000	0.000	0.000	0.684	0.000
0.3500	0.000	0.000	0.739	0.000
0.4000	0.000	0.000	0.790	0.000
0.4500	0.000	0.000	0.838	0.000
0.5000	0.000	0.000	0.883	0.000
0.5500	0.000	0.000	0.926	0.000
0.6000	0.000	0.000	0.968	0.000
0.6500	0.000	0.000	1.007	0.000
0.7000	0.000	0.000	1.045	0.000
0.7500	0.000	0.000	1.082	0.000
0.8000	0.000	0.000	1.117	0.000
0.8500	0.000	0.000	1.152	0.000
0.9000	0.000	0.000	1.185	0.000
0.9500	0.000	0.000	1.218	0.000
1.0000	0.000	0.000	1.249	0.000
1.0500	0.000	0.000	1.280	0.000
1.1000	0.000	0.000	1.310	0.000
1.1500	0.000	0.000	1.340	0.000
1.2000	0.000	0.000	1.369	0.000
1.2500	0.000	0.000	1.397	0.000
1.3000	0.000	0.000	1.424	0.000
1.3500	0.000	0.000	1.452	0.000
1.4000	0.000	0.000	1.478	0.000
1.4500	0.000	0.000	1.504	0.000
1.5000	0.000	0.000	1.530	0.000
1.5500	0.000	0.000	1.555	0.000

1.6000	0.001	0.000	1.580	0.000
1.6500	0.001	0.000	1.605	0.000
1.7000	0.001	0.000	1.629	0.000
1.7500	0.001	0.000	1.653	0.000
1.8000	0.001	0.000	1.676	0.000
1.8500	0.001	0.000	1.699	0.000
1.9000	0.001	0.000	1.722	0.000
1.9500	0.001	0.001	1.745	0.000
2.0000	0.001	0.001	1.767	0.000
2.0500	0.001	0.001	1.789	0.000
2.1000	0.001	0.001	1.811	0.000
2.1500	0.001	0.001	1.832	0.000
2.2000	0.001	0.001	1.853	0.000
2.2500	0.001	0.001	1.874	0.000
2.3000	0.002	0.001	1.895	0.000
2.3500	0.002	0.001	1.915	0.000
2.4000	0.002	0.001	1.936	0.000
2.4500	0.002	0.001	1.956	0.000
2.5000	0.002	0.002	1.975	0.000
2.5500	0.002	0.002	1.995	0.000
2.6000	0.002	0.002	2.015	0.000
2.6500	0.002	0.002	2.037	0.000
2.7000	0.002	0.002	2.236	0.000
2.7500	0.002	0.002	2.568	0.000
2.8000	0.003	0.002	2.989	0.000
2.8500	0.003	0.002	3.481	0.000
2.9000	0.003	0.003	4.036	0.000
2.9500	0.003	0.003	4.647	0.000
3.0000	0.003	0.003	5.309	0.000
3.0500	0.003	0.003	6.017	0.000
3.1000	0.003	0.003	6.771	0.000
3.1500	0.003	0.004	7.565	0.000
3.2000	0.003	0.004	8.399	0.000
3.2500	0.004	0.004	9.271	0.000
3.3000	0.004	0.004	10.18	0.000
3.3500	0.004	0.004	11.12	0.000
3.4000	0.004	0.005	12.09	0.000
3.4500	0.004	0.005	13.10	0.000
3.5000	0.004	0.005	14.14	0.000
3.5500	0.004	0.005	14.65	0.000
3.6000	0.004	0.005	15.56	0.000
3.6500	0.005	0.006	16.74	0.000
3.7000	0.005	0.006	18.13	0.000
3.7500	0.005	0.006	19.70	0.000
3.8000	0.005	0.006	21.44	0.000
3.8500	0.005	0.007	23.33	0.000
3.9000	0.005	0.007	25.36	0.000
3.9500	0.005	0.007	27.52	0.000
4.0000	0.006	0.008	29.80	0.000
4.0500	0.006	0.008	32.19	0.000
4.1000	0.006	0.008	34.70	0.000
4.1500	0.006	0.009	37.32	0.000
4.2000	0.006	0.009	40.03	0.000
4.2500	0.006	0.009	42.85	0.000
4.3000	0.006	0.010	45.75	0.000
4.3500	0.007	0.010	48.75	0.000
4.4000	0.007	0.010	51.84	0.000
4.4500	0.007	0.011	55.02	0.000

4.5000	0.007	0.011	58.28	0.000
4.5500	0.007	0.011	61.62	0.000

Bioretention 1

Bottom Length:	86.60 ft.
Bottom Width:	86.60 ft.
Material thickness of first layer:	1.5
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (ft):	0.5
Orifice Diameter (in):	5.9
Offset (in):	0
Flow Through Underdrain (ac-ft):	346.672
Total Outflow (ac-ft):	363.931
Percent Through Underdrain:	95.26
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	8 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.
Element Flows To:	
Outlet 1	Outlet 2
Trapezoidal Pond 1	

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
711.00	0.1921	0.0000	0.0000	0.0000
711.06	0.1919	0.0022	0.0000	0.0000
711.12	0.1914	0.0044	0.0000	0.0000
711.18	0.1910	0.0066	0.0022	0.0000
711.24	0.1905	0.0088	0.0052	0.0000
711.30	0.1900	0.0110	0.0101	0.0000
711.36	0.1895	0.0132	0.0171	0.0000
711.42	0.1890	0.0154	0.0266	0.0000
711.48	0.1886	0.0199	0.0387	0.0000
711.54	0.1881	0.0244	0.0537	0.0000
711.60	0.1876	0.0289	0.0625	0.0000
711.66	0.1871	0.0334	0.0930	0.0000
711.73	0.1866	0.0379	0.1049	0.0000
711.79	0.1861	0.0424	0.1313	0.0000
711.85	0.1857	0.0469	0.1615	0.0000
711.91	0.1852	0.0515	0.1770	0.0000
711.97	0.1847	0.0560	0.2334	0.0000
712.03	0.1842	0.0606	0.2411	0.0000
712.09	0.1837	0.0652	0.2908	0.0000
712.15	0.1833	0.0698	0.3218	0.0000
712.21	0.1828	0.0744	0.3328	0.0000
712.27	0.1823	0.0790	0.3700	0.0000
712.33	0.1818	0.0837	0.4036	0.0000
712.39	0.1813	0.0883	0.4345	0.0000
712.45	0.1808	0.0930	0.4633	0.0000
712.51	0.1804	0.0976	0.4903	0.0000
712.57	0.1799	0.1022	0.5160	0.0000
712.63	0.1794	0.1068	0.5403	0.0000

712.69	0.1789	0.1115	0.5636	0.0000
712.75	0.1784	0.1162	0.5860	0.0000
712.81	0.1779	0.1208	0.6075	0.0000
712.87	0.1775	0.1255	0.6283	0.0000
712.93	0.1770	0.1302	0.6485	0.0000
712.99	0.1765	0.1349	0.6680	0.0000
713.05	0.1760	0.1397	0.6869	0.0000
713.12	0.1755	0.1444	0.7120	0.0000
713.18	0.1751	0.1491	0.7472	0.0000
713.24	0.1746	0.1539	0.7809	0.0000
713.30	0.1741	0.1587	0.8133	0.0000
713.36	0.1736	0.1635	0.8447	0.0000
713.42	0.1731	0.1682	0.8754	0.0000
713.48	0.1726	0.1731	0.8885	0.0000
713.50	0.1722	0.1748	0.8767	0.0000

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended()cfs)	Infilt(cfs)
2.5000	0.1921	0.1748	0.0000	0.9243	0.0000
2.5604	0.1926	0.1864	0.0000	0.9243	0.0000
2.6209	0.1931	0.1981	0.0000	0.9601	0.0000
2.6813	0.1935	0.2098	0.0000	0.9959	0.0000
2.7418	0.1940	0.2215	0.0000	1.0317	0.0000
2.8022	0.1945	0.2332	0.0000	1.0675	0.0000
2.8626	0.1950	0.2450	0.0000	1.1033	0.0000
2.9231	0.1955	0.2568	0.0000	1.1391	0.0000
2.9835	0.1960	0.2686	0.0000	1.1749	0.0000
3.0440	0.1964	0.2805	0.0000	1.2107	0.0000
3.1044	0.1969	0.2924	0.0000	1.2465	0.0000
3.1648	0.1974	0.3043	0.0000	1.2823	0.0000
3.2253	0.1979	0.3162	0.0000	1.3181	0.0000
3.2857	0.1984	0.3282	0.0000	1.3539	0.0000
3.3462	0.1989	0.3402	0.0000	1.3897	0.0000
3.4066	0.1993	0.3522	0.0000	1.4255	0.0000
3.4670	0.1998	0.3643	0.0000	1.4613	0.0000
3.5275	0.2003	0.3764	0.0296	1.4971	0.0000
3.5879	0.2008	0.3885	0.1692	1.5329	0.0000
3.6484	0.2013	0.4007	0.3710	1.5687	0.0000
3.7088	0.2017	0.4128	0.6194	1.6045	0.0000
3.7692	0.2022	0.4251	0.9070	1.6403	0.0000
3.8297	0.2027	0.4373	1.2290	1.6761	0.0000
3.8901	0.2032	0.4496	1.5820	1.7119	0.0000
3.9505	0.2037	0.4619	1.9635	1.7477	0.0000
4.0110	0.2042	0.4742	2.3716	1.7835	0.0000
4.0714	0.2046	0.4865	2.8046	1.8193	0.0000
4.1319	0.2051	0.4989	3.2611	1.8551	0.0000
4.1923	0.2056	0.5113	3.7400	1.8909	0.0000
4.2527	0.2061	0.5238	4.2403	1.9267	0.0000
4.3132	0.2066	0.5362	4.7611	1.9625	0.0000
4.3736	0.2071	0.5487	5.3017	1.9983	0.0000
4.4341	0.2075	0.5613	5.8612	2.0341	0.0000
4.4945	0.2080	0.5738	6.4392	2.0699	0.0000
4.5549	0.2085	0.5864	7.0351	2.1057	0.0000
4.6154	0.2090	0.5990	7.6482	2.1415	0.0000
4.6758	0.2095	0.6117	8.2782	2.1773	0.0000
4.7363	0.2099	0.6243	8.9246	2.2131	0.0000
4.7967	0.2104	0.6371	9.5870	2.2489	0.0000
4.8571	0.2109	0.6498	10.265	2.2847	0.0000

4.9176	0.2114	0.6625	10.958	2.3205	0.0000
4.9780	0.2119	0.6753	11.667	2.3563	0.0000
5.0385	0.2124	0.6882	12.389	2.3921	0.0000
5.0989	0.2128	0.7010	13.127	2.4279	0.0000
5.1593	0.2133	0.7139	13.878	2.4637	0.0000
5.2198	0.2138	0.7268	14.643	2.4995	0.0000
5.2802	0.2143	0.7397	15.422	2.5353	0.0000
5.3407	0.2148	0.7527	16.214	2.5711	0.0000
5.4011	0.2153	0.7657	17.019	2.6069	0.0000
5.4615	0.2157	0.7787	17.837	2.6427	0.0000
5.5000	0.2160	0.7870	18.668	2.6655	0.0000

Surface retention 1

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 1

Bioretention 2

Bottom Length:	133.75 ft.
Bottom Width:	133.75 ft.
Material thickness of first layer:	1.5
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (ft):	0.5
Orifice Diameter (in):	5.9
Offset (in):	0
Flow Through Underdrain (ac-ft):	541.221
Total Outflow (ac-ft):	575.86
Percent Through Underdrain:	93.98
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	8 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.

Element Flows To:
Outlet 1 Outlet 2
Trapezoidal Pond 1

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
690.00	0.4415	0.0000	0.0000	0.0000
690.05	0.4411	0.0047	0.0000	0.0000
690.11	0.4404	0.0095	0.0000	0.0000
690.16	0.4398	0.0143	0.0000	0.0000
690.22	0.4391	0.0190	0.0043	0.0000
690.27	0.4384	0.0238	0.0100	0.0000
690.33	0.4377	0.0286	0.0193	0.0000
690.38	0.4371	0.0334	0.0325	0.0000
690.44	0.4364	0.0382	0.0504	0.0000
690.49	0.4357	0.0430	0.0732	0.0000
690.55	0.4350	0.0478	0.1013	0.0000
690.60	0.4344	0.0526	0.1353	0.0000
690.66	0.4337	0.0574	0.1753	0.0000
690.71	0.4330	0.0671	0.2201	0.0000
690.77	0.4323	0.0768	0.2694	0.0000
690.82	0.4317	0.0865	0.3042	0.0000
690.88	0.4310	0.0962	0.3106	0.0000
690.93	0.4303	0.1059	0.3468	0.0000
690.99	0.4296	0.1157	0.3794	0.0000
691.04	0.4289	0.1255	0.4094	0.0000
691.10	0.4283	0.1352	0.4372	0.0000
691.15	0.4276	0.1450	0.4633	0.0000
691.21	0.4269	0.1549	0.4879	0.0000
691.26	0.4262	0.1647	0.5114	0.0000
691.32	0.4256	0.1745	0.5338	0.0000
691.37	0.4249	0.1844	0.5553	0.0000
691.43	0.4242	0.1943	0.5760	0.0000
691.48	0.4235	0.2041	0.5959	0.0000

691.54	0.4229	0.2139	0.6152	0.0000
691.59	0.4222	0.2237	0.6339	0.0000
691.65	0.4215	0.2336	0.6521	0.0000
691.70	0.4208	0.2434	0.6697	0.0000
691.76	0.4201	0.2532	0.6869	0.0000
691.81	0.4195	0.2631	0.7037	0.0000
691.87	0.4188	0.2730	0.7201	0.0000
691.92	0.4181	0.2829	0.7362	0.0000
691.98	0.4174	0.2928	0.7519	0.0000
692.03	0.4168	0.3027	0.7673	0.0000
692.09	0.4161	0.3127	0.7824	0.0000
692.14	0.4154	0.3226	0.7973	0.0000
692.20	0.4147	0.3326	0.8119	0.0000
692.25	0.4141	0.3426	0.8263	0.0000
692.31	0.4134	0.3526	0.8405	0.0000
692.36	0.4127	0.3626	0.8545	0.0000
692.42	0.4120	0.3727	0.8740	0.0000
692.47	0.4114	0.3827	0.9137	0.0000
692.50	0.4107	0.3877	0.9205	0.0000

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended()cfs)	Infilt(cfs)
2.5000	0.4415	0.3877	0.0000	2.1970	0.0000
2.5549	0.4421	0.4120	0.0000	2.1970	0.0000
2.6099	0.4428	0.4363	0.0000	2.2747	0.0000
2.6648	0.4435	0.4607	0.0000	2.3523	0.0000
2.7198	0.4442	0.4851	0.0000	2.4299	0.0000
2.7747	0.4448	0.5095	0.0000	2.5076	0.0000
2.8297	0.4455	0.5339	0.0000	2.5852	0.0000
2.8846	0.4462	0.5584	0.0000	2.6628	0.0000
2.9396	0.4469	0.5830	0.0000	2.7405	0.0000
2.9945	0.4476	0.6075	0.0000	2.8181	0.0000
3.0495	0.4482	0.6322	0.0714	2.8957	0.0000
3.1044	0.4489	0.6568	0.2190	2.9734	0.0000
3.1593	0.4496	0.6815	0.4130	3.0510	0.0000
3.2143	0.4503	0.7062	0.6440	3.1286	0.0000
3.2692	0.4509	0.7310	0.9070	3.2063	0.0000
3.3242	0.4516	0.7558	1.1984	3.2839	0.0000
3.3791	0.4523	0.7806	1.5156	3.3615	0.0000
3.4341	0.4530	0.8055	1.8568	3.4392	0.0000
3.4890	0.4536	0.8304	2.2202	3.5168	0.0000
3.5440	0.4543	0.8553	2.6048	3.5944	0.0000
3.5989	0.4550	0.8803	3.0092	3.6721	0.0000
3.6538	0.4557	0.9053	3.4327	3.7497	0.0000
3.7088	0.4564	0.9304	3.8744	3.8273	0.0000
3.7637	0.4570	0.9555	4.3335	3.9050	0.0000
3.8187	0.4577	0.9806	4.8095	3.9826	0.0000
3.8736	0.4584	1.0058	5.3017	4.0603	0.0000
3.9286	0.4591	1.0310	5.8096	4.1379	0.0000
3.9835	0.4597	1.0562	6.3328	4.2155	0.0000
4.0385	0.4604	1.0815	6.8708	4.2932	0.0000
4.0934	0.4611	1.1068	7.4233	4.3708	0.0000
4.1484	0.4618	1.1322	7.9898	4.4484	0.0000
4.2033	0.4624	1.1575	8.5700	4.5261	0.0000
4.2582	0.4631	1.1830	9.1637	4.6037	0.0000
4.3132	0.4638	1.2084	9.7704	4.6813	0.0000
4.3681	0.4645	1.2339	10.390	4.7590	0.0000
4.4231	0.4652	1.2595	11.022	4.8366	0.0000

4.4780	0.4658	1.2851	11.667	4.9142	0.0000
4.5330	0.4665	1.3107	12.323	4.9919	0.0000
4.5879	0.4672	1.3363	12.992	5.0695	0.0000
4.6429	0.4679	1.3620	13.672	5.1471	0.0000
4.6978	0.4685	1.3877	14.363	5.2248	0.0000
4.7527	0.4692	1.4135	15.066	5.3024	0.0000
4.8077	0.4699	1.4393	15.780	5.3800	0.0000
4.8626	0.4706	1.4651	16.505	5.4577	0.0000
4.9176	0.4712	1.4910	17.241	5.5353	0.0000
4.9725	0.4719	1.5169	17.987	5.6129	0.0000
5.0000	0.4723	1.5299	18.744	5.6517	0.0000

Surface retention 2

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 2

Bioretention 3

Bottom Length:	119.67 ft.
Bottom Width:	119.67 ft.
Material thickness of first layer:	1.5
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (ft):	0.5
Orifice Diameter (in):	5.9
Offset (in):	0
Flow Through Underdrain (ac-ft):	494.119
Total Outflow (ac-ft):	527.694
Percent Through Underdrain:	93.64
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.
Element Flows To:	
Outlet 1	Outlet 2
Trapezoidal Pond 1	

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
656.00	0.3563	0.0000	0.0000	0.0000
656.05	0.3560	0.0038	0.0000	0.0000
656.11	0.3554	0.0076	0.0000	0.0000
656.16	0.3548	0.0114	0.0000	0.0000
656.22	0.3542	0.0152	0.0034	0.0000
656.27	0.3536	0.0191	0.0080	0.0000
656.33	0.3530	0.0229	0.0154	0.0000
656.38	0.3524	0.0267	0.0261	0.0000
656.44	0.3518	0.0306	0.0403	0.0000
656.49	0.3512	0.0344	0.0586	0.0000
656.55	0.3506	0.0383	0.0811	0.0000
656.60	0.3500	0.0460	0.1083	0.0000
656.66	0.3493	0.0538	0.1403	0.0000
656.71	0.3487	0.0615	0.1775	0.0000
656.77	0.3481	0.0693	0.2201	0.0000
656.82	0.3475	0.0771	0.2684	0.0000
656.88	0.3469	0.0849	0.2694	0.0000
656.93	0.3463	0.0927	0.3106	0.0000
656.99	0.3457	0.1005	0.3468	0.0000
657.04	0.3451	0.1084	0.3794	0.0000
657.10	0.3445	0.1162	0.4094	0.0000
657.15	0.3439	0.1241	0.4372	0.0000
657.21	0.3433	0.1320	0.4633	0.0000
657.26	0.3427	0.1399	0.4879	0.0000
657.32	0.3421	0.1478	0.5114	0.0000
657.37	0.3415	0.1558	0.5338	0.0000
657.43	0.3409	0.1637	0.5553	0.0000
657.48	0.3403	0.1717	0.5760	0.0000

657.54	0.3397	0.1795	0.5959	0.0000
657.59	0.3391	0.1874	0.6152	0.0000
657.65	0.3384	0.1953	0.6339	0.0000
657.70	0.3378	0.2032	0.6521	0.0000
657.76	0.3372	0.2112	0.6697	0.0000
657.81	0.3366	0.2191	0.6869	0.0000
657.87	0.3360	0.2271	0.7037	0.0000
657.92	0.3354	0.2350	0.7201	0.0000
657.98	0.3348	0.2430	0.7362	0.0000
658.03	0.3342	0.2510	0.7519	0.0000
658.09	0.3336	0.2590	0.7673	0.0000
658.14	0.3330	0.2671	0.7824	0.0000
658.20	0.3324	0.2751	0.7973	0.0000
658.25	0.3318	0.2832	0.8119	0.0000
658.31	0.3312	0.2912	0.8263	0.0000
658.36	0.3306	0.2993	0.8461	0.0000
658.42	0.3300	0.3074	0.8740	0.0000
658.47	0.3294	0.3155	0.9137	0.0000
658.50	0.3288	0.3196	0.9205	0.0000

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended()cfs)	Infilt(cfs)
2.5000	0.3563	0.3196	0.0000	1.7588	0.0000
2.5549	0.3569	0.3392	0.0000	1.7588	0.0000
2.6099	0.3575	0.3588	0.0000	1.8210	0.0000
2.6648	0.3581	0.3785	0.0000	1.8831	0.0000
2.7198	0.3587	0.3982	0.0000	1.9453	0.0000
2.7747	0.3593	0.4179	0.0000	2.0074	0.0000
2.8297	0.3599	0.4377	0.0000	2.0696	0.0000
2.8846	0.3605	0.4575	0.0000	2.1317	0.0000
2.9396	0.3612	0.4773	0.0000	2.1939	0.0000
2.9945	0.3618	0.4971	0.0000	2.2560	0.0000
3.0495	0.3624	0.5170	0.1071	2.3182	0.0000
3.1044	0.3630	0.5370	0.3285	2.3803	0.0000
3.1593	0.3636	0.5569	0.6194	2.4425	0.0000
3.2143	0.3642	0.5769	0.9661	2.5046	0.0000
3.2692	0.3648	0.5969	1.3605	2.5668	0.0000
3.3242	0.3654	0.6170	1.7976	2.6289	0.0000
3.3791	0.3660	0.6371	2.2734	2.6911	0.0000
3.4341	0.3666	0.6572	2.7851	2.7532	0.0000
3.4890	0.3672	0.6774	3.3304	2.8153	0.0000
3.5440	0.3678	0.6976	3.9071	2.8775	0.0000
3.5989	0.3684	0.7178	4.5138	2.9396	0.0000
3.6538	0.3690	0.7381	5.1491	3.0018	0.0000
3.7088	0.3696	0.7584	5.8115	3.0639	0.0000
3.7637	0.3702	0.7787	6.5002	3.1261	0.0000
3.8187	0.3708	0.7990	7.2142	3.1882	0.0000
3.8736	0.3715	0.8194	7.9525	3.2504	0.0000
3.9286	0.3721	0.8399	8.7144	3.3125	0.0000
3.9835	0.3727	0.8603	9.4992	3.3747	0.0000
4.0385	0.3733	0.8808	10.306	3.4368	0.0000
4.0934	0.3739	0.9013	11.135	3.4990	0.0000
4.1484	0.3745	0.9219	11.985	3.5611	0.0000
4.2033	0.3751	0.9425	12.855	3.6233	0.0000
4.2582	0.3757	0.9631	13.745	3.6854	0.0000
4.3132	0.3763	0.9838	14.656	3.7476	0.0000
4.3681	0.3769	1.0045	15.585	3.8097	0.0000
4.4231	0.3775	1.0252	16.533	3.8719	0.0000

4.4780	0.3781	1.0459	17.500	3.9340	0.0000
4.5330	0.3787	1.0667	18.485	3.9962	0.0000
4.5879	0.3793	1.0876	19.487	4.0583	0.0000
4.6429	0.3799	1.1084	20.508	4.1205	0.0000
4.6978	0.3805	1.1293	21.545	4.1826	0.0000
4.7527	0.3811	1.1502	22.599	4.2448	0.0000
4.8077	0.3817	1.1712	23.670	4.3069	0.0000
4.8626	0.3824	1.1922	24.758	4.3691	0.0000
4.9176	0.3830	1.2132	25.861	4.4312	0.0000
4.9725	0.3836	1.2343	26.980	4.4934	0.0000
5.0000	0.3839	1.2448	28.116	4.5244	0.0000

Surface retention 3

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 3

Bioretention 4

Bottom Length:	147.04 ft.
Bottom Width:	147.04 ft.
Material thickness of first layer:	1.5
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (ft):	0.5
Orifice Diameter (in):	5.9
Offset (in):	0
Flow Through Underdrain (ac-ft):	742.428
Total Outflow (ac-ft):	817.927
Percent Through Underdrain:	90.77
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	18 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.

Element Flows To:
Outlet 1 Outlet 2
Trapezoidal Pond 1

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
636.00	0.5302	0.0000	0.0000	0.0000
636.06	0.5299	0.0057	0.0000	0.0000
636.11	0.5291	0.0115	0.0000	0.0000
636.17	0.5284	0.0173	0.0000	0.0000
636.22	0.5276	0.0230	0.0000	0.0000
636.28	0.5269	0.0288	0.0000	0.0000
636.33	0.5262	0.0346	0.0000	0.0000
636.39	0.5254	0.0404	0.0000	0.0000
636.44	0.5247	0.0462	0.0000	0.0000
636.50	0.5239	0.0520	0.0000	0.0000
636.55	0.5232	0.0578	0.0000	0.0000
636.61	0.5224	0.0636	0.0000	0.0000
636.66	0.5217	0.0695	0.0000	0.0000
636.72	0.5209	0.0753	0.0000	0.0000
636.77	0.5202	0.0870	0.0000	0.0000
636.83	0.5194	0.0988	0.0000	0.0000
636.88	0.5187	0.1105	0.0000	0.0000
636.94	0.5180	0.1223	0.0000	0.0000
636.99	0.5172	0.1340	0.0000	0.0000
637.05	0.5165	0.1458	0.0000	0.0000
637.10	0.5157	0.1577	0.0000	0.0000
637.16	0.5150	0.1695	0.0000	0.0000
637.21	0.5142	0.1813	0.0000	0.0000
637.27	0.5135	0.1932	0.0000	0.0000
637.32	0.5127	0.2051	0.0000	0.0000
637.38	0.5120	0.2170	0.0000	0.0000
637.43	0.5113	0.2289	0.0000	0.0000
637.49	0.5105	0.2408	0.0000	0.0000

637.54	0.5098	0.2526	0.0000	0.0000
637.60	0.5090	0.2645	0.0000	0.0000
637.65	0.5083	0.2763	0.0000	0.0000
637.71	0.5075	0.2882	0.0000	0.0000
637.76	0.5068	0.3000	0.0000	0.0000
637.82	0.5060	0.3119	0.0000	0.0000
637.87	0.5053	0.3239	0.0000	0.0000
637.93	0.5045	0.3358	0.0000	0.0000
637.98	0.5038	0.3477	0.0000	0.0000
638.04	0.5031	0.3597	0.0000	0.0000
638.09	0.5023	0.3717	0.0000	0.0000
638.15	0.5016	0.3837	0.0000	0.0000
638.20	0.5008	0.3957	0.0000	0.0000
638.26	0.5001	0.4077	0.0000	0.0000
638.31	0.4993	0.4198	0.0000	0.0000
638.37	0.4986	0.4318	0.0000	0.0000
638.42	0.4978	0.4439	0.0000	0.0000
638.48	0.4971	0.4560	0.0000	0.0000
638.50	0.4963	0.4609	0.0000	0.0000

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended()cfs)	Infilt(cfs)
2.5000	0.5302	0.4609	0.0000	2.6555	0.0000
2.5551	0.5309	0.4902	0.0000	2.6555	0.0000
2.6101	0.5317	0.5194	0.0000	2.7495	0.0000
2.6652	0.5324	0.5487	0.0000	2.8436	0.0000
2.7202	0.5332	0.5780	0.0052	2.9376	0.0000
2.7753	0.5339	0.6074	0.0122	3.0316	0.0000
2.8303	0.5347	0.6368	0.0234	3.1256	0.0000
2.8854	0.5354	0.6663	0.0395	3.2196	0.0000
2.9404	0.5362	0.6958	0.0612	3.3136	0.0000
2.9955	0.5369	0.7253	0.0889	3.4077	0.0000
3.0505	0.5376	0.7549	0.1231	3.5017	0.0000
3.1056	0.5384	0.7845	0.1643	3.5957	0.0000
3.1607	0.5391	0.8142	0.2129	3.6897	0.0000
3.2157	0.5399	0.8439	0.2205	3.7837	0.0000
3.2708	0.5406	0.8736	0.2698	3.8777	0.0000
3.3258	0.5414	0.9034	0.3111	3.9718	0.0000
3.3809	0.5421	0.9332	0.3473	4.0658	0.0000
3.4359	0.5429	0.9631	0.3799	4.1598	0.0000
3.4910	0.5436	0.9930	0.4099	4.2538	0.0000
3.5460	0.5444	1.0230	0.4377	4.3478	0.0000
3.6011	0.5451	1.0529	0.4638	4.4418	0.0000
3.6562	0.5458	1.0830	0.4885	4.5359	0.0000
3.7112	0.5466	1.1131	0.5120	4.6299	0.0000
3.7663	0.5473	1.1432	0.5344	4.7239	0.0000
3.8213	0.5481	1.1733	0.5559	4.8179	0.0000
3.8764	0.5488	1.2035	0.5766	4.9119	0.0000
3.9314	0.5496	1.2338	0.5966	5.0059	0.0000
3.9865	0.5503	1.2640	0.6159	5.1000	0.0000
4.0415	0.5511	1.2943	0.6346	5.1940	0.0000
4.0966	0.5518	1.3247	0.6528	5.2880	0.0000
4.1516	0.5526	1.3551	0.6705	5.3820	0.0000
4.2067	0.5533	1.3855	0.6877	5.4760	0.0000
4.2618	0.5540	1.4160	0.7045	5.5700	0.0000
4.3168	0.5548	1.4466	0.7209	5.6640	0.0000
4.3719	0.5555	1.4771	0.7370	5.7581	0.0000
4.4269	0.5563	1.5077	0.7527	5.8521	0.0000

4.4820	0.5570	1.5384	0.7681	5.9461	0.0000
4.5370	0.5578	1.5691	0.7833	6.0401	0.0000
4.5921	0.5585	1.5998	0.7981	6.1341	0.0000
4.6471	0.5593	1.6306	0.8128	6.2281	0.0000
4.7022	0.5600	1.6614	0.8272	6.3222	0.0000
4.7573	0.5608	1.6922	0.8414	6.4162	0.0000
4.8123	0.5615	1.7231	0.8554	6.5102	0.0000
4.8674	0.5623	1.7540	0.8694	6.6042	0.0000
4.9224	0.5630	1.7850	0.8834	6.6982	0.0000
4.9775	0.5637	1.8160	0.9165	6.7922	0.0000
5.0000	0.5640	1.8287	0.9217	6.8307	0.0000

Surface retention 4

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 4

Bioretention 5

Bottom Length:	123.07 ft.
Bottom Width:	123.07 ft.
Material thickness of first layer:	1.5
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (ft):	0.5
Orifice Diameter (in):	5.9
Offset (in):	0
Flow Through Underdrain (ac-ft):	494.855
Total Outflow (ac-ft):	646.905
Percent Through Underdrain:	76.5
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	24 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.
Element Flows To:	
Outlet 1	Outlet 2
Trapezoidal Pond 1	

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
636.00	0.3760	0.0000	0.0000	0.0000
636.06	0.3758	0.0040	0.0000	0.0000
636.11	0.3751	0.0081	0.0000	0.0000
636.17	0.3745	0.0121	0.0000	0.0000
636.22	0.3739	0.0161	0.0036	0.0000
636.28	0.3733	0.0202	0.0085	0.0000
636.33	0.3726	0.0242	0.0164	0.0000
636.39	0.3720	0.0283	0.0277	0.0000
636.44	0.3714	0.0324	0.0429	0.0000
636.50	0.3708	0.0365	0.0622	0.0000
636.55	0.3701	0.0406	0.0862	0.0000
636.61	0.3695	0.0447	0.1151	0.0000
636.66	0.3689	0.0529	0.1491	0.0000
636.72	0.3683	0.0611	0.1887	0.0000
636.77	0.3676	0.0693	0.2205	0.0000
636.83	0.3670	0.0776	0.2698	0.0000
636.88	0.3664	0.0858	0.3111	0.0000
636.94	0.3658	0.0941	0.3427	0.0000
636.99	0.3652	0.1024	0.3473	0.0000
637.05	0.3645	0.1107	0.3799	0.0000
637.10	0.3639	0.1190	0.4099	0.0000
637.16	0.3633	0.1274	0.4377	0.0000
637.21	0.3627	0.1357	0.4638	0.0000
637.27	0.3620	0.1441	0.4885	0.0000
637.32	0.3614	0.1525	0.5120	0.0000
637.38	0.3608	0.1608	0.5344	0.0000
637.43	0.3602	0.1693	0.5559	0.0000
637.49	0.3595	0.1777	0.5766	0.0000

637.54	0.3589	0.1860	0.5966	0.0000
637.60	0.3583	0.1944	0.6159	0.0000
637.65	0.3577	0.2027	0.6346	0.0000
637.71	0.3570	0.2111	0.6528	0.0000
637.76	0.3564	0.2195	0.6705	0.0000
637.82	0.3558	0.2279	0.6877	0.0000
637.87	0.3552	0.2363	0.7045	0.0000
637.93	0.3545	0.2448	0.7209	0.0000
637.98	0.3539	0.2532	0.7370	0.0000
638.04	0.3533	0.2617	0.7527	0.0000
638.09	0.3527	0.2702	0.7681	0.0000
638.15	0.3521	0.2786	0.7833	0.0000
638.20	0.3514	0.2871	0.7981	0.0000
638.26	0.3508	0.2957	0.8128	0.0000
638.31	0.3502	0.3042	0.8272	0.0000
638.37	0.3496	0.3128	0.8485	0.0000
638.42	0.3489	0.3213	0.8765	0.0000
638.48	0.3483	0.3299	0.9165	0.0000
638.50	0.3477	0.3334	0.9217	0.0000

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended()cfs)	Infilt(cfs)
2.5000	0.3760	0.3334	0.0000	1.8602	0.0000
2.5551	0.3766	0.3541	0.0000	1.8602	0.0000
2.6101	0.3773	0.3749	0.0000	1.9260	0.0000
2.6652	0.3779	0.3957	0.0000	1.9919	0.0000
2.7202	0.3785	0.4165	0.0000	2.0578	0.0000
2.7753	0.3791	0.4373	0.0000	2.1236	0.0000
2.8303	0.3798	0.4582	0.0000	2.1895	0.0000
2.8854	0.3804	0.4792	0.0000	2.2553	0.0000
2.9404	0.3810	0.5001	0.0000	2.3212	0.0000
2.9955	0.3816	0.5211	0.0000	2.3871	0.0000
3.0505	0.3823	0.5421	0.2214	2.4529	0.0000
3.1056	0.3829	0.5632	0.6684	2.5188	0.0000
3.1607	0.3835	0.5843	1.2543	2.5846	0.0000
3.2157	0.3841	0.6054	1.9515	2.6505	0.0000
3.2708	0.3848	0.6266	2.7444	2.7163	0.0000
3.3258	0.3854	0.6478	3.6226	2.7822	0.0000
3.3809	0.3860	0.6690	4.5785	2.8481	0.0000
3.4359	0.3866	0.6903	5.6063	2.9139	0.0000
3.4910	0.3872	0.7116	6.7012	2.9798	0.0000
3.5460	0.3879	0.7329	7.8593	3.0456	0.0000
3.6011	0.3885	0.7543	9.0774	3.1115	0.0000
3.6562	0.3891	0.7757	10.353	3.1773	0.0000
3.7112	0.3897	0.7972	11.683	3.2432	0.0000
3.7663	0.3904	0.8186	13.065	3.3091	0.0000
3.8213	0.3910	0.8401	14.498	3.3749	0.0000
3.8764	0.3916	0.8617	15.980	3.4408	0.0000
3.9314	0.3922	0.8833	17.509	3.5066	0.0000
3.9865	0.3929	0.9049	19.084	3.5725	0.0000
4.0415	0.3935	0.9265	20.704	3.6383	0.0000
4.0966	0.3941	0.9482	22.367	3.7042	0.0000
4.1516	0.3947	0.9699	24.073	3.7701	0.0000
4.2067	0.3954	0.9917	25.819	3.8359	0.0000
4.2618	0.3960	1.0135	27.606	3.9018	0.0000
4.3168	0.3966	1.0353	29.433	3.9676	0.0000
4.3719	0.3972	1.0571	31.298	4.0335	0.0000
4.4269	0.3979	1.0790	33.201	4.0994	0.0000

4.4820	0.3985	1.1009	35.140	4.1652	0.0000
4.5370	0.3991	1.1229	37.117	4.2311	0.0000
4.5921	0.3997	1.1449	39.129	4.2969	0.0000
4.6471	0.4004	1.1669	41.176	4.3628	0.0000
4.7022	0.4010	1.1890	43.257	4.4286	0.0000
4.7573	0.4016	1.2111	45.373	4.4945	0.0000
4.8123	0.4022	1.2332	47.522	4.5604	0.0000
4.8674	0.4029	1.2553	49.704	4.6262	0.0000
4.9224	0.4035	1.2775	51.918	4.6921	0.0000
4.9775	0.4041	1.2998	54.164	4.7579	0.0000
5.0000	0.4044	1.3089	56.442	4.7849	0.0000

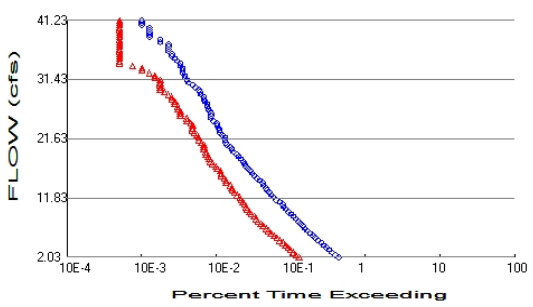
Surface retention 5

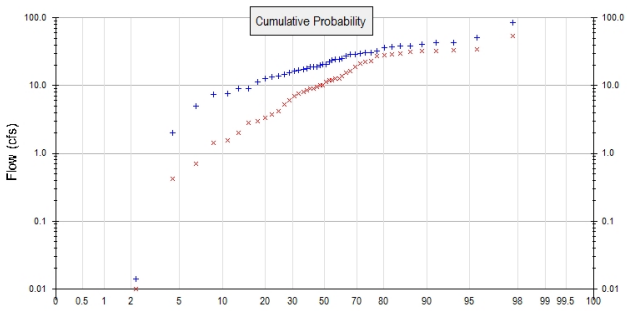
Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 5

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 79.4
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 23.82
Total Impervious Area: 55.57

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	20.3285
5 year	35.18367
10 year	41.234191
25 year	53.477543

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	10.1505
5 year	27.814574
10 year	32.408617
25 year	35.565978

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1960	17.149	6.055
1961	12.585	2.816
1962	20.402	8.417
1963	22.351	19.016
1964	28.866	28.615
1965	16.979	9.108
1966	14.682	1.995
1967	83.915	54.198
1968	30.435	27.975
1969	28.686	21.409
1970	24.510	10.031
1971	24.900	12.147
1972	2.026	1.547
1973	50.579	32.774

1974	38.176	15.450
1975	18.835	7.662
1976	0.009	0.000
1977	0.014	0.000
1978	26.896	6.963
1979	30.367	9.131
1980	20.329	11.428
1981	13.390	3.332
1982	42.759	31.574
1983	32.361	22.414
1984	18.613	8.033
1985	11.256	3.714
1986	40.421	33.633
1987	13.865	10.151
1988	7.376	0.420
1989	7.711	1.436
1990	18.603	12.587
1991	15.324	9.434
1992	17.902	12.666
1993	20.106	16.309
1994	8.946	2.991
1995	35.968	29.672
1996	42.794	32.214
1997	23.663	12.128
1998	38.309	22.708
1999	24.560	4.214
2000	16.374	13.934
2001	4.922	5.317
2002	9.150	0.693
2003	29.805	27.236
2004	37.658	33.792

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	83.9154	54.1980
2	50.5787	33.7915
3	42.7938	33.6331
4	42.7593	32.7739
5	40.4208	32.2138
6	38.3093	31.5739
7	38.1755	29.6722
8	37.6577	28.6147
9	35.9678	27.9754
10	32.3608	27.2356
11	30.4347	22.7082
12	30.3667	22.4135
13	29.8046	21.4093
14	28.8661	19.0156
15	28.6861	16.3085
16	26.8959	15.4498
17	24.9000	13.9338
18	24.5596	12.6662
19	24.5096	12.5872
20	23.6634	12.1467
21	22.3506	12.1280
22	20.4021	11.4276
23	20.3285	10.1505

24	20.1058	10.0313
25	18.8348	9.4337
26	18.6134	9.1313
27	18.6034	9.1083
28	17.9024	8.4167
29	17.1489	8.0328
30	16.9793	7.6620
31	16.3739	6.9632
32	15.3237	6.0550
33	14.6818	5.3175
34	13.8654	4.2142
35	13.3898	3.7141
36	12.5853	3.3315
37	11.2560	2.9910
38	9.1501	2.8161
39	8.9459	1.9952
40	7.7115	1.5466
41	7.3757	1.4357
42	4.9224	0.6933
43	2.0257	0.4204
44	0.0139	0.0000
45	0.0092	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
2.0329	1735	509	29	Pass
2.4288	1558	464	29	Pass
2.8248	1396	421	30	Pass
3.2208	1292	389	30	Pass
3.6167	1193	363	30	Pass
4.0127	1090	337	30	Pass
4.4087	1009	313	31	Pass
4.8047	919	280	30	Pass
5.2006	837	258	30	Pass
5.5966	781	235	30	Pass
5.9926	715	215	30	Pass
6.3886	657	201	30	Pass
6.7845	614	185	30	Pass
7.1805	575	169	29	Pass
7.5765	539	157	29	Pass
7.9724	501	143	28	Pass
8.3684	461	135	29	Pass
8.7644	428	128	29	Pass
9.1604	398	117	29	Pass
9.5563	366	110	30	Pass
9.9523	345	103	29	Pass
10.3483	322	99	30	Pass
10.7443	305	95	31	Pass
11.1402	284	90	31	Pass
11.5362	253	85	33	Pass
11.9322	236	82	34	Pass
12.3282	219	75	34	Pass
12.7241	203	69	33	Pass
13.1201	192	65	33	Pass
13.5161	183	64	34	Pass
13.9120	173	61	35	Pass
14.3080	164	53	32	Pass
14.7040	151	53	35	Pass
15.1000	139	51	36	Pass
15.4959	128	46	35	Pass
15.8919	122	46	37	Pass
16.2879	112	45	40	Pass
16.6839	105	41	39	Pass
17.0798	99	39	39	Pass
17.4758	96	35	36	Pass
17.8718	91	33	36	Pass
18.2677	84	32	38	Pass
18.6637	79	31	39	Pass
19.0597	75	29	38	Pass
19.4557	67	29	43	Pass
19.8516	64	27	42	Pass
20.2476	61	27	44	Pass
20.6436	55	27	49	Pass
21.0396	53	25	47	Pass
21.4355	52	23	44	Pass
21.8315	52	23	44	Pass
22.2275	48	22	45	Pass
22.6235	45	20	44	Pass

23.0194	44	19	43	Pass
23.4154	43	19	44	Pass
23.8114	41	19	46	Pass
24.2073	40	18	45	Pass
24.6033	36	16	44	Pass
24.9993	34	16	47	Pass
25.3953	34	13	38	Pass
25.7912	34	13	38	Pass
26.1872	33	13	39	Pass
26.5832	31	12	38	Pass
26.9792	30	12	40	Pass
27.3751	30	11	36	Pass
27.7711	28	11	39	Pass
28.1671	27	10	37	Pass
28.5631	27	10	37	Pass
28.9590	25	9	36	Pass
29.3550	24	8	33	Pass
29.7510	23	7	30	Pass
30.1469	21	7	33	Pass
30.5429	19	7	36	Pass
30.9389	17	7	41	Pass
31.3349	16	7	43	Pass
31.7308	15	6	40	Pass
32.1268	15	6	40	Pass
32.5228	14	5	35	Pass
32.9188	14	4	28	Pass
33.3147	14	4	28	Pass
33.7107	13	3	23	Pass
34.1067	13	2	15	Pass
34.5026	12	2	16	Pass
34.8986	11	2	18	Pass
35.2946	10	2	20	Pass
35.6906	10	2	20	Pass
36.0865	9	2	22	Pass
36.4825	9	2	22	Pass
36.8785	9	2	22	Pass
37.2745	9	2	22	Pass
37.6704	7	2	28	Pass
38.0664	7	2	28	Pass
38.4624	5	2	40	Pass
38.8584	5	2	40	Pass
39.2543	5	2	40	Pass
39.6503	5	2	40	Pass
40.0463	5	2	40	Pass
40.4422	4	2	50	Pass
40.8382	4	2	50	Pass
41.2342	4	2	50	Pass

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

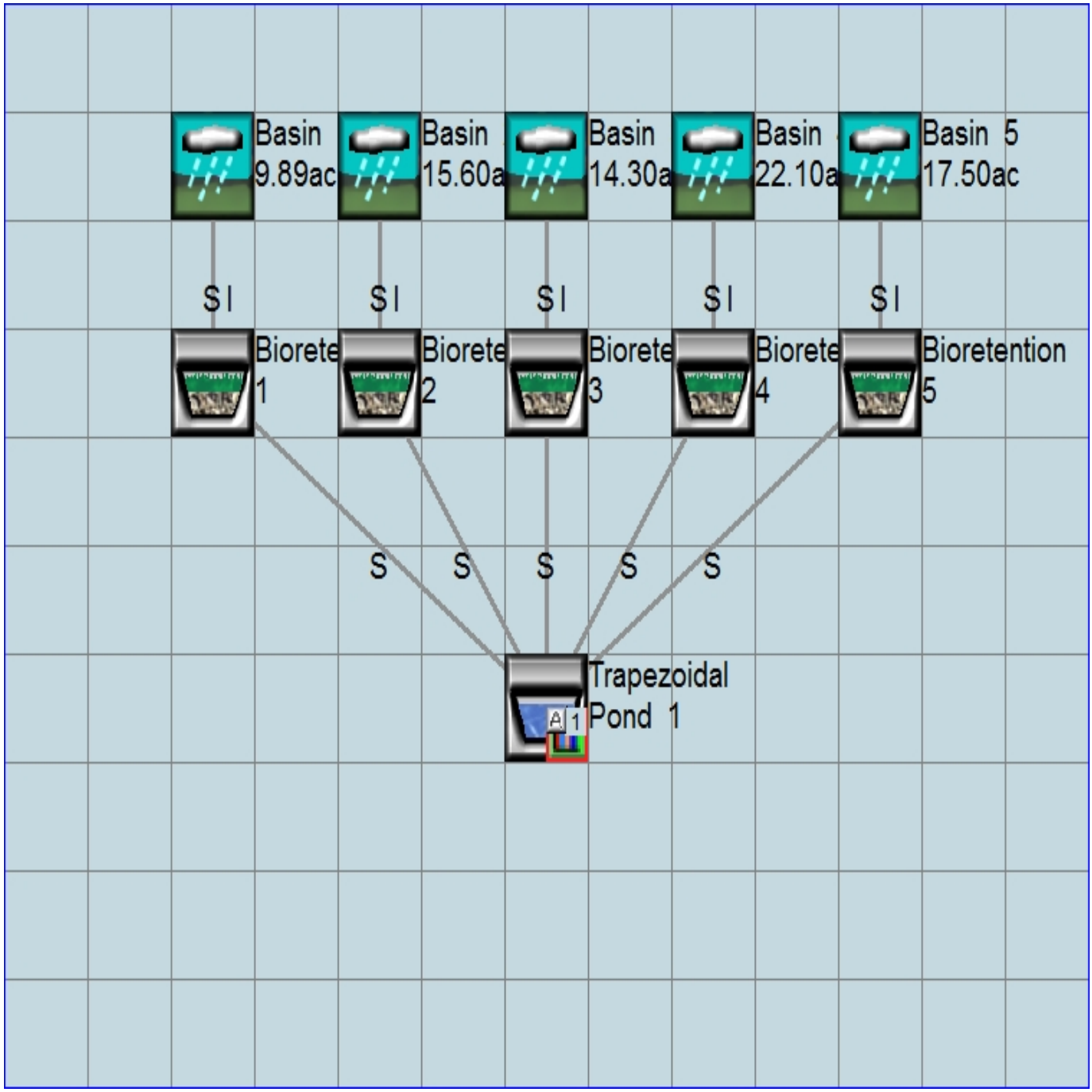
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1959 10 01        END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   19569.04.wdm
MESSU       25   Pre19569.04.MES
            27   Pre19569.04.L61
            28   Pre19569.04.L62
            30   POC19569.041.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      44
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                      in  out           ***
   44     C/D,Grass,Very(>20%)    1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   44         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   44         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   44         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   44             0       3.4     0.025       200      0.25         2      0.95
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   44            40        35         3         2      0.15      0.15         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   44             0      0.15      0.25      0.15      0.35         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   44       0.4  0.4  0.4 0.45  0.5 0.55 0.55 0.55 0.55 0.55 0.45  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   44      0.12 0.12 0.12 0.11  0.1  0.1  0.1  0.1  0.1  0.1 0.11 0.12
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   44             0         0      0.01         0       0.5       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2
```

```
  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  44                        79.4     COPY   501     12
PERLND  44                        79.4     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><---><--->
  END HYDR-INIT
END RCHRES
```

```
SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.067          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.067          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1959 10 01        END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   19569.04.wdm
MESSU       25   Mit19569.04.MES
            27   Mit19569.04.L61
            28   Mit19569.04.L62
            30   POC19569.041.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      44
      IMPLND       1
      IMPLND       3
      IMPLND       5
      IMPLND       7
      IMPLND      10
      GENER        2
      RCHRES       1
      RCHRES       2
      GENER        4
      RCHRES       3
      RCHRES       4
      GENER        6
      RCHRES       5
      RCHRES       6
      GENER        8
      RCHRES       7
      RCHRES       8
      GENER       10
      RCHRES       9
      RCHRES      10
      RCHRES      11
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
    4        24
    6        24
    8        24
```

```
   10        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
    4             0.
    6             0.
    8             0.
   10             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   44     C/D,Grass,Very(>20%)    1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   44         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   44         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   44         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   44              0       3.4     0.025       200      0.25         2      0.95
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   44             40        35         3         2      0.15      0.15         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   44              0      0.15      0.25      0.15      0.35         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   44       0.4  0.4  0.4 0.45  0.5 0.55 0.55 0.55 0.55 0.55 0.45  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   44      0.12 0.12 0.12 0.11  0.1  0.1  0.1  0.1  0.1  0.1 0.11 0.12
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   44              0         0      0.01         0       0.5       0.3      0.01
```

```
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    1     Roads,Flat(0-5%)        1    1    1   27    0
    3     Roads,Steep(10-20%)     1    1    1   27    0
    5     Roof Area               1    1    1   27    0
    7     Driveways,Mod(5-10%)    1    1    1   27    0
   10     Sidewalks,Flat(0-5%)    1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    3         0    0    1    0    0    0
    5         0    0    1    0    0    0
    7         0    0    1    0    0    0
   10         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
    3         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
    7         0    0    4    0    0    0    1    9
   10         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    3         0    0    0    0    0
    5         0    0    0    0    0
    7         0    0    0    0    0
   10         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1           100      0.05       0.1        0.1
    3           100      0.15       0.1       0.08
    5           100      0.05       0.1        0.1
    7           100       0.1       0.1       0.09
   10           100      0.05       0.1        0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
    3             0         0
    5             0         0
    7             0         0
   10             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
```

```
    1              0         0
    3              0         0
    5              0         0
    7              0         0
   10              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  44                       2.97     RCHRES   1      2
PERLND  44                       2.97     RCHRES   1      3
IMPLND   1                       1.38     RCHRES   1      5
IMPLND   3                       1.38     RCHRES   1      5
IMPLND   5                       3.61     RCHRES   1      5
IMPLND   7                       0.49     RCHRES   1      5
IMPLND  10                       0.06     RCHRES   1      5
Basin  2***
PERLND  44                       4.68     RCHRES   3      2
PERLND  44                       4.68     RCHRES   3      3
IMPLND   1                       2.18     RCHRES   3      5
IMPLND   3                       2.18     RCHRES   3      5
IMPLND   5                       5.69     RCHRES   3      5
IMPLND   7                       0.77     RCHRES   3      5
IMPLND  10                        0.1     RCHRES   3      5
Basin  3***
PERLND  44                       4.29     RCHRES   5      2
PERLND  44                       4.29     RCHRES   5      3
IMPLND   1                          2     RCHRES   5      5
IMPLND   3                          2     RCHRES   5      5
IMPLND   5                       5.22     RCHRES   5      5
IMPLND   7                        0.7     RCHRES   5      5
IMPLND  10                       0.09     RCHRES   5      5
Basin  4***
PERLND  44                       6.63     RCHRES   7      2
PERLND  44                       6.63     RCHRES   7      3
IMPLND   1                       3.09     RCHRES   7      5
IMPLND   3                       3.09     RCHRES   7      5
IMPLND   5                       8.06     RCHRES   7      5
IMPLND   7                       1.09     RCHRES   7      5
IMPLND  10                       0.14     RCHRES   7      5
Basin  5***
PERLND  44                       5.25     RCHRES   9      2
PERLND  44                       5.25     RCHRES   9      3
IMPLND   1                       2.45     RCHRES   9      5
IMPLND   3                       2.45     RCHRES   9      5
IMPLND   5                       6.38     RCHRES   9      5
IMPLND   7                       0.86     RCHRES   9      5
IMPLND  10                       0.11     RCHRES   9      5

******Routing******
RCHRES   1                          1     RCHRES  11      7
RCHRES   1                                COPY     1     17
RCHRES   1                          1     RCHRES   2      8
RCHRES   3                          1     RCHRES  11      7
RCHRES   3                                COPY     1     17
RCHRES   3                          1     RCHRES   4      8
RCHRES   5                          1     RCHRES  11      7
RCHRES   5                                COPY     1     17
RCHRES   5                          1     RCHRES   6      8
RCHRES   7                          1     RCHRES  11      7
RCHRES   7                                COPY     1     17
RCHRES   7                          1     RCHRES   8      8
RCHRES   9                          1     RCHRES  11      7
RCHRES   9                                COPY     1     17
RCHRES   9                          1     RCHRES  10      8
RCHRES  11                          1     COPY   501     16
```

```
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0002778     RCHRES   1     EXTNL  OUTDGT 1
GENER    4 OUTPUT TIMSER      .0002778     RCHRES   3     EXTNL  OUTDGT 1
GENER    6 OUTPUT TIMSER      .0002778     RCHRES   5     EXTNL  OUTDGT 1
GENER    8 OUTPUT TIMSER      .0002778     RCHRES   7     EXTNL  OUTDGT 1
GENER   10 OUTPUT TIMSER      .0002778     RCHRES   9     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<-----------------><---> User T-series  Engl Metr LKFG            ***
                                       in  out                               ***
    1     Surface retentio-010    3    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
    3     Surface retentio-016    3    1    1    1   28    0    1
    4     Bioretention  2         1    1    1    1   28    0    1
    5     Surface retentio-018    3    1    1    1   28    0    1
    6     Bioretention  3         1    1    1    1   28    0    1
    7     Surface retentio-020    3    1    1    1   28    0    1
    8     Bioretention  4         1    1    1    1   28    0    1
    9     Surface retentio-022    3    1    1    1   28    0    1
   10     Bioretention  5         1    1    1    1   28    0    1
   11     Trapezoidal Pond-008    1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
    6         1    0    0    0    0    0    0    0    0    0
    7         1    0    0    0    0    0    0    0    0    0
    8         1    0    0    0    0    0    0    0    0    0
    9         1    0    0    0    0    0    0    0    0    0
   10         1    0    0    0    0    0    0    0    0    0
   11         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
    6         4    0    0    0    0    0    0    0    0    0    1    9
    7         4    0    0    0    0    0    0    0    0    0    1    9
    8         4    0    0    0    0    0    0    0    0    0    1    9
    9         4    0    0    0    0    0    0    0    0    0    1    9
   10         4    0    0    0    0    0    0    0    0    0    1    9
   11         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
```

```
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit       possible  exit
            *  *  *  *    *  *  *  *  *      *  *  *  *  *          ***
    1       0  1  0  0    4  5  6  0  0       0  1  0  0  0        2  1  2  2  2
    2       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
    3       0  1  0  0    4  5  6  0  0       0  1  0  0  0        2  1  2  2  2
    4       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
    5       0  1  0  0    4  5  6  0  0       0  1  0  0  0        2  1  2  2  2
    6       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
    7       0  1  0  0    4  5  6  0  0       0  1  0  0  0        2  1  2  2  2
    8       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
    9       0  1  0  0    4  5  6  0  0       0  1  0  0  0        2  1  2  2  2
   10       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
   11       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0     711.0       0.5       0.0
    2              2      0.02       0.0     711.0       0.5       0.0
    3              3      0.01       0.0     690.0       0.5       0.0
    4              4      0.03       0.0     690.0       0.5       0.0
    5              5      0.01       0.0     656.0       0.5       0.0
    6              6      0.02       0.0     656.0       0.5       0.0
    7              7      0.01       0.0     636.0       0.5       0.0
    8              8      0.03       0.0     636.0       0.5       0.0
    9              9      0.01       0.0     636.0       0.5       0.0
   10             10      0.02       0.0     636.0       0.5       0.0
   11             11      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  0.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3            0         4.0  0.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5            0         4.0  0.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    7            0         4.0  0.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    8            0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    9            0         4.0  0.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
   10         0            4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
   11         0            4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL              4
  UVQUAN v2m2   GLOBAL     WORKSP  1        3
  UVQUAN vpo2   GLOBAL     WORKSP  2        3
  UVQUAN v2d2   GENER    2 K       1        3
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol4   RCHRES   4 VOL              4
  UVQUAN v2m4   GLOBAL     WORKSP  3        3
  UVQUAN vpo4   GLOBAL     WORKSP  4        3
  UVQUAN v2d4   GENER    4 K       1        3
```

```
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol6   RCHRES   6 VOL              4
  UVQUAN v2m6   GLOBAL     WORKSP  5        3
  UVQUAN vpo6   GLOBAL     WORKSP  6        3
  UVQUAN v2d6   GENER    6 K       1        3
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol8   RCHRES   8 VOL              4
  UVQUAN v2m8   GLOBAL     WORKSP  7        3
  UVQUAN vpo8   GLOBAL     WORKSP  8        3
  UVQUAN v2d8   GENER    8 K       1        3
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol10  RCHRES  10 VOL              4
  UVQUAN v2m10  GLOBAL     WORKSP  9        3
  UVQUAN vpo10  GLOBAL     WORKSP 10        3
  UVQUAN v2d10  GENER   10 K       1        3
*** User-Defined Target Variable Names
***                   addr or                          addr or
***                  <------>                         <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** User-Defined Target Variable Names
***                   addr or                          addr or
***                  <------>                         <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m4    1 WORKSP  3         1.0 QUAN
  UVNAME  vpo4    1 WORKSP  4         1.0 QUAN
  UVNAME  v2d4    1 K       1         1.0 QUAN
*** User-Defined Target Variable Names
***                   addr or                          addr or
***                  <------>                         <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m6    1 WORKSP  5         1.0 QUAN
  UVNAME  vpo6    1 WORKSP  6         1.0 QUAN
  UVNAME  v2d6    1 K       1         1.0 QUAN
*** User-Defined Target Variable Names
***                   addr or                          addr or
***                  <------>                         <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m8    1 WORKSP  7         1.0 QUAN
  UVNAME  vpo8    1 WORKSP  8         1.0 QUAN
  UVNAME  v2d8    1 K       1         1.0 QUAN
*** User-Defined Target Variable Names
***                   addr or                          addr or
***                  <------>                         <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m10   1 WORKSP  9         1.0 QUAN
  UVNAME  vpo10   1 WORKSP 10         1.0 QUAN
  UVNAME  v2d10   1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   2                               v2m2            =  7161.
```

```
*** Compute remaining available pore space
  GENER   2                                 vpo2           =  v2m2
  GENER   2                                 vpo2          -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                                 vpo2           =  0.0
END IF
*** Infiltration volume
  GENER   2                                 v2d2           =  vpo2
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   4                                 v2m4           =  15837.
*** Compute remaining available pore space
  GENER   4                                 vpo4           =  v2m4
  GENER   4                                 vpo4          -=  vol4
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo4 < 0.0) THEN
  GENER   4                                 vpo4           =  0.0
END IF
*** Infiltration volume
  GENER   4                                 v2d4           =  vpo4
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   6                                 v2m6           =  13057.
*** Compute remaining available pore space
  GENER   6                                 vpo6           =  v2m6
  GENER   6                                 vpo6          -=  vol6
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo6 < 0.0) THEN
  GENER   6                                 vpo6           =  0.0
END IF
*** Infiltration volume
  GENER   6                                 v2d6           =  vpo6
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   8                                 v2m8           =  18870.
*** Compute remaining available pore space
  GENER   8                                 vpo8           =  v2m8
  GENER   8                                 vpo8          -=  vol8
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo8 < 0.0) THEN
  GENER   8                                 vpo8           =  0.0
END IF
*** Infiltration volume
  GENER   8                                 v2d8           =  vpo8
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER  10                                 v2m10          =  13652.
*** Compute remaining available pore space
  GENER  10                                 vpo10          =  v2m10
  GENER  10                                 vpo10         -=  vol10
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo10 < 0.0) THEN
  GENER  10                                 vpo10          =  0.0
END IF
*** Infiltration volume
  GENER  10                                 v2d10          =  vpo10
END SPEC-ACTIONS
FTABLES
  FTABLE     11
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.000000  0.000000  0.000000
  0.050000  0.000003  0.000000  0.279441
  0.100000  0.000007  0.000000  0.395190
  0.150000  0.000012  0.000001  0.484006
  0.200000  0.000020  0.000002  0.558882
  0.250000  0.000030  0.000003  0.624849
  0.300000  0.000041  0.000005  0.684488
```

0.350000	0.000054	0.000007	0.739332
0.400000	0.000069	0.000010	0.790379
0.450000	0.000086	0.000014	0.838324
0.500000	0.000105	0.000019	0.883671
0.550000	0.000125	0.000025	0.926802
0.600000	0.000148	0.000031	0.968013
0.650000	0.000172	0.000039	1.007540
0.700000	0.000198	0.000049	1.045573
0.750000	0.000226	0.000059	1.082271
0.800000	0.000256	0.000071	1.117765
0.850000	0.000287	0.000085	1.152166
0.900000	0.000321	0.000100	1.185569
0.950000	0.000356	0.000117	1.218056
1.000000	0.000393	0.000136	1.249699
1.050000	0.000432	0.000156	1.280560
1.100000	0.000473	0.000179	1.310695
1.150000	0.000515	0.000204	1.340153
1.200000	0.000560	0.000230	1.368977
1.250000	0.000606	0.000260	1.397206
1.300000	0.000654	0.000291	1.424876
1.350000	0.000704	0.000325	1.452019
1.400000	0.000756	0.000362	1.478664
1.450000	0.000809	0.000401	1.504837
1.500000	0.000865	0.000443	1.530562
1.550000	0.000922	0.000487	1.555863
1.600000	0.000981	0.000535	1.580758
1.650000	0.001042	0.000585	1.605267
1.700000	0.001105	0.000639	1.629408
1.750000	0.001170	0.000696	1.653196
1.800000	0.001236	0.000756	1.676647
1.850000	0.001304	0.000820	1.699774
1.900000	0.001374	0.000887	1.722591
1.950000	0.001446	0.000957	1.745110
2.000000	0.001520	0.001031	1.767341
2.050000	0.001596	0.001109	1.789297
2.100000	0.001673	0.001191	1.810986
2.150000	0.001753	0.001277	1.832418
2.200000	0.001834	0.001366	1.853603
2.250000	0.001917	0.001460	1.874548
2.300000	0.002002	0.001558	1.895262
2.350000	0.002088	0.001660	1.915752
2.400000	0.002177	0.001767	1.936025
2.450000	0.002267	0.001878	1.956088
2.500000	0.002359	0.001994	1.975948
2.550000	0.002453	0.002114	1.995609
2.600000	0.002549	0.002239	2.015079
2.650000	0.002647	0.002369	2.036979
2.700000	0.002746	0.002504	2.236947
2.750000	0.002848	0.002644	2.568636
2.800000	0.002951	0.002789	2.989033
2.850000	0.003056	0.002939	3.481559
2.900000	0.003163	0.003094	4.036505
2.950000	0.003272	0.003255	4.647276
3.000000	0.003382	0.003421	5.309013
3.050000	0.003494	0.003593	6.017941
3.100000	0.003609	0.003771	6.771018
3.150000	0.003725	0.003954	7.565723
3.200000	0.003843	0.004143	8.399925
3.250000	0.003962	0.004338	9.271788
3.300000	0.004084	0.004540	10.17971
3.350000	0.004207	0.004747	11.12228
3.400000	0.004333	0.004960	12.09825
3.450000	0.004460	0.005180	13.10647
3.500000	0.004588	0.005406	14.14594
3.550000	0.004719	0.005639	14.65256
3.600000	0.004852	0.005878	15.56498
3.650000	0.004986	0.006124	16.74154
3.700000	0.005122	0.006377	18.13168
3.750000	0.005261	0.006637	19.70618
3.800000	0.005400	0.006903	21.44534

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  3.850000  0.005542  0.007177  23.33468
  3.900000  0.005686  0.007457  25.36299
  3.950000  0.005831  0.007745  27.52126
  4.000000  0.005979  0.008041  29.80201
  4.050000  0.006128  0.008343  32.19896
  4.100000  0.006279  0.008653  34.70666
  4.150000  0.006431  0.008971  37.32040
  4.200000  0.006586  0.009297  40.03601
  4.250000  0.006742  0.009630  42.84978
  4.300000  0.006901  0.009971  45.75837
  4.350000  0.007061  0.010320  48.75876
  4.400000  0.007223  0.010677  51.84822
  4.450000  0.007387  0.011042  55.02423
  4.500000  0.007552  0.011416  58.28447
  END FTABLE 11
  FTABLE      2
   43    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.192102  0.000000  0.000000
  0.060440  0.191927  0.002188  0.000000
  0.120879  0.191445  0.004383  0.000000
  0.181319  0.190963  0.006583  0.002161
  0.241758  0.190481  0.008790  0.005196
  0.302198  0.189999  0.011002  0.010087
  0.362637  0.189517  0.013221  0.017131
  0.423077  0.189034  0.015446  0.026589
  0.483516  0.188552  0.019908  0.038695
  0.543956  0.188070  0.024383  0.053662
  0.604396  0.187588  0.028869  0.062528
  0.664835  0.187106  0.033368  0.092964
  0.725275  0.186624  0.037879  0.104874
  0.785714  0.186142  0.042402  0.131347
  0.846154  0.185660  0.046938  0.161492
  0.906593  0.185178  0.051486  0.177033
  0.967033  0.184696  0.056046  0.233415
  1.027473  0.184214  0.060618  0.241082
  1.087912  0.183732  0.065202  0.290786
  1.148352  0.183250  0.069799  0.321822
  1.208791  0.182768  0.074408  0.332840
  1.269231  0.182286  0.079029  0.369957
  1.329670  0.181804  0.083662  0.403552
  1.390110  0.181322  0.088308  0.434472
  1.450549  0.180840  0.092966  0.463274
  1.510989  0.180358  0.097580  0.490342
  1.571429  0.179876  0.102207  0.515959
  1.631868  0.179394  0.106846  0.540339
  1.692308  0.178913  0.111496  0.563647
  1.752747  0.178431  0.116159  0.586014
  1.813187  0.177949  0.120834  0.607549
  1.873626  0.177467  0.125521  0.628339
  1.934066  0.176985  0.130220  0.648459
  1.994505  0.176503  0.134931  0.667972
  2.054945  0.176021  0.139655  0.686932
  2.115385  0.175539  0.144390  0.711980
  2.175824  0.175057  0.149138  0.747224
  2.236264  0.174575  0.153897  0.780932
  2.296703  0.174094  0.158669  0.813340
  2.357143  0.173612  0.163453  0.844688
  2.417582  0.173130  0.168248  0.875377
  2.478022  0.172648  0.173056  0.888509
  2.500000  0.172166  0.367096  0.876701
  END FTABLE  2
  FTABLE      1
   51    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.172166  0.000000  0.000000  0.876701  0.000000
```

```
0.060440  0.192584  0.011625  0.000000  0.924310  0.000000
0.120879  0.193067  0.023279  0.000000  0.960111  0.000000
0.181319  0.193549  0.034963  0.000000  0.995912  0.000000
0.241758  0.194031  0.046675  0.000000  1.031712  0.000000
0.302198  0.194513  0.058417  0.000000  1.067513  0.000000
0.362637  0.194995  0.070188  0.000000  1.103314  0.000000
0.423077  0.195477  0.081988  0.000000  1.182515  0.000000
0.483516  0.195959  0.093817  0.000000  1.174915  0.000000
0.543956  0.196442  0.105675  0.000000  1.210716  0.000000
0.604396  0.196924  0.117563  0.000000  1.246517  0.000000
0.664835  0.197406  0.129479  0.000000  1.282318  0.000000
0.725275  0.197888  0.141425  0.000000  1.318118  0.000000
0.785714  0.198370  0.153400  0.000000  1.353919  0.000000
0.846154  0.198852  0.165404  0.000000  1.389720  0.000000
0.906593  0.199335  0.177437  0.000000  1.425521  0.000000
0.967033  0.199817  0.189499  0.000000  1.461321  0.000000
1.027473  0.200299  0.201591  0.029565  1.497122  0.000000
1.087912  0.200781  0.213711  0.169237  1.532923  0.000000
1.148352  0.201264  0.225861  0.370990  1.568724  0.000000
1.208791  0.201746  0.238040  0.619429  1.604524  0.000000
1.269231  0.202228  0.250248  0.907006  1.640325  0.000000
1.329670  0.202710  0.262485  1.228975  1.676126  0.000000
1.390110  0.203193  0.274751  1.581989  1.711927  0.000000
1.450549  0.203675  0.287047  1.963527  1.747727  0.000000
1.510989  0.204157  0.299371  2.371595  1.783528  0.000000
1.571429  0.204639  0.311725  2.804568  1.819329  0.000000
1.631868  0.205122  0.324108  3.261090  1.855129  0.000000
1.692308  0.205604  0.336520  3.740002  1.890930  0.000000
1.752747  0.206086  0.348961  4.240303  1.926731  0.000000
1.813187  0.206569  0.361431  4.761114  1.962532  0.000000
1.873626  0.207051  0.373931  5.301658  1.998332  0.000000
1.934066  0.207533  0.386460  5.861239  2.034133  0.000000
1.994505  0.208016  0.399017  6.439229  2.069934  0.000000
2.054945  0.208498  0.411604  7.035061  2.105735  0.000000
2.115385  0.208980  0.424220  7.648215  2.141535  0.000000
2.175824  0.209463  0.436866  8.278215  2.177336  0.000000
2.236264  0.209945  0.449540  8.924621  2.213137  0.000000
2.296703  0.210427  0.462244  9.587029  2.248938  0.000000
2.357143  0.210910  0.474976  10.26506  2.284738  0.000000
2.417582  0.211392  0.487738  10.95836  2.320539  0.000000
2.478022  0.211874  0.500529  11.66660  2.356340  0.000000
2.538462  0.212357  0.513349  12.38948  2.392141  0.000000
2.598901  0.212839  0.526199  13.12670  2.427941  0.000000
2.659341  0.213322  0.539077  13.87799  2.463742  0.000000
2.719780  0.213804  0.551985  14.64308  2.499543  0.000000
2.780220  0.214286  0.564922  15.42175  2.535344  0.000000
2.840659  0.214769  0.577888  16.21374  2.571144  0.000000
2.901099  0.215251  0.590883  17.01885  2.606945  0.000000
2.961538  0.215734  0.603907  17.83686  2.642746  0.000000
3.000000  0.216041  0.612210  18.66757  2.665528  0.000000
END FTABLE  1
FTABLE      4
 47    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.441464  0.000000  0.000000
0.054945  0.441125  0.004742  0.000000
0.109890  0.440448  0.009493  0.000000
0.164835  0.439772  0.014251  0.000000
0.219780  0.439095  0.019017  0.004251
0.274725  0.438418  0.023790  0.010013
0.329670  0.437741  0.028572  0.019258
0.384615  0.437065  0.033361  0.032547
0.439560  0.436388  0.038158  0.050370
0.494505  0.435711  0.042963  0.073166
0.549451  0.435035  0.047776  0.101339
0.604396  0.434358  0.052597  0.135264
0.659341  0.433681  0.057425  0.175290
0.714286  0.433004  0.067097  0.220074
0.769231  0.432328  0.076785  0.269392
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  0.824176  0.431651  0.086489  0.304190
  0.879121  0.430974  0.096208  0.310642
  0.934066  0.430298  0.105943  0.346817
  0.989011  0.429621  0.115693  0.379426
  1.043956  0.428944  0.125459  0.409354
  1.098901  0.428268  0.135241  0.437172
  1.153846  0.427591  0.145038  0.463274
  1.208791  0.426914  0.154851  0.487945
  1.263736  0.426238  0.164679  0.511399
  1.318681  0.425561  0.174523  0.533803
  1.373626  0.424884  0.184383  0.555286
  1.428571  0.424208  0.194258  0.575956
  1.483516  0.423531  0.204149  0.595900
  1.538462  0.422855  0.213938  0.615191
  1.593407  0.422178  0.223742  0.633890
  1.648352  0.421501  0.233561  0.652051
  1.703297  0.420825  0.243396  0.669718
  1.758242  0.420148  0.253246  0.686932
  1.813187  0.419472  0.263112  0.703729
  1.868132  0.418795  0.272993  0.720138
  1.923077  0.418118  0.282890  0.736188
  1.978022  0.417442  0.292802  0.751905
  2.032967  0.416765  0.302729  0.767312
  2.087912  0.416089  0.312672  0.782432
  2.142857  0.415412  0.322630  0.797284
  2.197802  0.414736  0.332604  0.811892
  2.252747  0.414059  0.342593  0.826276
  2.307692  0.413382  0.352598  0.840465
  2.362637  0.412706  0.362618  0.854493
  2.417582  0.412029  0.372654  0.873984
  2.472527  0.411353  0.382704  0.913660
  2.500000  0.410676  0.814245  0.920504
  END FTABLE  4
  FTABLE      3
   47    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.410676  0.000000  0.000000  0.920504  0.000000
  0.054945  0.442140  0.024275  0.000000  2.197038  0.000000
  0.109890  0.442817  0.048587  0.000000  2.274672  0.000000
  0.164835  0.443494  0.072936  0.000000  2.352306  0.000000
  0.219780  0.444171  0.097322  0.000000  2.429940  0.000000
  0.274725  0.444848  0.121746  0.000000  2.507574  0.000000
  0.329670  0.445524  0.146207  0.000000  2.585207  0.000000
  0.384615  0.446201  0.170705  0.000000  2.662841  0.000000
  0.439560  0.446878  0.195240  0.000000  2.740475  0.000000
  0.494505  0.447555  0.219812  0.000000  2.818109  0.000000
  0.549451  0.448232  0.244422  0.071397  2.895743  0.000000
  0.604396  0.448908  0.269068  0.219001  2.973377  0.000000
  0.659341  0.449585  0.293752  0.412965  3.051011  0.000000
  0.714286  0.450262  0.318473  0.644040  3.128644  0.000000
  0.769231  0.450939  0.343232  0.907006  3.206278  0.000000
  0.824176  0.451616  0.368027  1.198379  3.283912  0.000000
  0.879121  0.452293  0.392860  1.515618  3.361546  0.000000
  0.934066  0.452970  0.417730  1.856764  3.439180  0.000000
  0.989011  0.453646  0.442637  2.220246  3.516814  0.000000
  1.043956  0.454323  0.467581  2.604767  3.594448  0.000000
  1.098901  0.455000  0.492562  3.009233  3.672081  0.000000
  1.153846  0.455677  0.517581  3.432705  3.749715  0.000000
  1.208791  0.456354  0.542637  3.874366  3.827349  0.000000
  1.263736  0.457031  0.567730  4.333494  3.904983  0.000000
  1.318681  0.457708  0.592860  4.809450  3.982617  0.000000
  1.373626  0.458385  0.618027  5.301658  4.060251  0.000000
  1.428571  0.459062  0.643232  5.809598  4.137885  0.000000
  1.483516  0.459738  0.668474  6.332797  4.215519  0.000000
  1.538462  0.460415  0.693753  6.870823  4.293152  0.000000
  1.593407  0.461092  0.719069  7.423277  4.370786  0.000000
  1.648352  0.461769  0.744422  7.989792  4.448420  0.000000
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1.703297  0.462446  0.769813  8.570027  4.526054  0.000000
1.758242  0.463123  0.795240  9.163666  4.603688  0.000000
1.813187  0.463800  0.820705  9.770412  4.681322  0.000000
1.868132  0.464477  0.846207  10.38999  4.758956  0.000000
1.923077  0.465154  0.871747  11.02213  4.836589  0.000000
1.978022  0.465831  0.897323  11.66660  4.914223  0.000000
2.032967  0.466508  0.922937  12.32317  4.991857  0.000000
2.087912  0.467185  0.948588  12.99160  5.069491  0.000000
2.142857  0.467862  0.974276  13.67171  5.147125  0.000000
2.197802  0.468539  1.000001  14.36328  5.224759  0.000000
2.252747  0.469216  1.025764  15.06614  5.302393  0.000000
2.307692  0.469893  1.051563  15.78010  5.380026  0.000000
2.362637  0.470570  1.077400  16.50500  5.457660  0.000000
2.417582  0.471247  1.103274  17.24067  5.535294  0.000000
2.472527  0.471924  1.129186  17.98696  5.612928  0.000000
2.500000  0.472262  1.142155  18.74371  5.651745  0.000000
END FTABLE  3
FTABLE      6
 47    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.356310  0.000000  0.000000
0.054945  0.356007  0.003797  0.000000
0.109890  0.355401  0.007601  0.000000
0.164835  0.354796  0.011412  0.000000
0.219780  0.354190  0.015230  0.003403
0.274725  0.353585  0.019054  0.008016
0.329670  0.352979  0.022886  0.015417
0.384615  0.352374  0.026725  0.026055
0.439560  0.351768  0.030571  0.040323
0.494505  0.351163  0.034424  0.058573
0.549451  0.350557  0.038283  0.081126
0.604396  0.349952  0.046017  0.108284
0.659341  0.349346  0.053764  0.140327
0.714286  0.348741  0.061526  0.177520
0.769231  0.348135  0.069301  0.220074
0.824176  0.347530  0.077091  0.268356
0.879121  0.346924  0.084894  0.269392
0.934066  0.346319  0.092711  0.310642
0.989011  0.345713  0.100543  0.346817
1.043956  0.345108  0.108388  0.379426
1.098901  0.344502  0.116247  0.409354
1.153846  0.343897  0.124120  0.437172
1.208791  0.343292  0.132008  0.463274
1.263736  0.342686  0.139909  0.487945
1.318681  0.342081  0.147824  0.511399
1.373626  0.341475  0.155753  0.533803
1.428571  0.340870  0.163696  0.555286
1.483516  0.340265  0.171653  0.575956
1.538462  0.339659  0.179529  0.595900
1.593407  0.339054  0.187419  0.615191
1.648352  0.338448  0.195323  0.633890
1.703297  0.337843  0.203240  0.652051
1.758242  0.337238  0.211172  0.669718
1.813187  0.336632  0.219117  0.686932
1.868132  0.336027  0.227076  0.703729
1.923077  0.335421  0.235049  0.720138
1.978022  0.334816  0.243035  0.736188
2.032967  0.334211  0.251036  0.751905
2.087912  0.333605  0.259050  0.767312
2.142857  0.333000  0.267078  0.782432
2.197802  0.332395  0.275120  0.797284
2.252747  0.331789  0.283175  0.811892
2.307692  0.331184  0.291245  0.826276
2.362637  0.330579  0.299328  0.846093
2.417582  0.329973  0.307425  0.873984
2.472527  0.329368  0.315536  0.913660
2.500000  0.328763  0.671152  0.920504
END FTABLE  6
FTABLE      5
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```
   47    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.328763  0.000000  0.000000  0.920504  0.000000
  0.054945  0.356915  0.019594  0.000000  1.758817  0.000000
  0.109890  0.357521  0.039221  0.000000  1.820966  0.000000
  0.164835  0.358126  0.058882  0.000000  1.883115  0.000000
  0.219780  0.358732  0.078576  0.000000  1.945264  0.000000
  0.274725  0.359338  0.098303  0.000000  2.007413  0.000000
  0.329670  0.359943  0.118064  0.000000  2.069562  0.000000
  0.384615  0.360549  0.137857  0.000000  2.131711  0.000000
  0.439560  0.361154  0.157684  0.000000  2.193860  0.000000
  0.494505  0.361760  0.177545  0.000000  2.256009  0.000000
  0.549451  0.362365  0.197438  0.107095  2.318158  0.000000
  0.604396  0.362971  0.217365  0.328502  2.380307  0.000000
  0.659341  0.363577  0.237325  0.619447  2.442456  0.000000
  0.714286  0.364182  0.257319  0.966060  2.504605  0.000000
  0.769231  0.364788  0.277345  1.360509  2.566754  0.000000
  0.824176  0.365394  0.297405  1.797568  2.628903  0.000000
  0.879121  0.365999  0.317498  2.273427  2.691052  0.000000
  0.934066  0.366605  0.337625  2.785146  2.753201  0.000000
  0.989011  0.367211  0.357785  3.330369  2.815350  0.000000
  1.043956  0.367816  0.377978  3.907150  2.877499  0.000000
  1.098901  0.368422  0.398204  4.513849  2.939648  0.000000
  1.153846  0.369028  0.418464  5.149057  3.001797  0.000000
  1.208791  0.369633  0.438756  5.811548  3.063946  0.000000
  1.263736  0.370239  0.459083  6.500241  3.126095  0.000000
  1.318681  0.370845  0.479442  7.214175  3.188244  0.000000
  1.373626  0.371450  0.499835  7.952487  3.250393  0.000000
  1.428571  0.372056  0.520261  8.714397  3.312542  0.000000
  1.483516  0.372662  0.540720  9.499196  3.374691  0.000000
  1.538462  0.373267  0.561213  10.30623  3.436840  0.000000
  1.593407  0.373873  0.581738  11.13491  3.498989  0.000000
  1.648352  0.374479  0.602297  11.98469  3.561138  0.000000
  1.703297  0.375084  0.622890  12.85504  3.623287  0.000000
  1.758242  0.375690  0.643516  13.74550  3.685436  0.000000
  1.813187  0.376296  0.664175  14.65562  3.747585  0.000000
  1.868132  0.376902  0.684867  15.58498  3.809734  0.000000
  1.923077  0.377507  0.705592  16.53320  3.871883  0.000000
  1.978022  0.378113  0.726351  17.49991  3.934032  0.000000
  2.032967  0.378719  0.747143  18.48475  3.996181  0.000000
  2.087912  0.379325  0.767969  19.48741  4.058330  0.000000
  2.142857  0.379930  0.788827  20.50756  4.120479  0.000000
  2.197802  0.380536  0.809719  21.54493  4.182628  0.000000
  2.252747  0.381142  0.830644  22.59921  4.244777  0.000000
  2.307692  0.381748  0.851603  23.67016  4.306926  0.000000
  2.362637  0.382354  0.872595  24.75750  4.369075  0.000000
  2.417582  0.382959  0.893620  25.86101  4.431224  0.000000
  2.472527  0.383565  0.914678  26.98044  4.493373  0.000000
  2.500000  0.383868  0.925220  28.11557  4.524447  0.000000
  END FTABLE  5
  FTABLE      8
   47    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.530190  0.000000  0.000000
  0.055055  0.529885  0.005743  0.000000
  0.110110  0.529140  0.011494  0.000000
  0.165165  0.528394  0.017254  0.000000
  0.220220  0.527649  0.023023  0.005158
  0.275275  0.526903  0.028800  0.012156
  0.330330  0.526158  0.034586  0.023384
  0.385385  0.525412  0.040381  0.039524
  0.440440  0.524667  0.046184  0.061171
  0.495495  0.523922  0.051995  0.088860
  0.550549  0.523176  0.057816  0.123079
  0.605604  0.522431  0.063645  0.164284
  0.660659  0.521685  0.069482  0.212901
```

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  0.715714  0.520940  0.075329  0.220515
  0.770769  0.520194  0.087038  0.269837
  0.825824  0.519449  0.098765  0.311102
  0.880879  0.518704  0.110509  0.347296
  0.935934  0.517958  0.122271  0.379924
  0.990989  0.517213  0.134049  0.409872
  1.046044  0.516468  0.145845  0.437709
  1.101099  0.515722  0.157658  0.463831
  1.156154  0.514977  0.169488  0.488521
  1.211209  0.514231  0.181336  0.511994
  1.266264  0.513486  0.193201  0.534416
  1.321319  0.512741  0.205083  0.555918
  1.376374  0.511995  0.216982  0.576605
  1.431429  0.511250  0.228898  0.596566
  1.486484  0.510505  0.240832  0.615874
  1.541538  0.509759  0.252641  0.634590
  1.596593  0.509014  0.264466  0.652767
  1.651648  0.508269  0.276309  0.670450
  1.706703  0.507523  0.288169  0.687680
  1.761758  0.506778  0.300046  0.704492
  1.816813  0.506033  0.311940  0.720916
  1.871868  0.505288  0.323850  0.736982
  1.926923  0.504542  0.335778  0.752714
  1.981978  0.503797  0.347723  0.768136
  2.037033  0.503052  0.359685  0.783270
  2.092088  0.502306  0.371664  0.798138
  2.147143  0.501561  0.383660  0.812761
  2.202198  0.500816  0.395673  0.827162
  2.257253  0.500071  0.407703  0.841367
  2.312308  0.499325  0.419750  0.855414
  2.367363  0.498580  0.431814  0.869364
  2.422418  0.497835  0.443896  0.883361
  2.477473  0.497090  0.455994  0.916529
  2.500000  0.496344  0.967993  0.921651
  END FTABLE  8
  FTABLE      7
   47    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.496344  0.000000  0.000000  0.921651  0.000000
  0.055055  0.530936  0.029210  0.000000  2.655533  0.000000
  0.110110  0.531681  0.058461  0.000000  2.749549  0.000000
  0.165165  0.532427  0.087753  0.000000  2.843565  0.000000
  0.220220  0.533172  0.117087  0.000000  2.937581  0.000000
  0.275275  0.533918  0.146461  0.000000  3.031597  0.000000
  0.330330  0.534663  0.175876  0.000000  3.125614  0.000000
  0.385385  0.535409  0.205333  0.000000  3.219630  0.000000
  0.440440  0.536154  0.234830  0.000000  3.313646  0.000000
  0.495495  0.536900  0.264369  0.000000  3.407662  0.000000
  0.550549  0.537645  0.293948  0.166028  3.501678  0.000000
  0.605604  0.538391  0.323569  0.501336  3.595694  0.000000
  0.660659  0.539136  0.353230  0.940729  3.689710  0.000000
  0.715714  0.539882  0.382933  1.463605  3.783726  0.000000
  0.770769  0.540628  0.412677  2.058281  3.877742  0.000000
  0.825824  0.541373  0.442461  2.716943  3.971759  0.000000
  0.880879  0.542119  0.472287  3.433890  4.065775  0.000000
  0.935934  0.542864  0.502154  4.204718  4.159791  0.000000
  0.990989  0.543610  0.532062  5.025894  4.253807  0.000000
  1.046044  0.544355  0.562011  5.894501  4.347823  0.000000
  1.101099  0.545101  0.592001  6.808078  4.441839  0.000000
  1.156154  0.545847  0.622032  7.764512  4.535855  0.000000
  1.211209  0.546592  0.652104  8.761961  4.629871  0.000000
  1.266264  0.547338  0.682217  9.798803  4.723888  0.000000
  1.321319  0.548083  0.712371  10.87360  4.817904  0.000000
  1.376374  0.548829  0.742566  11.98504  4.911920  0.000000
  1.431429  0.549575  0.772803  13.13197  5.005936  0.000000
  1.486484  0.550320  0.803080  14.31332  5.099952  0.000000
  1.541538  0.551066  0.833398  15.52811  5.193968  0.000000
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1.596593  0.551811  0.863758  16.77545  5.287984  0.000000
1.651648  0.552557  0.894158  18.05450  5.382000  0.000000
1.706703  0.553303  0.924600  19.36450  5.476016  0.000000
1.761758  0.554048  0.955082  20.70474  5.570033  0.000000
1.816813  0.554794  0.985606  22.07455  5.664049  0.000000
1.871868  0.555540  1.016171  23.47330  5.758065  0.000000
1.926923  0.556285  1.046776  24.90041  5.852081  0.000000
1.981978  0.557031  1.077423  26.35532  5.946097  0.000000
2.037033  0.557777  1.108111  27.83751  6.040113  0.000000
2.092088  0.558522  1.138840  29.34649  6.134129  0.000000
2.147143  0.559268  1.169610  30.88179  6.228145  0.000000
2.202198  0.560014  1.200421  32.44297  6.322161  0.000000
2.257253  0.560760  1.231273  34.02961  6.416178  0.000000
2.312308  0.561505  1.262166  35.64130  6.510194  0.000000
2.367363  0.562251  1.293100  37.27766  6.604210  0.000000
2.422418  0.562997  1.324076  38.93832  6.698226  0.000000
2.477473  0.563742  1.355092  40.62294  6.792242  0.000000
2.500000  0.564048  1.367795  42.33117  6.830712  0.000000
END FTABLE  7
FTABLE     10
 47    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.376015  0.000000  0.000000
0.055055  0.375760  0.004023  0.000000
0.110110  0.375136  0.008054  0.000000
0.165165  0.374512  0.012092  0.000000
0.220220  0.373888  0.016137  0.003613
0.275275  0.373264  0.020189  0.008515
0.330330  0.372640  0.024249  0.016380
0.385385  0.372016  0.028315  0.027687
0.440440  0.371392  0.032389  0.042850
0.495495  0.370768  0.036470  0.062246
0.550549  0.370144  0.040559  0.086216
0.605604  0.369521  0.044654  0.115080
0.660659  0.368897  0.052859  0.149136
0.715714  0.368273  0.061079  0.188667
0.770769  0.367649  0.069314  0.220515
0.825824  0.367025  0.077562  0.269837
0.880879  0.366401  0.085826  0.311102
0.935934  0.365777  0.094103  0.342726
0.990989  0.365153  0.102395  0.347296
1.046044  0.364529  0.110702  0.379924
1.101099  0.363906  0.119022  0.409872
1.156154  0.363282  0.127358  0.437709
1.211209  0.362658  0.135707  0.463831
1.266264  0.362034  0.144072  0.488521
1.321319  0.361410  0.152450  0.511994
1.376374  0.360786  0.160843  0.534416
1.431429  0.360162  0.169250  0.555918
1.486484  0.359539  0.177672  0.576605
1.541538  0.358915  0.186008  0.596566
1.596593  0.358291  0.194358  0.615874
1.651648  0.357667  0.202723  0.634590
1.706703  0.357043  0.211101  0.652767
1.761758  0.356420  0.219494  0.670450
1.816813  0.355796  0.227901  0.687680
1.871868  0.355172  0.236322  0.704492
1.926923  0.354548  0.244758  0.720916
1.981978  0.353924  0.253208  0.736982
2.037033  0.353301  0.261672  0.752714
2.092088  0.352677  0.270150  0.768136
2.147143  0.352053  0.278643  0.783270
2.202198  0.351429  0.287150  0.798138
2.257253  0.350806  0.295671  0.812761
2.312308  0.350182  0.304206  0.827162
2.367363  0.349558  0.312756  0.848534
2.422418  0.348934  0.321320  0.876465
2.477473  0.348311  0.329898  0.916529
2.500000  0.347687  0.700166  0.921651
```

```
  END FTABLE 10
  FTABLE      9
   47    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.347687  0.000000  0.000000  0.921651  0.000000
  0.055055  0.376639  0.020719  0.000000  1.860188  0.000000
  0.110110  0.377263  0.041472  0.000000  1.926046  0.000000
  0.165165  0.377887  0.062259  0.000000  1.991904  0.000000
  0.220220  0.378511  0.083081  0.000000  2.057762  0.000000
  0.275275  0.379135  0.103937  0.000000  2.123620  0.000000
  0.330330  0.379759  0.124827  0.000000  2.189477  0.000000
  0.385385  0.380383  0.145752  0.000000  2.255335  0.000000
  0.440440  0.381007  0.166711  0.000000  2.321193  0.000000
  0.495495  0.381631  0.187705  0.000000  2.387051  0.000000
  0.550549  0.382255  0.208733  0.221370  2.452909  0.000000
  0.605604  0.382879  0.229795  0.668448  2.518767  0.000000
  0.660659  0.383503  0.250892  1.254306  2.584624  0.000000
  0.715714  0.384127  0.272022  1.951474  2.650482  0.000000
  0.770769  0.384752  0.293188  2.744374  2.716340  0.000000
  0.825824  0.385376  0.314387  3.622591  2.782198  0.000000
  0.880879  0.386000  0.335621  4.578520  2.848056  0.000000
  0.935934  0.386624  0.356890  5.606290  2.913914  0.000000
  0.990989  0.387248  0.378193  6.701191  2.979771  0.000000
  1.046044  0.387872  0.399530  7.859334  3.045629  0.000000
  1.101099  0.388496  0.420901  9.077437  3.111487  0.000000
  1.156154  0.389120  0.442307  10.35268  3.177345  0.000000
  1.211209  0.389744  0.463747  11.68261  3.243203  0.000000
  1.266264  0.390368  0.485222  13.06507  3.309061  0.000000
  1.321319  0.390992  0.506730  14.49813  3.374919  0.000000
  1.376374  0.391616  0.528274  15.98006  3.440776  0.000000
  1.431429  0.392241  0.549851  17.50930  3.506634  0.000000
  1.486484  0.392865  0.571463  19.08443  3.572492  0.000000
  1.541538  0.393489  0.593110  20.70415  3.638350  0.000000
  1.596593  0.394113  0.614790  22.36726  3.704208  0.000000
  1.651648  0.394737  0.636505  24.07267  3.770066  0.000000
  1.706703  0.395361  0.658255  25.81934  3.835923  0.000000
  1.761758  0.395985  0.680038  27.60632  3.901781  0.000000
  1.816813  0.396610  0.701857  29.43273  3.967639  0.000000
  1.871868  0.397234  0.723709  31.29774  4.033497  0.000000
  1.926923  0.397858  0.745596  33.20054  4.099355  0.000000
  1.981978  0.398482  0.767517  35.14042  4.165213  0.000000
  2.037033  0.399106  0.789473  37.11668  4.231070  0.000000
  2.092088  0.399730  0.811463  39.12866  4.296928  0.000000
  2.147143  0.400355  0.833487  41.17573  4.362786  0.000000
  2.202198  0.400979  0.855546  43.25730  4.428644  0.000000
  2.257253  0.401603  0.877639  45.37281  4.494502  0.000000
  2.312308  0.402227  0.899766  47.52173  4.560360  0.000000
  2.367363  0.402851  0.921928  49.70354  4.626217  0.000000
  2.422418  0.403476  0.944124  51.91776  4.692075  0.000000
  2.477473  0.404100  0.966355  54.16392  4.757933  0.000000
  2.500000  0.404355  0.975461  56.44156  4.784881  0.000000
  END FTABLE  9
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.067          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.067          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.067          RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1.067          RCHRES   3     EXTNL  PREC
WDM      2 PREC     ENGL    1.067          RCHRES   5     EXTNL  PREC
WDM      2 PREC     ENGL    1.067          RCHRES   7     EXTNL  PREC
WDM      2 PREC     ENGL    1.067          RCHRES   9     EXTNL  PREC
WDM      2 PREC     ENGL    1.067          RCHRES  11     EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.5             RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7             RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5             RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7             RCHRES   4     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5             RCHRES   5     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7             RCHRES   6     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5             RCHRES   7     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7             RCHRES   8     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5             RCHRES   9     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7             RCHRES  10     EXTNL  POTEV
WDM      1 EVAP     ENGL    1               RCHRES  11     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES  11 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES  11 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     12.1      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       16
RCHRES     ROFLOW                         COPY           INPUT  MEAN
  END MASS-LINK   16

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1967/ 1/21 20: 0

RCHRES:    11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
91 4.8099E+02  497.28     663.08
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1967/ 1/21 20: 0

RCHRES:    11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
7.1874E+00  643.56    -7.274E+03   10.151     10.151        4
```

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APPENDIX E-2 – BAHM CALCULATIONS FOR PROVIDED HYDROMODIFICATION DETENTION

BAHM2013

PROJECT REPORT

General Model Information

Project Name:	19569.07
Site Name:	Moller Ranch
Site Address:	
City:	Dublin
Report Date:	6/26/2015
Gage:	LIVERMORE
Data Start:	1959/10/01
Data End:	2004/09/30
Timestep:	Hourly
Precip Scale:	1.07
Version:	2014/02/10

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	79.4
Pervious Total	79.4

Impervious Land Use	Acres
Impervious Total	0
Basin Total	79.4

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	2.97
Pervious Total	2.97

Impervious Land Use	Acres
Roads,Flat(0-5%)	1.38
Roads,Steep(10-20%)	1.38
Roof Area	3.61
Driveways,Mod(5-10%)	0.49
Sidewalks,Flat(0-5%)	0.06
Impervious Total	6.92
Basin Total	9.89

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

Basin 2

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	4.68
Pervious Total	4.68

Impervious Land Use	Acres
Roads,Flat(0-5%)	2.18
Roads,Steep(10-20%)	2.18
Roof Area	5.69
Driveways,Mod(5-10%)	0.77
Sidewalks,Flat(0-5%)	0.1
Impervious Total	10.92
Basin Total	15.6

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 2	Surface retention 2	

Basin 3

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	4.29
Pervious Total	4.29

Impervious Land Use	Acres
Roads,Flat(0-5%)	2
Roads,Steep(10-20%)	2
Roof Area	5.22
Driveways,Mod(5-10%)	0.7
Sidewalks,Flat(0-5%)	0.09
Impervious Total	10.01
Basin Total	14.3

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 3	Surface retention 3	

Basin 4

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	6.63
Pervious Total	6.63

Impervious Land Use	Acres
Roads,Flat(0-5%)	3.09
Roads,Steep(10-20%)	3.09
Roof Area	8.06
Driveways,Mod(5-10%)	1.09
Sidewalks,Flat(0-5%)	0.14
Impervious Total	15.47
Basin Total	22.1

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 4	Surface retention 4	

Basin 5

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C D,Grass,Very(>20%)	5.25
Pervious Total	5.25

Impervious Land Use	Acres
Roads,Flat(0-5%)	2.45
Roads,Steep(10-20%)	2.45
Roof Area	6.38
Driveways,Mod(5-10%)	0.86
Sidewalks,Flat(0-5%)	0.11
Impervious Total	12.25
Basin Total	17.5

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 5	Surface retention 5	

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1

Bottom Length: 60.31 ft.
Bottom Width: 60.31 ft.
Depth: 4.5 ft.
Volume at riser head: 0.4643 acre-ft.
Side slope 1: 2 To 1
Side slope 2: 2 To 1
Side slope 3: 2 To 1
Side slope 4: 2 To 1
Discharge Structure
Riser Height: 4.2 ft.
Riser Diameter: 54 in.
Notch Type: Rectangular
Notch Width: 4.500 ft.
Notch Height: 0.853 ft.
Orifice 1 Diameter: 6.898 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.083	0.000	0.000	0.000
0.0500	0.084	0.004	0.279	0.000
0.1000	0.084	0.008	0.395	0.000
0.1500	0.085	0.012	0.484	0.000
0.2000	0.085	0.016	0.558	0.000
0.2500	0.086	0.021	0.624	0.000
0.3000	0.086	0.025	0.684	0.000
0.3500	0.087	0.029	0.739	0.000
0.4000	0.088	0.034	0.790	0.000
0.4500	0.088	0.038	0.838	0.000
0.5000	0.089	0.043	0.883	0.000
0.5500	0.089	0.047	0.926	0.000
0.6000	0.090	0.052	0.968	0.000
0.6500	0.090	0.056	1.007	0.000
0.7000	0.091	0.061	1.045	0.000
0.7500	0.092	0.065	1.082	0.000
0.8000	0.092	0.070	1.117	0.000
0.8500	0.093	0.075	1.152	0.000
0.9000	0.093	0.079	1.185	0.000
0.9500	0.094	0.084	1.218	0.000
1.0000	0.094	0.089	1.249	0.000
1.0500	0.095	0.093	1.280	0.000
1.1000	0.096	0.098	1.310	0.000
1.1500	0.096	0.103	1.340	0.000
1.2000	0.097	0.108	1.369	0.000
1.2500	0.097	0.113	1.397	0.000
1.3000	0.098	0.118	1.424	0.000
1.3500	0.099	0.123	1.452	0.000
1.4000	0.099	0.128	1.478	0.000
1.4500	0.100	0.133	1.504	0.000
1.5000	0.100	0.138	1.530	0.000
1.5500	0.101	0.143	1.555	0.000

1.6000	0.102	0.148	1.580	0.000
1.6500	0.102	0.153	1.605	0.000
1.7000	0.103	0.158	1.629	0.000
1.7500	0.104	0.163	1.653	0.000
1.8000	0.104	0.168	1.676	0.000
1.8500	0.105	0.174	1.699	0.000
1.9000	0.105	0.179	1.722	0.000
1.9500	0.106	0.184	1.745	0.000
2.0000	0.107	0.190	1.767	0.000
2.0500	0.107	0.195	1.789	0.000
2.1000	0.108	0.200	1.811	0.000
2.1500	0.109	0.206	1.832	0.000
2.2000	0.109	0.211	1.853	0.000
2.2500	0.110	0.217	1.874	0.000
2.3000	0.110	0.222	1.895	0.000
2.3500	0.111	0.228	1.915	0.000
2.4000	0.112	0.234	1.936	0.000
2.4500	0.112	0.239	1.956	0.000
2.5000	0.113	0.245	1.975	0.000
2.5500	0.114	0.250	1.995	0.000
2.6000	0.114	0.256	2.015	0.000
2.6500	0.115	0.262	2.034	0.000
2.7000	0.116	0.268	2.053	0.000
2.7500	0.116	0.274	2.072	0.000
2.8000	0.117	0.279	2.091	0.000
2.8500	0.118	0.285	2.109	0.000
2.9000	0.118	0.291	2.128	0.000
2.9500	0.119	0.297	2.146	0.000
3.0000	0.120	0.303	2.164	0.000
3.0500	0.120	0.309	2.182	0.000
3.1000	0.121	0.315	2.200	0.000
3.1500	0.122	0.321	2.218	0.000
3.2000	0.122	0.327	2.235	0.000
3.2500	0.123	0.334	2.252	0.000
3.3000	0.124	0.340	2.270	0.000
3.3500	0.124	0.346	2.289	0.000
3.4000	0.125	0.352	2.487	0.000
3.4500	0.126	0.359	2.817	0.000
3.5000	0.126	0.365	3.235	0.000
3.5500	0.127	0.371	3.726	0.000
3.6000	0.128	0.378	4.279	0.000
3.6500	0.128	0.384	4.888	0.000
3.7000	0.129	0.390	5.548	0.000
3.7500	0.130	0.397	6.255	0.000
3.8000	0.130	0.404	7.006	0.000
3.8500	0.131	0.410	7.799	0.000
3.9000	0.132	0.417	8.632	0.000
3.9500	0.133	0.423	9.502	0.000
4.0000	0.133	0.430	10.40	0.000
4.0500	0.134	0.437	11.35	0.000
4.1000	0.135	0.443	12.32	0.000
4.1500	0.135	0.450	13.33	0.000
4.2000	0.136	0.457	14.36	0.000
4.2500	0.137	0.464	14.87	0.000
4.3000	0.137	0.471	15.78	0.000
4.3500	0.138	0.478	16.96	0.000
4.4000	0.139	0.485	18.34	0.000
4.4500	0.140	0.492	19.92	0.000

4.5000	0.140	0.499	21.66	0.000
4.5500	0.141	0.506	23.54	0.000

Bioretention 1

Bottom Length:	86.60 ft.
Bottom Width:	86.60 ft.
Material thickness of first layer:	1.5
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (ft):	0.5
Orifice Diameter (in):	5.9
Offset (in):	0
Flow Through Underdrain (ac-ft):	263.88
Total Outflow (ac-ft):	284.998
Percent Through Underdrain:	92.59
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	8 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.

Element Flows To:
Outlet 1 Outlet 2
Trapezoidal Pond 1

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
711.00	0.1921	0.0000	0.0000	0.0000
711.06	0.1919	0.0022	0.0000	0.0000
711.12	0.1914	0.0044	0.0000	0.0000
711.18	0.1910	0.0066	0.0000	0.0000
711.24	0.1905	0.0088	0.0000	0.0000
711.30	0.1900	0.0110	0.0000	0.0000
711.36	0.1895	0.0132	0.0000	0.0000
711.42	0.1890	0.0154	0.0000	0.0000
711.48	0.1886	0.0199	0.0000	0.0000
711.54	0.1881	0.0244	0.0000	0.0000
711.60	0.1876	0.0289	0.0000	0.0000
711.66	0.1871	0.0334	0.0000	0.0000
711.73	0.1866	0.0379	0.0000	0.0000
711.79	0.1861	0.0424	0.0000	0.0000
711.85	0.1857	0.0469	0.0000	0.0000
711.91	0.1852	0.0515	0.0000	0.0000
711.97	0.1847	0.0560	0.0000	0.0000
712.03	0.1842	0.0606	0.0000	0.0000
712.09	0.1837	0.0652	0.0000	0.0000
712.15	0.1833	0.0698	0.0000	0.0000
712.21	0.1828	0.0744	0.0000	0.0000
712.27	0.1823	0.0790	0.0000	0.0000
712.33	0.1818	0.0837	0.0000	0.0000
712.39	0.1813	0.0883	0.0000	0.0000
712.45	0.1808	0.0930	0.0000	0.0000
712.51	0.1804	0.0976	0.0000	0.0000
712.57	0.1799	0.1022	0.0000	0.0000
712.63	0.1794	0.1068	0.0000	0.0000

712.69	0.1789	0.1115	0.0000	0.0000
712.75	0.1784	0.1162	0.0000	0.0000
712.81	0.1779	0.1208	0.0000	0.0000
712.87	0.1775	0.1255	0.0000	0.0000
712.93	0.1770	0.1302	0.0000	0.0000
712.99	0.1765	0.1349	0.0000	0.0000
713.05	0.1760	0.1397	0.0000	0.0000
713.12	0.1755	0.1444	0.0000	0.0000
713.18	0.1751	0.1491	0.0000	0.0000
713.24	0.1746	0.1539	0.0000	0.0000
713.30	0.1741	0.1587	0.0000	0.0000
713.36	0.1736	0.1635	0.0000	0.0000
713.42	0.1731	0.1682	0.0000	0.0000
713.48	0.1726	0.1731	0.0000	0.0000
713.50	0.1722	0.1748	0.0000	0.0000

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended()cfs)	Infilt(cfs)
2.5000	0.1921	0.1748	0.0000	0.9243	0.0000
2.5604	0.1926	0.1864	0.0000	0.9243	0.0000
2.6209	0.1931	0.1981	0.0000	0.9601	0.0000
2.6813	0.1935	0.2098	0.0022	0.9959	0.0000
2.7418	0.1940	0.2215	0.0052	1.0317	0.0000
2.8022	0.1945	0.2332	0.0101	1.0675	0.0000
2.8626	0.1950	0.2450	0.0171	1.1033	0.0000
2.9231	0.1955	0.2568	0.0266	1.1391	0.0000
2.9835	0.1960	0.2686	0.0387	1.1749	0.0000
3.0440	0.1964	0.2805	0.0537	1.2107	0.0000
3.1044	0.1969	0.2924	0.0625	1.2465	0.0000
3.1648	0.1974	0.3043	0.0930	1.2823	0.0000
3.2253	0.1979	0.3162	0.1049	1.3181	0.0000
3.2857	0.1984	0.3282	0.1313	1.3539	0.0000
3.3462	0.1989	0.3402	0.1615	1.3897	0.0000
3.4066	0.1993	0.3522	0.1770	1.4255	0.0000
3.4670	0.1998	0.3643	0.2334	1.4613	0.0000
3.5275	0.2003	0.3764	0.2411	1.4971	0.0000
3.5879	0.2008	0.3885	0.2908	1.5329	0.0000
3.6484	0.2013	0.4007	0.3218	1.5687	0.0000
3.7088	0.2017	0.4128	0.3328	1.6045	0.0000
3.7692	0.2022	0.4251	0.3700	1.6403	0.0000
3.8297	0.2027	0.4373	0.4036	1.6761	0.0000
3.8901	0.2032	0.4496	0.4345	1.7119	0.0000
3.9505	0.2037	0.4619	0.4633	1.7477	0.0000
4.0110	0.2042	0.4742	0.4903	1.7835	0.0000
4.0714	0.2046	0.4865	0.5160	1.8193	0.0000
4.1319	0.2051	0.4989	0.5403	1.8551	0.0000
4.1923	0.2056	0.5113	0.5636	1.8909	0.0000
4.2527	0.2061	0.5238	0.5860	1.9267	0.0000
4.3132	0.2066	0.5362	0.6075	1.9625	0.0000
4.3736	0.2071	0.5487	0.6283	1.9983	0.0000
4.4341	0.2075	0.5613	0.6485	2.0341	0.0000
4.4945	0.2080	0.5738	0.6680	2.0699	0.0000
4.5549	0.2085	0.5864	0.6869	2.1057	0.0000
4.6154	0.2090	0.5990	0.7120	2.1415	0.0000
4.6758	0.2095	0.6117	0.7472	2.1773	0.0000
4.7363	0.2099	0.6243	0.7809	2.2131	0.0000
4.7967	0.2104	0.6371	0.8133	2.2489	0.0000
4.8571	0.2109	0.6498	0.8447	2.2847	0.0000

4.9176	0.2114	0.6625	0.8754	2.3205	0.0000
4.9780	0.2119	0.6753	0.8885	2.3563	0.0000
5.0385	0.2124	0.6882	0.8767	2.3921	0.0000
5.0989	0.2128	0.7010	13.127	2.4279	0.0000
5.1593	0.2133	0.7139	13.878	2.4637	0.0000
5.2198	0.2138	0.7268	14.643	2.4995	0.0000
5.2802	0.2143	0.7397	15.422	2.5353	0.0000
5.3407	0.2148	0.7527	16.214	2.5711	0.0000
5.4011	0.2153	0.7657	17.019	2.6069	0.0000
5.4615	0.2157	0.7787	17.837	2.6427	0.0000
5.5000	0.2160	0.7870	18.668	2.6655	0.0000

Surface retention 1

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 1

Bioretention 2

Bottom Length:	133.75 ft.
Bottom Width:	133.75 ft.
Material thickness of first layer:	1.5
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (ft):	0.5
Orifice Diameter (in):	5.9
Offset (in):	0
Flow Through Underdrain (ac-ft):	412.8
Total Outflow (ac-ft):	449.244
Percent Through Underdrain:	91.89
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	8 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.

Element Flows To:
Outlet 1 Outlet 2
Trapezoidal Pond 1

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
690.00	0.4415	0.0000	0.0000	0.0000
690.05	0.4411	0.0047	0.0000	0.0000
690.11	0.4404	0.0095	0.0000	0.0000
690.16	0.4398	0.0143	0.0000	0.0000
690.22	0.4391	0.0190	0.0000	0.0000
690.27	0.4384	0.0238	0.0000	0.0000
690.33	0.4377	0.0286	0.0000	0.0000
690.38	0.4371	0.0334	0.0000	0.0000
690.44	0.4364	0.0382	0.0000	0.0000
690.49	0.4357	0.0430	0.0000	0.0000
690.55	0.4350	0.0478	0.0000	0.0000
690.60	0.4344	0.0526	0.0000	0.0000
690.66	0.4337	0.0574	0.0000	0.0000
690.71	0.4330	0.0671	0.0000	0.0000
690.77	0.4323	0.0768	0.0000	0.0000
690.82	0.4317	0.0865	0.0000	0.0000
690.88	0.4310	0.0962	0.0000	0.0000
690.93	0.4303	0.1059	0.0000	0.0000
690.99	0.4296	0.1157	0.0000	0.0000
691.04	0.4289	0.1255	0.0000	0.0000
691.10	0.4283	0.1352	0.0000	0.0000
691.15	0.4276	0.1450	0.0000	0.0000
691.21	0.4269	0.1549	0.0000	0.0000
691.26	0.4262	0.1647	0.0000	0.0000
691.32	0.4256	0.1745	0.0000	0.0000
691.37	0.4249	0.1844	0.0000	0.0000
691.43	0.4242	0.1943	0.0000	0.0000
691.48	0.4235	0.2041	0.0000	0.0000

691.54	0.4229	0.2139	0.0000	0.0000
691.59	0.4222	0.2237	0.0000	0.0000
691.65	0.4215	0.2336	0.0000	0.0000
691.70	0.4208	0.2434	0.0000	0.0000
691.76	0.4201	0.2532	0.0000	0.0000
691.81	0.4195	0.2631	0.0000	0.0000
691.87	0.4188	0.2730	0.0000	0.0000
691.92	0.4181	0.2829	0.0000	0.0000
691.98	0.4174	0.2928	0.0000	0.0000
692.03	0.4168	0.3027	0.0000	0.0000
692.09	0.4161	0.3127	0.0000	0.0000
692.14	0.4154	0.3226	0.0000	0.0000
692.20	0.4147	0.3326	0.0000	0.0000
692.25	0.4141	0.3426	0.0000	0.0000
692.31	0.4134	0.3526	0.0000	0.0000
692.36	0.4127	0.3626	0.0000	0.0000
692.42	0.4120	0.3727	0.0000	0.0000
692.47	0.4114	0.3827	0.0000	0.0000
692.50	0.4107	0.3877	0.0000	0.0000

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended()cfs)	Infilt(cfs)
2.5000	0.4415	0.3877	0.0000	2.1970	0.0000
2.5549	0.4421	0.4120	0.0000	2.1970	0.0000
2.6099	0.4428	0.4363	0.0000	2.2747	0.0000
2.6648	0.4435	0.4607	0.0000	2.3523	0.0000
2.7198	0.4442	0.4851	0.0043	2.4299	0.0000
2.7747	0.4448	0.5095	0.0100	2.5076	0.0000
2.8297	0.4455	0.5339	0.0193	2.5852	0.0000
2.8846	0.4462	0.5584	0.0325	2.6628	0.0000
2.9396	0.4469	0.5830	0.0504	2.7405	0.0000
2.9945	0.4476	0.6075	0.0732	2.8181	0.0000
3.0495	0.4482	0.6322	0.1013	2.8957	0.0000
3.1044	0.4489	0.6568	0.1353	2.9734	0.0000
3.1593	0.4496	0.6815	0.1753	3.0510	0.0000
3.2143	0.4503	0.7062	0.2201	3.1286	0.0000
3.2692	0.4509	0.7310	0.2694	3.2063	0.0000
3.3242	0.4516	0.7558	0.3042	3.2839	0.0000
3.3791	0.4523	0.7806	0.3106	3.3615	0.0000
3.4341	0.4530	0.8055	0.3468	3.4392	0.0000
3.4890	0.4536	0.8304	0.3794	3.5168	0.0000
3.5440	0.4543	0.8553	0.4094	3.5944	0.0000
3.5989	0.4550	0.8803	0.4372	3.6721	0.0000
3.6538	0.4557	0.9053	0.4633	3.7497	0.0000
3.7088	0.4564	0.9304	0.4879	3.8273	0.0000
3.7637	0.4570	0.9555	0.5114	3.9050	0.0000
3.8187	0.4577	0.9806	0.5338	3.9826	0.0000
3.8736	0.4584	1.0058	0.5553	4.0603	0.0000
3.9286	0.4591	1.0310	0.5760	4.1379	0.0000
3.9835	0.4597	1.0562	0.5959	4.2155	0.0000
4.0385	0.4604	1.0815	0.6152	4.2932	0.0000
4.0934	0.4611	1.1068	0.6339	4.3708	0.0000
4.1484	0.4618	1.1322	0.6521	4.4484	0.0000
4.2033	0.4624	1.1575	0.6697	4.5261	0.0000
4.2582	0.4631	1.1830	0.6869	4.6037	0.0000
4.3132	0.4638	1.2084	0.7037	4.6813	0.0000
4.3681	0.4645	1.2339	0.7201	4.7590	0.0000
4.4231	0.4652	1.2595	0.7362	4.8366	0.0000

4.4780	0.4658	1.2851	0.7519	4.9142	0.0000
4.5330	0.4665	1.3107	0.7673	4.9919	0.0000
4.5879	0.4672	1.3363	0.7824	5.0695	0.0000
4.6429	0.4679	1.3620	0.7973	5.1471	0.0000
4.6978	0.4685	1.3877	0.8119	5.2248	0.0000
4.7527	0.4692	1.4135	0.8263	5.3024	0.0000
4.8077	0.4699	1.4393	0.8405	5.3800	0.0000
4.8626	0.4706	1.4651	0.8545	5.4577	0.0000
4.9176	0.4712	1.4910	0.8740	5.5353	0.0000
4.9725	0.4719	1.5169	0.9137	5.6129	0.0000
5.0000	0.4723	1.5299	0.9205	5.6517	0.0000

Surface retention 2

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 2

Bioretention 3

Bottom Length:	119.67 ft.
Bottom Width:	119.67 ft.
Material thickness of first layer:	1.5
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (ft):	0.5
Orifice Diameter (in):	5.9
Offset (in):	0
Flow Through Underdrain (ac-ft):	371.688
Total Outflow (ac-ft):	411.746
Percent Through Underdrain:	90.27
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	12 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.

Element Flows To:
Outlet 1 Outlet 2
Trapezoidal Pond 1

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
656.00	0.3563	0.0000	0.0000	0.0000
656.05	0.3560	0.0038	0.0000	0.0000
656.11	0.3554	0.0076	0.0000	0.0000
656.16	0.3548	0.0114	0.0000	0.0000
656.22	0.3542	0.0152	0.0000	0.0000
656.27	0.3536	0.0191	0.0000	0.0000
656.33	0.3530	0.0229	0.0000	0.0000
656.38	0.3524	0.0267	0.0000	0.0000
656.44	0.3518	0.0306	0.0000	0.0000
656.49	0.3512	0.0344	0.0000	0.0000
656.55	0.3506	0.0383	0.0000	0.0000
656.60	0.3500	0.0460	0.0000	0.0000
656.66	0.3493	0.0538	0.0000	0.0000
656.71	0.3487	0.0615	0.0000	0.0000
656.77	0.3481	0.0693	0.0000	0.0000
656.82	0.3475	0.0771	0.0000	0.0000
656.88	0.3469	0.0849	0.0000	0.0000
656.93	0.3463	0.0927	0.0000	0.0000
656.99	0.3457	0.1005	0.0000	0.0000
657.04	0.3451	0.1084	0.0000	0.0000
657.10	0.3445	0.1162	0.0000	0.0000
657.15	0.3439	0.1241	0.0000	0.0000
657.21	0.3433	0.1320	0.0000	0.0000
657.26	0.3427	0.1399	0.0000	0.0000
657.32	0.3421	0.1478	0.0000	0.0000
657.37	0.3415	0.1558	0.0000	0.0000
657.43	0.3409	0.1637	0.0000	0.0000
657.48	0.3403	0.1717	0.0000	0.0000

657.54	0.3397	0.1795	0.0000	0.0000
657.59	0.3391	0.1874	0.0000	0.0000
657.65	0.3384	0.1953	0.0000	0.0000
657.70	0.3378	0.2032	0.0000	0.0000
657.76	0.3372	0.2112	0.0000	0.0000
657.81	0.3366	0.2191	0.0000	0.0000
657.87	0.3360	0.2271	0.0000	0.0000
657.92	0.3354	0.2350	0.0000	0.0000
657.98	0.3348	0.2430	0.0000	0.0000
658.03	0.3342	0.2510	0.0000	0.0000
658.09	0.3336	0.2590	0.0000	0.0000
658.14	0.3330	0.2671	0.0000	0.0000
658.20	0.3324	0.2751	0.0000	0.0000
658.25	0.3318	0.2832	0.0000	0.0000
658.31	0.3312	0.2912	0.0000	0.0000
658.36	0.3306	0.2993	0.0000	0.0000
658.42	0.3300	0.3074	0.0000	0.0000
658.47	0.3294	0.3155	0.0000	0.0000
658.50	0.3288	0.3196	0.0000	0.0000

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended()cfs)	Infilt(cfs)
2.5000	0.3563	0.3196	0.0000	1.7588	0.0000
2.5549	0.3569	0.3392	0.0000	1.7588	0.0000
2.6099	0.3575	0.3588	0.0000	1.8210	0.0000
2.6648	0.3581	0.3785	0.0000	1.8831	0.0000
2.7198	0.3587	0.3982	0.0034	1.9453	0.0000
2.7747	0.3593	0.4179	0.0080	2.0074	0.0000
2.8297	0.3599	0.4377	0.0154	2.0696	0.0000
2.8846	0.3605	0.4575	0.0261	2.1317	0.0000
2.9396	0.3612	0.4773	0.0403	2.1939	0.0000
2.9945	0.3618	0.4971	0.0586	2.2560	0.0000
3.0495	0.3624	0.5170	0.0811	2.3182	0.0000
3.1044	0.3630	0.5370	0.1083	2.3803	0.0000
3.1593	0.3636	0.5569	0.1403	2.4425	0.0000
3.2143	0.3642	0.5769	0.1775	2.5046	0.0000
3.2692	0.3648	0.5969	0.2201	2.5668	0.0000
3.3242	0.3654	0.6170	0.2684	2.6289	0.0000
3.3791	0.3660	0.6371	0.2694	2.6911	0.0000
3.4341	0.3666	0.6572	0.3106	2.7532	0.0000
3.4890	0.3672	0.6774	0.3468	2.8153	0.0000
3.5440	0.3678	0.6976	0.3794	2.8775	0.0000
3.5989	0.3684	0.7178	0.4094	2.9396	0.0000
3.6538	0.3690	0.7381	0.4372	3.0018	0.0000
3.7088	0.3696	0.7584	0.4633	3.0639	0.0000
3.7637	0.3702	0.7787	0.4879	3.1261	0.0000
3.8187	0.3708	0.7990	0.5114	3.1882	0.0000
3.8736	0.3715	0.8194	0.5338	3.2504	0.0000
3.9286	0.3721	0.8399	0.5553	3.3125	0.0000
3.9835	0.3727	0.8603	0.5760	3.3747	0.0000
4.0385	0.3733	0.8808	0.5959	3.4368	0.0000
4.0934	0.3739	0.9013	0.6152	3.4990	0.0000
4.1484	0.3745	0.9219	0.6339	3.5611	0.0000
4.2033	0.3751	0.9425	0.6521	3.6233	0.0000
4.2582	0.3757	0.9631	0.6697	3.6854	0.0000
4.3132	0.3763	0.9838	0.6869	3.7476	0.0000
4.3681	0.3769	1.0045	0.7037	3.8097	0.0000
4.4231	0.3775	1.0252	0.7201	3.8719	0.0000

4.4780	0.3781	1.0459	0.7362	3.9340	0.0000
4.5330	0.3787	1.0667	0.7519	3.9962	0.0000
4.5879	0.3793	1.0876	0.7673	4.0583	0.0000
4.6429	0.3799	1.1084	0.7824	4.1205	0.0000
4.6978	0.3805	1.1293	0.7973	4.1826	0.0000
4.7527	0.3811	1.1502	0.8119	4.2448	0.0000
4.8077	0.3817	1.1712	0.8263	4.3069	0.0000
4.8626	0.3824	1.1922	0.8461	4.3691	0.0000
4.9176	0.3830	1.2132	0.8740	4.4312	0.0000
4.9725	0.3836	1.2343	0.9137	4.4934	0.0000
5.0000	0.3839	1.2448	0.9205	4.5244	0.0000

Surface retention 3

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 3

Bioretention 4

Bottom Length:	147.04 ft.
Bottom Width:	147.04 ft.
Material thickness of first layer:	1.5
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (ft):	0.5
Orifice Diameter (in):	5.9
Offset (in):	0
Flow Through Underdrain (ac-ft):	552.013
Total Outflow (ac-ft):	638.229
Percent Through Underdrain:	86.49
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	18 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.

Element Flows To:
Outlet 1 Outlet 2
Trapezoidal Pond 1

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
636.00	0.5302	0.0000	0.0000	0.0000
636.06	0.5299	0.0057	0.0000	0.0000
636.11	0.5291	0.0115	0.0000	0.0000
636.17	0.5284	0.0173	0.0000	0.0000
636.22	0.5276	0.0230	0.0000	0.0000
636.28	0.5269	0.0288	0.0000	0.0000
636.33	0.5262	0.0346	0.0000	0.0000
636.39	0.5254	0.0404	0.0000	0.0000
636.44	0.5247	0.0462	0.0000	0.0000
636.50	0.5239	0.0520	0.0000	0.0000
636.55	0.5232	0.0578	0.0000	0.0000
636.61	0.5224	0.0636	0.0000	0.0000
636.66	0.5217	0.0695	0.0000	0.0000
636.72	0.5209	0.0753	0.0000	0.0000
636.77	0.5202	0.0870	0.0000	0.0000
636.83	0.5194	0.0988	0.0000	0.0000
636.88	0.5187	0.1105	0.0000	0.0000
636.94	0.5180	0.1223	0.0000	0.0000
636.99	0.5172	0.1340	0.0000	0.0000
637.05	0.5165	0.1458	0.0000	0.0000
637.10	0.5157	0.1577	0.0000	0.0000
637.16	0.5150	0.1695	0.0000	0.0000
637.21	0.5142	0.1813	0.0000	0.0000
637.27	0.5135	0.1932	0.0000	0.0000
637.32	0.5127	0.2051	0.0000	0.0000
637.38	0.5120	0.2170	0.0000	0.0000
637.43	0.5113	0.2289	0.0000	0.0000
637.49	0.5105	0.2408	0.0000	0.0000

637.54	0.5098	0.2526	0.0000	0.0000
637.60	0.5090	0.2645	0.0000	0.0000
637.65	0.5083	0.2763	0.0000	0.0000
637.71	0.5075	0.2882	0.0000	0.0000
637.76	0.5068	0.3000	0.0000	0.0000
637.82	0.5060	0.3119	0.0000	0.0000
637.87	0.5053	0.3239	0.0000	0.0000
637.93	0.5045	0.3358	0.0000	0.0000
637.98	0.5038	0.3477	0.0000	0.0000
638.04	0.5031	0.3597	0.0000	0.0000
638.09	0.5023	0.3717	0.0000	0.0000
638.15	0.5016	0.3837	0.0000	0.0000
638.20	0.5008	0.3957	0.0000	0.0000
638.26	0.5001	0.4077	0.0000	0.0000
638.31	0.4993	0.4198	0.0000	0.0000
638.37	0.4986	0.4318	0.0000	0.0000
638.42	0.4978	0.4439	0.0000	0.0000
638.48	0.4971	0.4560	0.0000	0.0000
638.50	0.4963	0.4609	0.0000	0.0000

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended()cfs)	Infilt(cfs)
2.5000	0.5302	0.4609	0.0000	2.6555	0.0000
2.5551	0.5309	0.4902	0.0000	2.6555	0.0000
2.6101	0.5317	0.5194	0.0000	2.7495	0.0000
2.6652	0.5324	0.5487	0.0000	2.8436	0.0000
2.7202	0.5332	0.5780	0.0052	2.9376	0.0000
2.7753	0.5339	0.6074	0.0122	3.0316	0.0000
2.8303	0.5347	0.6368	0.0234	3.1256	0.0000
2.8854	0.5354	0.6663	0.0395	3.2196	0.0000
2.9404	0.5362	0.6958	0.0612	3.3136	0.0000
2.9955	0.5369	0.7253	0.0889	3.4077	0.0000
3.0505	0.5376	0.7549	0.1231	3.5017	0.0000
3.1056	0.5384	0.7845	0.1643	3.5957	0.0000
3.1607	0.5391	0.8142	0.2129	3.6897	0.0000
3.2157	0.5399	0.8439	0.2205	3.7837	0.0000
3.2708	0.5406	0.8736	0.2698	3.8777	0.0000
3.3258	0.5414	0.9034	0.3111	3.9718	0.0000
3.3809	0.5421	0.9332	0.3473	4.0658	0.0000
3.4359	0.5429	0.9631	0.3799	4.1598	0.0000
3.4910	0.5436	0.9930	0.4099	4.2538	0.0000
3.5460	0.5444	1.0230	0.4377	4.3478	0.0000
3.6011	0.5451	1.0529	0.4638	4.4418	0.0000
3.6562	0.5458	1.0830	0.4885	4.5359	0.0000
3.7112	0.5466	1.1131	0.5120	4.6299	0.0000
3.7663	0.5473	1.1432	0.5344	4.7239	0.0000
3.8213	0.5481	1.1733	0.5559	4.8179	0.0000
3.8764	0.5488	1.2035	0.5766	4.9119	0.0000
3.9314	0.5496	1.2338	0.5966	5.0059	0.0000
3.9865	0.5503	1.2640	0.6159	5.1000	0.0000
4.0415	0.5511	1.2943	0.6346	5.1940	0.0000
4.0966	0.5518	1.3247	0.6528	5.2880	0.0000
4.1516	0.5526	1.3551	0.6705	5.3820	0.0000
4.2067	0.5533	1.3855	0.6877	5.4760	0.0000
4.2618	0.5540	1.4160	0.7045	5.5700	0.0000
4.3168	0.5548	1.4466	0.7209	5.6640	0.0000
4.3719	0.5555	1.4771	0.7370	5.7581	0.0000
4.4269	0.5563	1.5077	0.7527	5.8521	0.0000

4.4820	0.5570	1.5384	0.7681	5.9461	0.0000
4.5370	0.5578	1.5691	0.7833	6.0401	0.0000
4.5921	0.5585	1.5998	0.7981	6.1341	0.0000
4.6471	0.5593	1.6306	0.8128	6.2281	0.0000
4.7022	0.5600	1.6614	0.8272	6.3222	0.0000
4.7573	0.5608	1.6922	0.8414	6.4162	0.0000
4.8123	0.5615	1.7231	0.8554	6.5102	0.0000
4.8674	0.5623	1.7540	0.8694	6.6042	0.0000
4.9224	0.5630	1.7850	0.8834	6.6982	0.0000
4.9775	0.5637	1.8160	0.9165	6.7922	0.0000
5.0000	0.5640	1.8287	0.9217	6.8307	0.0000

Surface retention 4

Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 4

Bioretention 5

Bottom Length:	123.07 ft.
Bottom Width:	123.07 ft.
Material thickness of first layer:	1.5
Material type for first layer:	Amended 5 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (ft):	0.5
Orifice Diameter (in):	5.9
Offset (in):	0
Flow Through Underdrain (ac-ft):	433.537
Total Outflow (ac-ft):	504.81
Percent Through Underdrain:	85.88
Discharge Structure	
Riser Height:	0.5 ft.
Riser Diameter:	24 in.
Notch Type:	Rectangular
Notch Width:	0.000 ft.
Notch Height:	0.000 ft.

Element Flows To:
Outlet 1 Outlet 2
Trapezoidal Pond 1

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
636.00	0.3760	0.0000	0.0000	0.0000
636.06	0.3758	0.0040	0.0000	0.0000
636.11	0.3751	0.0081	0.0000	0.0000
636.17	0.3745	0.0121	0.0000	0.0000
636.22	0.3739	0.0161	0.0000	0.0000
636.28	0.3733	0.0202	0.0000	0.0000
636.33	0.3726	0.0242	0.0000	0.0000
636.39	0.3720	0.0283	0.0000	0.0000
636.44	0.3714	0.0324	0.0000	0.0000
636.50	0.3708	0.0365	0.0000	0.0000
636.55	0.3701	0.0406	0.0000	0.0000
636.61	0.3695	0.0447	0.0000	0.0000
636.66	0.3689	0.0529	0.0000	0.0000
636.72	0.3683	0.0611	0.0000	0.0000
636.77	0.3676	0.0693	0.0000	0.0000
636.83	0.3670	0.0776	0.0000	0.0000
636.88	0.3664	0.0858	0.0000	0.0000
636.94	0.3658	0.0941	0.0000	0.0000
636.99	0.3652	0.1024	0.0000	0.0000
637.05	0.3645	0.1107	0.0000	0.0000
637.10	0.3639	0.1190	0.0000	0.0000
637.16	0.3633	0.1274	0.0000	0.0000
637.21	0.3627	0.1357	0.0000	0.0000
637.27	0.3620	0.1441	0.0000	0.0000
637.32	0.3614	0.1525	0.0000	0.0000
637.38	0.3608	0.1608	0.0000	0.0000
637.43	0.3602	0.1693	0.0000	0.0000
637.49	0.3595	0.1777	0.0000	0.0000

637.54	0.3589	0.1860	0.0000	0.0000
637.60	0.3583	0.1944	0.0000	0.0000
637.65	0.3577	0.2027	0.0000	0.0000
637.71	0.3570	0.2111	0.0000	0.0000
637.76	0.3564	0.2195	0.0000	0.0000
637.82	0.3558	0.2279	0.0000	0.0000
637.87	0.3552	0.2363	0.0000	0.0000
637.93	0.3545	0.2448	0.0000	0.0000
637.98	0.3539	0.2532	0.0000	0.0000
638.04	0.3533	0.2617	0.0000	0.0000
638.09	0.3527	0.2702	0.0000	0.0000
638.15	0.3521	0.2786	0.0000	0.0000
638.20	0.3514	0.2871	0.0000	0.0000
638.26	0.3508	0.2957	0.0000	0.0000
638.31	0.3502	0.3042	0.0000	0.0000
638.37	0.3496	0.3128	0.0000	0.0000
638.42	0.3489	0.3213	0.0000	0.0000
638.48	0.3483	0.3299	0.0000	0.0000
638.50	0.3477	0.3334	0.0000	0.0000

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended()cfs)	Infilt(cfs)
2.5000	0.3760	0.3334	0.0000	1.8602	0.0000
2.5551	0.3766	0.3541	0.0000	1.8602	0.0000
2.6101	0.3773	0.3749	0.0000	1.9260	0.0000
2.6652	0.3779	0.3957	0.0000	1.9919	0.0000
2.7202	0.3785	0.4165	0.0036	2.0578	0.0000
2.7753	0.3791	0.4373	0.0085	2.1236	0.0000
2.8303	0.3798	0.4582	0.0164	2.1895	0.0000
2.8854	0.3804	0.4792	0.0277	2.2553	0.0000
2.9404	0.3810	0.5001	0.0429	2.3212	0.0000
2.9955	0.3816	0.5211	0.0622	2.3871	0.0000
3.0505	0.3823	0.5421	0.0862	2.4529	0.0000
3.1056	0.3829	0.5632	0.1151	2.5188	0.0000
3.1607	0.3835	0.5843	0.1491	2.5846	0.0000
3.2157	0.3841	0.6054	0.1887	2.6505	0.0000
3.2708	0.3848	0.6266	0.2205	2.7163	0.0000
3.3258	0.3854	0.6478	0.2698	2.7822	0.0000
3.3809	0.3860	0.6690	0.3111	2.8481	0.0000
3.4359	0.3866	0.6903	0.3427	2.9139	0.0000
3.4910	0.3872	0.7116	0.3473	2.9798	0.0000
3.5460	0.3879	0.7329	0.3799	3.0456	0.0000
3.6011	0.3885	0.7543	0.4099	3.1115	0.0000
3.6562	0.3891	0.7757	0.4377	3.1773	0.0000
3.7112	0.3897	0.7972	0.4638	3.2432	0.0000
3.7663	0.3904	0.8186	0.4885	3.3091	0.0000
3.8213	0.3910	0.8401	0.5120	3.3749	0.0000
3.8764	0.3916	0.8617	0.5344	3.4408	0.0000
3.9314	0.3922	0.8833	0.5559	3.5066	0.0000
3.9865	0.3929	0.9049	0.5766	3.5725	0.0000
4.0415	0.3935	0.9265	0.5966	3.6383	0.0000
4.0966	0.3941	0.9482	0.6159	3.7042	0.0000
4.1516	0.3947	0.9699	0.6346	3.7701	0.0000
4.2067	0.3954	0.9917	0.6528	3.8359	0.0000
4.2618	0.3960	1.0135	0.6705	3.9018	0.0000
4.3168	0.3966	1.0353	0.6877	3.9676	0.0000
4.3719	0.3972	1.0571	0.7045	4.0335	0.0000
4.4269	0.3979	1.0790	0.7209	4.0994	0.0000

4.4820	0.3985	1.1009	0.7370	4.1652	0.0000
4.5370	0.3991	1.1229	0.7527	4.2311	0.0000
4.5921	0.3997	1.1449	0.7681	4.2969	0.0000
4.6471	0.4004	1.1669	0.7833	4.3628	0.0000
4.7022	0.4010	1.1890	0.7981	4.4286	0.0000
4.7573	0.4016	1.2111	0.8128	4.4945	0.0000
4.8123	0.4022	1.2332	0.8272	4.5604	0.0000
4.8674	0.4029	1.2553	0.8485	4.6262	0.0000
4.9224	0.4035	1.2775	0.8765	4.6921	0.0000
4.9775	0.4041	1.2998	0.9165	4.7579	0.0000
5.0000	0.4044	1.3089	0.9217	4.7849	0.0000

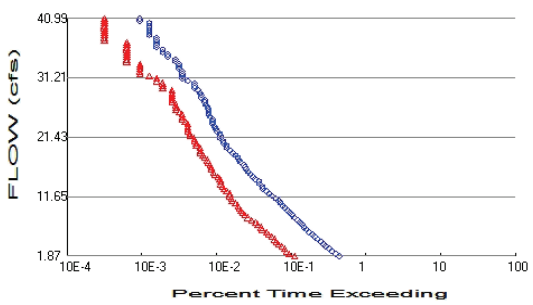
Surface retention 5

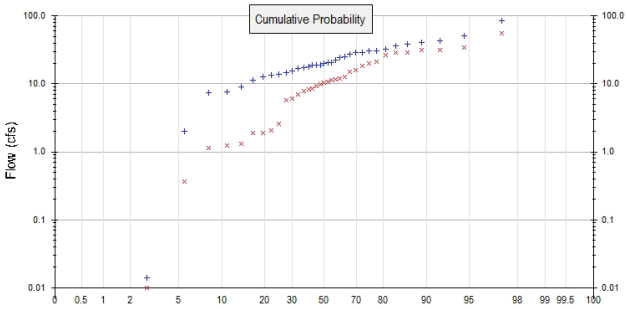
Element Flows To:

Outlet 1	Outlet 2
Trapezoidal Pond 1	Bioretention 5

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 79.4
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 23.82
Total Impervious Area: 55.57

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	18.721108
5 year	31.527892
10 year	40.989624
25 year	62.291595

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	9.52763
5 year	24.393538
10 year	31.518524
25 year	41.562554

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1960	17.149	5.696
1961	12.585	1.910
1962	20.402	7.754
1963	22.351	18.566
1964	28.866	26.783
1965	16.979	9.154
1966	14.682	1.328
1967	83.915	55.969
1968	30.435	29.131
1969	28.686	19.991
1970	24.510	10.326
1971	24.900	12.147
1972	2.026	1.222
1973	50.579	31.486

1974	38.176	15.776
1975	18.835	6.904
1976	0.009	0.000
1977	0.014	0.000
1978	26.896	6.111
1979	30.367	8.432
1980	20.329	11.461
1981	13.390	2.078
1982	42.759	31.619
1983	32.361	21.258
1984	18.613	8.268
1985	11.256	2.566
1986	40.421	33.759
1987	13.865	10.624
1988	7.376	0.362
1989	7.711	1.148
1990	18.603	12.819
1991	15.324	9.922
1992	17.902	11.730
1993	20.106	15.175
1994	8.946	1.911
1995	35.968	29.226

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	83.9154	55.9693
2	50.5787	33.7589
3	42.7593	31.6194
4	40.4208	31.4861
5	38.1755	29.2255
6	35.9678	29.1314
7	32.3608	26.7829
8	30.4347	21.2575
9	30.3667	19.9912
10	28.8661	18.5664
11	28.6861	15.7755
12	26.8959	15.1749
13	24.9000	12.8186
14	24.5096	12.1468
15	22.3506	11.7299
16	20.4021	11.4609
17	20.3285	10.6242
18	20.1058	10.3260
19	18.8348	9.9219
20	18.6134	9.1541
21	18.6034	8.4320
22	17.9024	8.2683
23	17.1489	7.7538
24	16.9793	6.9041
25	15.3237	6.1109
26	14.6818	5.6963
27	13.8654	2.5663
28	13.3898	2.0776
29	12.5853	1.9114
30	11.2560	1.9096
31	8.9459	1.3279
32	7.7115	1.2221

33	7.3757	1.1477
34	2.0257	0.3621
35	0.0139	0.0000
36	0.0092	0.0000

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
1.8721	1382	352	25	Pass
2.2672	1245	297	23	Pass
2.6624	1106	273	24	Pass
3.0575	1015	257	25	Pass
3.4526	928	238	25	Pass
3.8477	849	214	25	Pass
4.2429	784	200	25	Pass
4.6380	726	188	25	Pass
5.0331	655	173	26	Pass
5.4282	607	157	25	Pass
5.8234	553	148	26	Pass
6.2185	506	131	25	Pass
6.6136	471	124	26	Pass
7.0088	446	112	25	Pass
7.4039	412	106	25	Pass
7.7990	388	93	23	Pass
8.1941	351	83	23	Pass
8.5893	325	76	23	Pass
8.9844	305	71	23	Pass
9.3795	282	67	23	Pass
9.7746	259	64	24	Pass
10.1698	244	62	25	Pass
10.5649	227	56	24	Pass
10.9600	213	51	23	Pass
11.3551	197	50	25	Pass
11.7503	175	48	27	Pass
12.1454	161	48	29	Pass
12.5405	147	43	29	Pass
12.9356	134	40	29	Pass
13.3308	131	38	29	Pass
13.7259	121	36	29	Pass
14.1210	117	36	30	Pass
14.5162	105	35	33	Pass
14.9113	98	33	33	Pass
15.3064	91	30	32	Pass
15.7015	85	29	34	Pass
16.0967	79	27	34	Pass
16.4918	76	27	35	Pass
16.8869	73	26	35	Pass
17.2820	67	25	37	Pass
17.6772	65	24	36	Pass
18.0723	61	22	36	Pass
18.4674	57	21	36	Pass
18.8625	52	19	36	Pass
19.2577	48	19	39	Pass
19.6528	43	19	44	Pass
20.0479	43	17	39	Pass
20.4431	40	17	42	Pass
20.8382	39	16	41	Pass
21.2333	36	16	44	Pass
21.6284	36	14	38	Pass
22.0236	35	14	40	Pass
22.4187	32	13	40	Pass

22.8138	31	13	41	Pass
23.2089	30	13	43	Pass
23.6041	28	13	46	Pass
23.9992	28	12	42	Pass
24.3943	28	11	39	Pass
24.7894	26	11	42	Pass
25.1846	25	11	44	Pass
25.5797	25	10	40	Pass
25.9748	25	9	36	Pass
26.3699	24	9	37	Pass
26.7651	23	9	39	Pass
27.1602	22	8	36	Pass
27.5553	22	8	36	Pass
27.9505	20	8	40	Pass
28.3456	20	8	40	Pass
28.7407	19	8	42	Pass
29.1358	18	8	44	Pass
29.5310	16	6	37	Pass
29.9261	16	6	37	Pass
30.3212	16	6	37	Pass
30.7163	13	5	38	Pass
31.1115	11	5	45	Pass
31.5066	11	4	36	Pass
31.9017	11	3	27	Pass
32.2968	11	3	27	Pass
32.6920	10	3	30	Pass
33.0871	10	3	30	Pass
33.4822	10	3	30	Pass
33.8773	9	2	22	Pass
34.2725	9	2	22	Pass
34.6676	7	2	28	Pass
35.0627	7	2	28	Pass
35.4579	6	2	33	Pass
35.8530	6	2	33	Pass
36.2481	5	2	40	Pass
36.6432	5	2	40	Pass
37.0384	5	2	40	Pass
37.4335	5	1	20	Pass
37.8286	5	1	20	Pass
38.2237	4	1	25	Pass
38.6189	4	1	25	Pass
39.0140	4	1	25	Pass
39.4091	4	1	25	Pass
39.8042	4	1	25	Pass
40.1994	4	1	25	Pass
40.5945	3	1	33	Pass
40.9896	3	1	33	Pass

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

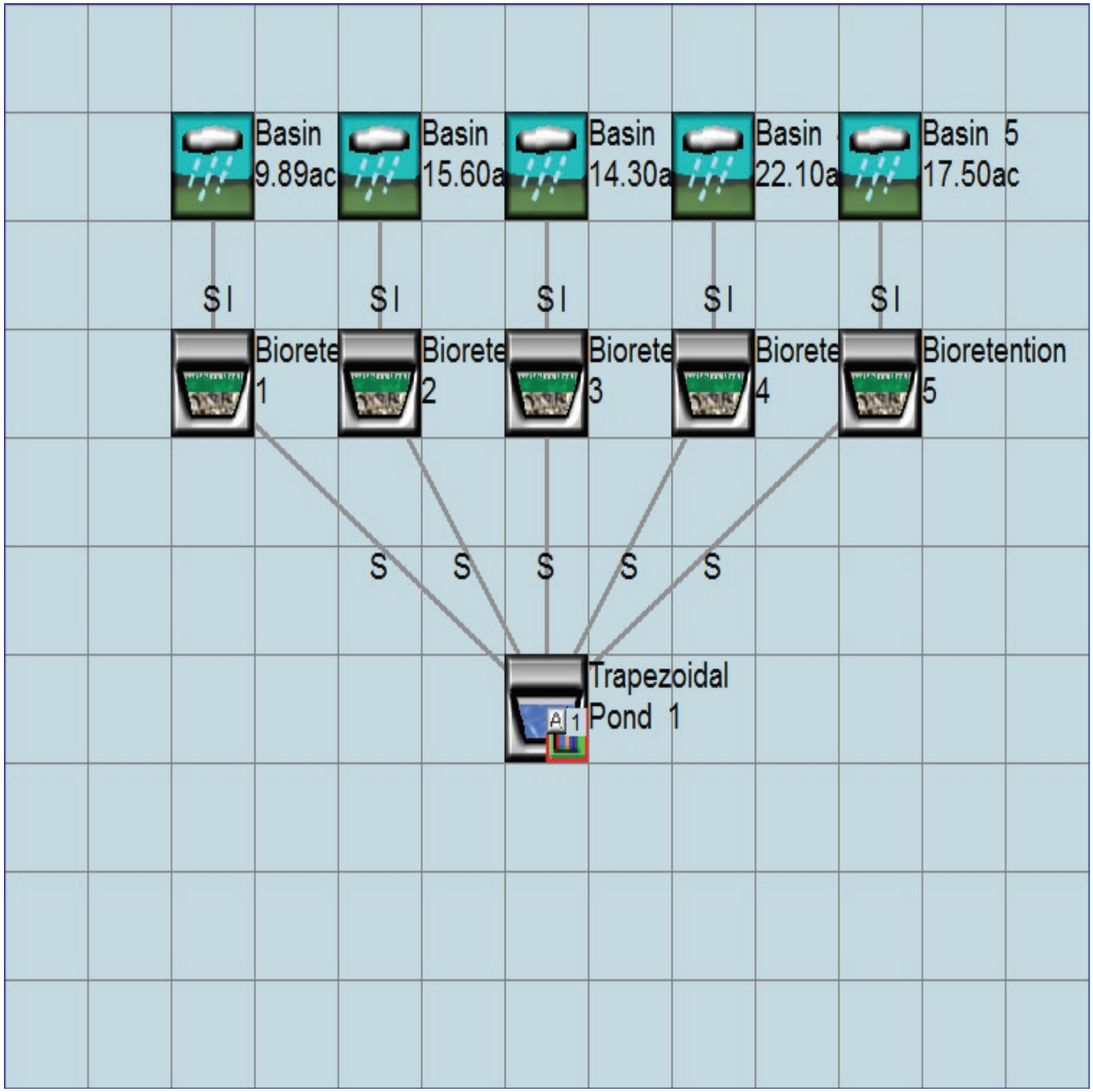
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1959 10 01        END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   19569.07.wdm
MESSU       25   Pre19569.07.MES
            27   Pre19569.07.L61
            28   Pre19569.07.L62
            30   POC19569.071.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:60
      PERLND      44
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                      in  out           ***
   44     C/D,Grass,Very(>20%)    1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   44         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   44         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   44         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   44              0       3.4     0.025       200      0.25         2      0.95
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   44             40        35         3         2      0.15      0.15         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   44              0      0.15      0.25      0.15      0.35         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   44       0.4  0.4  0.4 0.45  0.5 0.55 0.55 0.55 0.55 0.55 0.45  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   44      0.12 0.12 0.12 0.11  0.1  0.1  0.1  0.1  0.1  0.1 0.11 0.12
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   44              0         0      0.01         0       0.5       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2
```

```
  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  44                        79.4     COPY   501     12
PERLND  44                        79.4     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                  ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------->      ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                     ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><--------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES
```

```
SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.067          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.067          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1959 10 01         END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   19569.07.wdm
MESSU       25   Mit19569.07.MES
            27   Mit19569.07.L61
            28   Mit19569.07.L62
            30   POC19569.071.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:60
      PERLND      44
      IMPLND       1
      IMPLND       3
      IMPLND       5
      IMPLND       7
      IMPLND      10
      GENER        2
      RCHRES       1
      RCHRES       2
      GENER        4
      RCHRES       3
      RCHRES       4
      GENER        6
      RCHRES       5
      RCHRES       6
      GENER        8
      RCHRES       7
      RCHRES       8
      GENER       10
      RCHRES       9
      RCHRES      10
      RCHRES      11
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
    4        24
    6        24
    8        24
```

```
   10        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
    4             0.
    6             0.
    8             0.
   10             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                        in  out           ***
   44     C/D,Grass,Very(>20%)    1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   44         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   44         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   44         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   44              0       3.4     0.025       200      0.25         2      0.95
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   44             40        35         3         2      0.15      0.15         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   44              0      0.15      0.25      0.15      0.35         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   44       0.4  0.4  0.4 0.45  0.5 0.55 0.55 0.55 0.55 0.55 0.45  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   44      0.12 0.12 0.12 0.11  0.1  0.1  0.1  0.1  0.1  0.1 0.11 0.12
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   44              0         0      0.01         0       0.5       0.3      0.01
```

```
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    1     Roads,Flat(0-5%)        1    1    1   27    0
    3     Roads,Steep(10-20%)     1    1    1   27    0
    5     Roof Area               1    1    1   27    0
    7     Driveways,Mod(5-10%)    1    1    1   27    0
   10     Sidewalks,Flat(0-5%)    1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    3         0    0    1    0    0    0
    5         0    0    1    0    0    0
    7         0    0    1    0    0    0
   10         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
    3         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
    7         0    0    4    0    0    0    1    9
   10         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    3         0    0    0    0    0
    5         0    0    0    0    0
    7         0    0    0    0    0
   10         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1           100      0.05       0.1        0.1
    3           100      0.15       0.1       0.08
    5           100      0.05       0.1        0.1
    7           100       0.1       0.1       0.09
   10           100      0.05       0.1        0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
    3             0         0
    5             0         0
    7             0         0
   10             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
```

```
    1              0         0
    3              0         0
    5              0         0
    7              0         0
   10              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK   ***
<Name>   #                 <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  44                       2.97     RCHRES   1      2
PERLND  44                       2.97     RCHRES   1      3
IMPLND   1                       1.38     RCHRES   1      5
IMPLND   3                       1.38     RCHRES   1      5
IMPLND   5                       3.61     RCHRES   1      5
IMPLND   7                       0.49     RCHRES   1      5
IMPLND  10                       0.06     RCHRES   1      5
Basin  2***
PERLND  44                       4.68     RCHRES   3      2
PERLND  44                       4.68     RCHRES   3      3
IMPLND   1                       2.18     RCHRES   3      5
IMPLND   3                       2.18     RCHRES   3      5
IMPLND   5                       5.69     RCHRES   3      5
IMPLND   7                       0.77     RCHRES   3      5
IMPLND  10                        0.1     RCHRES   3      5
Basin  3***
PERLND  44                       4.29     RCHRES   5      2
PERLND  44                       4.29     RCHRES   5      3
IMPLND   1                          2     RCHRES   5      5
IMPLND   3                          2     RCHRES   5      5
IMPLND   5                       5.22     RCHRES   5      5
IMPLND   7                        0.7     RCHRES   5      5
IMPLND  10                       0.09     RCHRES   5      5
Basin  4***
PERLND  44                       6.63     RCHRES   7      2
PERLND  44                       6.63     RCHRES   7      3
IMPLND   1                       3.09     RCHRES   7      5
IMPLND   3                       3.09     RCHRES   7      5
IMPLND   5                       8.06     RCHRES   7      5
IMPLND   7                       1.09     RCHRES   7      5
IMPLND  10                       0.14     RCHRES   7      5
Basin  5***
PERLND  44                       5.25     RCHRES   9      2
PERLND  44                       5.25     RCHRES   9      3
IMPLND   1                       2.45     RCHRES   9      5
IMPLND   3                       2.45     RCHRES   9      5
IMPLND   5                       6.38     RCHRES   9      5
IMPLND   7                       0.86     RCHRES   9      5
IMPLND  10                       0.11     RCHRES   9      5

******Routing******
RCHRES   1                          1     RCHRES  11      7
RCHRES   1                                COPY     1     17
RCHRES   1                          1     RCHRES   2      8
RCHRES   3                          1     RCHRES  11      7
RCHRES   3                                COPY     1     17
RCHRES   3                          1     RCHRES   4      8
RCHRES   5                          1     RCHRES  11      7
RCHRES   5                                COPY     1     17
RCHRES   5                          1     RCHRES   6      8
RCHRES   7                          1     RCHRES  11      7
RCHRES   7                                COPY     1     17
RCHRES   7                          1     RCHRES   8      8
RCHRES   9                          1     RCHRES  11      7
RCHRES   9                                COPY     1     17
RCHRES   9                          1     RCHRES  10      8
RCHRES  11                          1     COPY   501     16
```

```
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0002778     RCHRES   1     EXTNL  OUTDGT 1
GENER    4 OUTPUT TIMSER      .0002778     RCHRES   3     EXTNL  OUTDGT 1
GENER    6 OUTPUT TIMSER      .0002778     RCHRES   5     EXTNL  OUTDGT 1
GENER    8 OUTPUT TIMSER      .0002778     RCHRES   7     EXTNL  OUTDGT 1
GENER   10 OUTPUT TIMSER      .0002778     RCHRES   9     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                              ***
    1     Surface retentio-010    3    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
    3     Surface retentio-016    3    1    1    1   28    0    1
    4     Bioretention  2         1    1    1    1   28    0    1
    5     Surface retentio-018    3    1    1    1   28    0    1
    6     Bioretention  3         1    1    1    1   28    0    1
    7     Surface retentio-020    3    1    1    1   28    0    1
    8     Bioretention  4         1    1    1    1   28    0    1
    9     Surface retentio-022    3    1    1    1   28    0    1
   10     Bioretention  5         1    1    1    1   28    0    1
   11     Trapezoidal Pond-008    1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
    4         1    0    0    0    0    0    0    0    0    0
    5         1    0    0    0    0    0    0    0    0    0
    6         1    0    0    0    0    0    0    0    0    0
    7         1    0    0    0    0    0    0    0    0    0
    8         1    0    0    0    0    0    0    0    0    0
    9         1    0    0    0    0    0    0    0    0    0
   10         1    0    0    0    0    0    0    0    0    0
   11         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
    4         4    0    0    0    0    0    0    0    0    0    1    9
    5         4    0    0    0    0    0    0    0    0    0    1    9
    6         4    0    0    0    0    0    0    0    0    0    1    9
    7         4    0    0    0    0    0    0    0    0    0    1    9
    8         4    0    0    0    0    0    0    0    0    0    1    9
    9         4    0    0    0    0    0    0    0    0    0    1    9
   10         4    0    0    0    0    0    0    0    0    0    1    9
   11         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
```

```
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit       possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *          ***
    1       0  1  0  0    4  5  6  0  0       0  1  0  0  0        2  1  2  2  2
    2       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
    3       0  1  0  0    4  5  6  0  0       0  1  0  0  0        2  1  2  2  2
    4       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
    5       0  1  0  0    4  5  6  0  0       0  1  0  0  0        2  1  2  2  2
    6       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
    7       0  1  0  0    4  5  6  0  0       0  1  0  0  0        2  1  2  2  2
    8       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
    9       0  1  0  0    4  5  6  0  0       0  1  0  0  0        2  1  2  2  2
   10       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
   11       0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><--------->      ***
    1              1      0.01       0.0     711.0       0.5       0.0
    2              2      0.02       0.0     711.0       0.5       0.0
    3              3      0.01       0.0     690.0       0.5       0.0
    4              4      0.03       0.0     690.0       0.5       0.0
    5              5      0.01       0.0     656.0       0.5       0.0
    6              6      0.02       0.0     656.0       0.5       0.0
    7              7      0.01       0.0     636.0       0.5       0.0
    8              8      0.03       0.0     636.0       0.5       0.0
    9              9      0.01       0.0     636.0       0.5       0.0
   10             10      0.02       0.0     636.0       0.5       0.0
   11             11      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><--------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1             0         4.0  0.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2             0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3             0         4.0  0.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    4             0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    5             0         4.0  0.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    6             0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    7             0         4.0  0.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    8             0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    9             0         4.0  0.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
   10         0             4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
   11         0             4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><---------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL              4
  UVQUAN v2m2   GLOBAL     WORKSP  1        3
  UVQUAN vpo2   GLOBAL     WORKSP  2        3
  UVQUAN v2d2   GENER    2 K       1        3
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><---------> <><-> <><-> <--> ***
  UVQUAN vol4   RCHRES   4 VOL              4
  UVQUAN v2m4   GLOBAL     WORKSP  3        3
  UVQUAN vpo4   GLOBAL     WORKSP  4        3
  UVQUAN v2d4   GENER    4 K       1        3
```

```
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><---------> <><-> <><-> <--> ***
  UVQUAN vol6   RCHRES   6 VOL              4
  UVQUAN v2m6   GLOBAL     WORKSP  5        3
  UVQUAN vpo6   GLOBAL     WORKSP  6        3
  UVQUAN v2d6   GENER    6 K       1        3
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><---------> <><-> <><-> <--> ***
  UVQUAN vol8   RCHRES   8 VOL              4
  UVQUAN v2m8   GLOBAL     WORKSP  7        3
  UVQUAN vpo8   GLOBAL     WORKSP  8        3
  UVQUAN v2d8   GENER    8 K       1        3
*** User-Defined Variable Quantity Lines
***                          addr
***                         <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><---------> <><-> <><-> <--> ***
  UVQUAN vol10  RCHRES  10 VOL              4
  UVQUAN v2m10  GLOBAL     WORKSP  9        3
  UVQUAN vpo10  GLOBAL     WORKSP 10        3
  UVQUAN v2d10  GENER   10 K       1        3
*** User-Defined Target Variable Names
***                   addr or                          addr or
***                  <------>                         <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** User-Defined Target Variable Names
***                   addr or                          addr or
***                  <------>                         <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m4    1 WORKSP  3         1.0 QUAN
  UVNAME  vpo4    1 WORKSP  4         1.0 QUAN
  UVNAME  v2d4    1 K       1         1.0 QUAN
*** User-Defined Target Variable Names
***                   addr or                          addr or
***                  <------>                         <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m6    1 WORKSP  5         1.0 QUAN
  UVNAME  vpo6    1 WORKSP  6         1.0 QUAN
  UVNAME  v2d6    1 K       1         1.0 QUAN
*** User-Defined Target Variable Names
***                   addr or                          addr or
***                  <------>                         <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m8    1 WORKSP  7         1.0 QUAN
  UVNAME  vpo8    1 WORKSP  8         1.0 QUAN
  UVNAME  v2d8    1 K       1         1.0 QUAN
*** User-Defined Target Variable Names
***                   addr or                          addr or
***                  <------>                         <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m10   1 WORKSP  9         1.0 QUAN
  UVNAME  vpo10   1 WORKSP 10         1.0 QUAN
  UVNAME  v2d10   1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><---------> <> <-><->
  GENER   2                              v2m2            =  7161.
```

```
*** Compute remaining available pore space
  GENER   2                                 vpo2            =  v2m2
  GENER   2                                 vpo2           -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                                 vpo2            =  0.0
END IF
*** Infiltration volume
  GENER   2                                 v2d2            =  vpo2
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   4                                 v2m4            =  15837.
*** Compute remaining available pore space
  GENER   4                                 vpo4            =  v2m4
  GENER   4                                 vpo4           -=  vol4
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo4 < 0.0) THEN
  GENER   4                                 vpo4            =  0.0
END IF
*** Infiltration volume
  GENER   4                                 v2d4            =  vpo4
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   6                                 v2m6            =  13057.
*** Compute remaining available pore space
  GENER   6                                 vpo6            =  v2m6
  GENER   6                                 vpo6           -=  vol6
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo6 < 0.0) THEN
  GENER   6                                 vpo6            =  0.0
END IF
*** Infiltration volume
  GENER   6                                 v2d6            =  vpo6
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   8                                 v2m8            =  18870.
*** Compute remaining available pore space
  GENER   8                                 vpo8            =  v2m8
  GENER   8                                 vpo8           -=  vol8
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo8 < 0.0) THEN
  GENER   8                                 vpo8            =  0.0
END IF
*** Infiltration volume
  GENER   8                                 v2d8            =  vpo8
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER  10                                 v2m10           =  13652.
*** Compute remaining available pore space
  GENER  10                                 vpo10           =  v2m10
  GENER  10                                 vpo10          -=  vol10
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo10 < 0.0) THEN
  GENER  10                                 vpo10           =  0.0
END IF
*** Infiltration volume
  GENER  10                                 v2d10           =  vpo10
END SPEC-ACTIONS
FTABLES
  FTABLE     11
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.083493  0.000000  0.000000
  0.050000  0.084047  0.004188  0.279441
  0.100000  0.084604  0.008405  0.395190
  0.150000  0.085162  0.012649  0.484006
  0.200000  0.085722  0.016921  0.558882
  0.250000  0.086284  0.021221  0.624849
  0.300000  0.086848  0.025550  0.684488
```

0.350000	0.087414	0.029906	0.739332
0.400000	0.087982	0.034291	0.790379
0.450000	0.088551	0.038704	0.838324
0.500000	0.089122	0.043146	0.883671
0.550000	0.089695	0.047617	0.926802
0.600000	0.090270	0.052116	0.968013
0.650000	0.090847	0.056644	1.007540
0.700000	0.091425	0.061200	1.045573
0.750000	0.092006	0.065786	1.082271
0.800000	0.092588	0.070401	1.117765
0.850000	0.093172	0.075045	1.152166
0.900000	0.093758	0.079718	1.185569
0.950000	0.094346	0.084421	1.218056
1.000000	0.094935	0.089153	1.249699
1.050000	0.095527	0.093915	1.280560
1.100000	0.096120	0.098706	1.310695
1.150000	0.096715	0.103527	1.340153
1.200000	0.097312	0.108377	1.368977
1.250000	0.097911	0.113258	1.397206
1.300000	0.098512	0.118168	1.424876
1.350000	0.099114	0.123109	1.452019
1.400000	0.099718	0.128080	1.478664
1.450000	0.100325	0.133081	1.504837
1.500000	0.100932	0.138112	1.530562
1.550000	0.101542	0.143174	1.555863
1.600000	0.102154	0.148267	1.580758
1.650000	0.102767	0.153390	1.605267
1.700000	0.103383	0.158543	1.629408
1.750000	0.104000	0.163728	1.653196
1.800000	0.104619	0.168943	1.676647
1.850000	0.105240	0.174190	1.699774
1.900000	0.105862	0.179467	1.722591
1.950000	0.106487	0.184776	1.745110
2.000000	0.107113	0.190116	1.767341
2.050000	0.107741	0.195488	1.789297
2.100000	0.108371	0.200890	1.810986
2.150000	0.109003	0.206325	1.832418
2.200000	0.109637	0.211791	1.853603
2.250000	0.110272	0.217288	1.874548
2.300000	0.110910	0.222818	1.895262
2.350000	0.111549	0.228379	1.915752
2.400000	0.112190	0.233973	1.936025
2.450000	0.112833	0.239598	1.956088
2.500000	0.113477	0.245256	1.975948
2.550000	0.114124	0.250946	1.995609
2.600000	0.114772	0.256669	2.015079
2.650000	0.115422	0.262424	2.034363
2.700000	0.116075	0.268211	2.053465
2.750000	0.116728	0.274031	2.072391
2.800000	0.117384	0.279884	2.091146
2.850000	0.118042	0.285769	2.109735
2.900000	0.118701	0.291688	2.128161
2.950000	0.119362	0.297640	2.146428
3.000000	0.120025	0.303624	2.164542
3.050000	0.120690	0.309642	2.182505
3.100000	0.121357	0.315693	2.200322
3.150000	0.122025	0.321778	2.217996
3.200000	0.122696	0.327896	2.235529
3.250000	0.123368	0.334048	2.252927
3.300000	0.124042	0.340233	2.270191
3.350000	0.124718	0.346452	2.289941
3.400000	0.125396	0.352705	2.487813
3.450000	0.126075	0.358991	2.817458
3.500000	0.126757	0.365312	3.235859
3.550000	0.127440	0.371667	3.726438
3.600000	0.128125	0.378056	4.279481
3.650000	0.128812	0.384480	4.888394
3.700000	0.129501	0.390938	5.548315
3.750000	0.130192	0.397430	6.255467
3.800000	0.130884	0.403957	7.006807

```
  3.850000  0.131578  0.410518  7.799814
  3.900000  0.132274  0.417115  8.632353
  3.950000  0.132972  0.423746  9.502588
  4.000000  0.133672  0.430412  10.40892
  4.050000  0.134374  0.437113  11.34993
  4.100000  0.135077  0.443849  12.32437
  4.150000  0.135783  0.450621  13.33109
  4.200000  0.136490  0.457428  14.36908
  4.250000  0.137199  0.464270  14.87427
  4.300000  0.137909  0.471148  15.78528
  4.350000  0.138622  0.478061  16.96045
  4.400000  0.139337  0.485010  18.34922
  4.450000  0.140053  0.491995  19.92239
  4.500000  0.140771  0.499015  21.66024
  END FTABLE 11
  FTABLE      2
   43    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.192102  0.000000  0.000000
  0.060440  0.191927  0.002188  0.000000
  0.120879  0.191445  0.004383  0.000000
  0.181319  0.190963  0.006583  0.002161
  0.241758  0.190481  0.008790  0.005196
  0.302198  0.189999  0.011002  0.010087
  0.362637  0.189517  0.013221  0.017131
  0.423077  0.189034  0.015446  0.026589
  0.483516  0.188552  0.019908  0.038695
  0.543956  0.188070  0.024383  0.053662
  0.604396  0.187588  0.028869  0.062528
  0.664835  0.187106  0.033368  0.092964
  0.725275  0.186624  0.037879  0.104874
  0.785714  0.186142  0.042402  0.131347
  0.846154  0.185660  0.046938  0.161492
  0.906593  0.185178  0.051486  0.177033
  0.967033  0.184696  0.056046  0.233415
  1.027473  0.184214  0.060618  0.241082
  1.087912  0.183732  0.065202  0.290786
  1.148352  0.183250  0.069799  0.321822
  1.208791  0.182768  0.074408  0.332840
  1.269231  0.182286  0.079029  0.369957
  1.329670  0.181804  0.083662  0.403552
  1.390110  0.181322  0.088308  0.434472
  1.450549  0.180840  0.092966  0.463274
  1.510989  0.180358  0.097580  0.490342
  1.571429  0.179876  0.102207  0.515959
  1.631868  0.179394  0.106846  0.540339
  1.692308  0.178913  0.111496  0.563647
  1.752747  0.178431  0.116159  0.586014
  1.813187  0.177949  0.120834  0.607549
  1.873626  0.177467  0.125521  0.628339
  1.934066  0.176985  0.130220  0.648459
  1.994505  0.176503  0.134931  0.667972
  2.054945  0.176021  0.139655  0.686932
  2.115385  0.175539  0.144390  0.711980
  2.175824  0.175057  0.149138  0.747224
  2.236264  0.174575  0.153897  0.780932
  2.296703  0.174094  0.158669  0.813340
  2.357143  0.173612  0.163453  0.844688
  2.417582  0.173130  0.168248  0.875377
  2.478022  0.172648  0.173056  0.888509
  2.500000  0.172166  0.367096  0.876701
  END FTABLE  2
  FTABLE      1
   51    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.172166  0.000000  0.000000  0.876701  0.000000
```

```
0.060440  0.192584  0.011625  0.000000  0.924310  0.000000
0.120879  0.193067  0.023279  0.000000  0.960111  0.000000
0.181319  0.193549  0.034963  0.000000  0.995912  0.000000
0.241758  0.194031  0.046675  0.000000  1.031712  0.000000
0.302198  0.194513  0.058417  0.000000  1.067513  0.000000
0.362637  0.194995  0.070188  0.000000  1.103314  0.000000
0.423077  0.195477  0.081988  0.000000  1.182515  0.000000
0.483516  0.195959  0.093817  0.000000  1.174915  0.000000
0.543956  0.196442  0.105675  0.000000  1.210716  0.000000
0.604396  0.196924  0.117563  0.000000  1.246517  0.000000
0.664835  0.197406  0.129479  0.000000  1.282318  0.000000
0.725275  0.197888  0.141425  0.000000  1.318118  0.000000
0.785714  0.198370  0.153400  0.000000  1.353919  0.000000
0.846154  0.198852  0.165404  0.000000  1.389720  0.000000
0.906593  0.199335  0.177437  0.000000  1.425521  0.000000
0.967033  0.199817  0.189499  0.000000  1.461321  0.000000
1.027473  0.200299  0.201591  0.029565  1.497122  0.000000
1.087912  0.200781  0.213711  0.169237  1.532923  0.000000
1.148352  0.201264  0.225861  0.370990  1.568724  0.000000
1.208791  0.201746  0.238040  0.619429  1.604524  0.000000
1.269231  0.202228  0.250248  0.907006  1.640325  0.000000
1.329670  0.202710  0.262485  1.228975  1.676126  0.000000
1.390110  0.203193  0.274751  1.581989  1.711927  0.000000
1.450549  0.203675  0.287047  1.963527  1.747727  0.000000
1.510989  0.204157  0.299371  2.371595  1.783528  0.000000
1.571429  0.204639  0.311725  2.804568  1.819329  0.000000
1.631868  0.205122  0.324108  3.261090  1.855129  0.000000
1.692308  0.205604  0.336520  3.740002  1.890930  0.000000
1.752747  0.206086  0.348961  4.240303  1.926731  0.000000
1.813187  0.206569  0.361431  4.761114  1.962532  0.000000
1.873626  0.207051  0.373931  5.301658  1.998332  0.000000
1.934066  0.207533  0.386460  5.861239  2.034133  0.000000
1.994505  0.208016  0.399017  6.439229  2.069934  0.000000
2.054945  0.208498  0.411604  7.035061  2.105735  0.000000
2.115385  0.208980  0.424220  7.648215  2.141535  0.000000
2.175824  0.209463  0.436866  8.278215  2.177336  0.000000
2.236264  0.209945  0.449540  8.924621  2.213137  0.000000
2.296703  0.210427  0.462244  9.587029  2.248938  0.000000
2.357143  0.210910  0.474976  10.26506  2.284738  0.000000
2.417582  0.211392  0.487738  10.95836  2.320539  0.000000
2.478022  0.211874  0.500529  11.66660  2.356340  0.000000
2.538462  0.212357  0.513349  12.38948  2.392141  0.000000
2.598901  0.212839  0.526199  13.12670  2.427941  0.000000
2.659341  0.213322  0.539077  13.87799  2.463742  0.000000
2.719780  0.213804  0.551985  14.64308  2.499543  0.000000
2.780220  0.214286  0.564922  15.42175  2.535344  0.000000
2.840659  0.214769  0.577888  16.21374  2.571144  0.000000
2.901099  0.215251  0.590883  17.01885  2.606945  0.000000
2.961538  0.215734  0.603907  17.83686  2.642746  0.000000
3.000000  0.216041  0.612210  18.66757  2.665528  0.000000
END FTABLE  1
FTABLE      4
 47    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.441464  0.000000  0.000000
0.054945  0.441125  0.004742  0.000000
0.109890  0.440448  0.009493  0.000000
0.164835  0.439772  0.014251  0.000000
0.219780  0.439095  0.019017  0.004251
0.274725  0.438418  0.023790  0.010013
0.329670  0.437741  0.028572  0.019258
0.384615  0.437065  0.033361  0.032547
0.439560  0.436388  0.038158  0.050370
0.494505  0.435711  0.042963  0.073166
0.549451  0.435035  0.047776  0.101339
0.604396  0.434358  0.052597  0.135264
0.659341  0.433681  0.057425  0.175290
0.714286  0.433004  0.067097  0.220074
0.769231  0.432328  0.076785  0.269392
```

```
  0.824176  0.431651  0.086489  0.304190
  0.879121  0.430974  0.096208  0.310642
  0.934066  0.430298  0.105943  0.346817
  0.989011  0.429621  0.115693  0.379426
  1.043956  0.428944  0.125459  0.409354
  1.098901  0.428268  0.135241  0.437172
  1.153846  0.427591  0.145038  0.463274
  1.208791  0.426914  0.154851  0.487945
  1.263736  0.426238  0.164679  0.511399
  1.318681  0.425561  0.174523  0.533803
  1.373626  0.424884  0.184383  0.555286
  1.428571  0.424208  0.194258  0.575956
  1.483516  0.423531  0.204149  0.595900
  1.538462  0.422855  0.213938  0.615191
  1.593407  0.422178  0.223742  0.633890
  1.648352  0.421501  0.233561  0.652051
  1.703297  0.420825  0.243396  0.669718
  1.758242  0.420148  0.253246  0.686932
  1.813187  0.419472  0.263112  0.703729
  1.868132  0.418795  0.272993  0.720138
  1.923077  0.418118  0.282890  0.736188
  1.978022  0.417442  0.292802  0.751905
  2.032967  0.416765  0.302729  0.767312
  2.087912  0.416089  0.312672  0.782432
  2.142857  0.415412  0.322630  0.797284
  2.197802  0.414736  0.332604  0.811892
  2.252747  0.414059  0.342593  0.826276
  2.307692  0.413382  0.352598  0.840465
  2.362637  0.412706  0.362618  0.854493
  2.417582  0.412029  0.372654  0.873984
  2.472527  0.411353  0.382704  0.913660
  2.500000  0.410676  0.814245  0.920504
  END FTABLE  4
  FTABLE      3
   47    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.410676  0.000000  0.000000  0.920504  0.000000
  0.054945  0.442140  0.024275  0.000000  2.197038  0.000000
  0.109890  0.442817  0.048587  0.000000  2.274672  0.000000
  0.164835  0.443494  0.072936  0.000000  2.352306  0.000000
  0.219780  0.444171  0.097322  0.000000  2.429940  0.000000
  0.274725  0.444848  0.121746  0.000000  2.507574  0.000000
  0.329670  0.445524  0.146207  0.000000  2.585207  0.000000
  0.384615  0.446201  0.170705  0.000000  2.662841  0.000000
  0.439560  0.446878  0.195240  0.000000  2.740475  0.000000
  0.494505  0.447555  0.219812  0.000000  2.818109  0.000000
  0.549451  0.448232  0.244422  0.071397  2.895743  0.000000
  0.604396  0.448908  0.269068  0.219001  2.973377  0.000000
  0.659341  0.449585  0.293752  0.412965  3.051011  0.000000
  0.714286  0.450262  0.318473  0.644040  3.128644  0.000000
  0.769231  0.450939  0.343232  0.907006  3.206278  0.000000
  0.824176  0.451616  0.368027  1.198379  3.283912  0.000000
  0.879121  0.452293  0.392860  1.515618  3.361546  0.000000
  0.934066  0.452970  0.417730  1.856764  3.439180  0.000000
  0.989011  0.453646  0.442637  2.220246  3.516814  0.000000
  1.043956  0.454323  0.467581  2.604767  3.594448  0.000000
  1.098901  0.455000  0.492562  3.009233  3.672081  0.000000
  1.153846  0.455677  0.517581  3.432705  3.749715  0.000000
  1.208791  0.456354  0.542637  3.874366  3.827349  0.000000
  1.263736  0.457031  0.567730  4.333494  3.904983  0.000000
  1.318681  0.457708  0.592860  4.809450  3.982617  0.000000
  1.373626  0.458385  0.618027  5.301658  4.060251  0.000000
  1.428571  0.459062  0.643232  5.809598  4.137885  0.000000
  1.483516  0.459738  0.668474  6.332797  4.215519  0.000000
  1.538462  0.460415  0.693753  6.870823  4.293152  0.000000
  1.593407  0.461092  0.719069  7.423277  4.370786  0.000000
  1.648352  0.461769  0.744422  7.989792  4.448420  0.000000
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1.703297  0.462446  0.769813  8.570027  4.526054  0.000000
1.758242  0.463123  0.795240  9.163666  4.603688  0.000000
1.813187  0.463800  0.820705  9.770412  4.681322  0.000000
1.868132  0.464477  0.846207  10.38999  4.758956  0.000000
1.923077  0.465154  0.871747  11.02213  4.836589  0.000000
1.978022  0.465831  0.897323  11.66660  4.914223  0.000000
2.032967  0.466508  0.922937  12.32317  4.991857  0.000000
2.087912  0.467185  0.948588  12.99160  5.069491  0.000000
2.142857  0.467862  0.974276  13.67171  5.147125  0.000000
2.197802  0.468539  1.000001  14.36328  5.224759  0.000000
2.252747  0.469216  1.025764  15.06614  5.302393  0.000000
2.307692  0.469893  1.051563  15.78010  5.380026  0.000000
2.362637  0.470570  1.077400  16.50500  5.457660  0.000000
2.417582  0.471247  1.103274  17.24067  5.535294  0.000000
2.472527  0.471924  1.129186  17.98696  5.612928  0.000000
2.500000  0.472262  1.142155  18.74371  5.651745  0.000000
END FTABLE  3
FTABLE      6
 47    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.356310  0.000000  0.000000
0.054945  0.356007  0.003797  0.000000
0.109890  0.355401  0.007601  0.000000
0.164835  0.354796  0.011412  0.000000
0.219780  0.354190  0.015230  0.003403
0.274725  0.353585  0.019054  0.008016
0.329670  0.352979  0.022886  0.015417
0.384615  0.352374  0.026725  0.026055
0.439560  0.351768  0.030571  0.040323
0.494505  0.351163  0.034424  0.058573
0.549451  0.350557  0.038283  0.081126
0.604396  0.349952  0.046017  0.108284
0.659341  0.349346  0.053764  0.140327
0.714286  0.348741  0.061526  0.177520
0.769231  0.348135  0.069301  0.220074
0.824176  0.347530  0.077091  0.268356
0.879121  0.346924  0.084894  0.269392
0.934066  0.346319  0.092711  0.310642
0.989011  0.345713  0.100543  0.346817
1.043956  0.345108  0.108388  0.379426
1.098901  0.344502  0.116247  0.409354
1.153846  0.343897  0.124120  0.437172
1.208791  0.343292  0.132008  0.463274
1.263736  0.342686  0.139909  0.487945
1.318681  0.342081  0.147824  0.511399
1.373626  0.341475  0.155753  0.533803
1.428571  0.340870  0.163696  0.555286
1.483516  0.340265  0.171653  0.575956
1.538462  0.339659  0.179529  0.595900
1.593407  0.339054  0.187419  0.615191
1.648352  0.338448  0.195323  0.633890
1.703297  0.337843  0.203240  0.652051
1.758242  0.337238  0.211172  0.669718
1.813187  0.336632  0.219117  0.686932
1.868132  0.336027  0.227076  0.703729
1.923077  0.335421  0.235049  0.720138
1.978022  0.334816  0.243035  0.736188
2.032967  0.334211  0.251036  0.751905
2.087912  0.333605  0.259050  0.767312
2.142857  0.333000  0.267078  0.782432
2.197802  0.332395  0.275120  0.797284
2.252747  0.331789  0.283175  0.811892
2.307692  0.331184  0.291245  0.826276
2.362637  0.330579  0.299328  0.846093
2.417582  0.329973  0.307425  0.873984
2.472527  0.329368  0.315536  0.913660
2.500000  0.328763  0.671152  0.920504
END FTABLE  6
FTABLE      5
```

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   47    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.328763  0.000000  0.000000  0.920504  0.000000
  0.054945  0.356915  0.019594  0.000000  1.758817  0.000000
  0.109890  0.357521  0.039221  0.000000  1.820966  0.000000
  0.164835  0.358126  0.058882  0.000000  1.883115  0.000000
  0.219780  0.358732  0.078576  0.000000  1.945264  0.000000
  0.274725  0.359338  0.098303  0.000000  2.007413  0.000000
  0.329670  0.359943  0.118064  0.000000  2.069562  0.000000
  0.384615  0.360549  0.137857  0.000000  2.131711  0.000000
  0.439560  0.361154  0.157684  0.000000  2.193860  0.000000
  0.494505  0.361760  0.177545  0.000000  2.256009  0.000000
  0.549451  0.362365  0.197438  0.107095  2.318158  0.000000
  0.604396  0.362971  0.217365  0.328502  2.380307  0.000000
  0.659341  0.363577  0.237325  0.619447  2.442456  0.000000
  0.714286  0.364182  0.257319  0.966060  2.504605  0.000000
  0.769231  0.364788  0.277345  1.360509  2.566754  0.000000
  0.824176  0.365394  0.297405  1.797568  2.628903  0.000000
  0.879121  0.365999  0.317498  2.273427  2.691052  0.000000
  0.934066  0.366605  0.337625  2.785146  2.753201  0.000000
  0.989011  0.367211  0.357785  3.330369  2.815350  0.000000
  1.043956  0.367816  0.377978  3.907150  2.877499  0.000000
  1.098901  0.368422  0.398204  4.513849  2.939648  0.000000
  1.153846  0.369028  0.418464  5.149057  3.001797  0.000000
  1.208791  0.369633  0.438756  5.811548  3.063946  0.000000
  1.263736  0.370239  0.459083  6.500241  3.126095  0.000000
  1.318681  0.370845  0.479442  7.214175  3.188244  0.000000
  1.373626  0.371450  0.499835  7.952487  3.250393  0.000000
  1.428571  0.372056  0.520261  8.714397  3.312542  0.000000
  1.483516  0.372662  0.540720  9.499196  3.374691  0.000000
  1.538462  0.373267  0.561213  10.30623  3.436840  0.000000
  1.593407  0.373873  0.581738  11.13491  3.498989  0.000000
  1.648352  0.374479  0.602297  11.98469  3.561138  0.000000
  1.703297  0.375084  0.622890  12.85504  3.623287  0.000000
  1.758242  0.375690  0.643516  13.74550  3.685436  0.000000
  1.813187  0.376296  0.664175  14.65562  3.747585  0.000000
  1.868132  0.376902  0.684867  15.58498  3.809734  0.000000
  1.923077  0.377507  0.705592  16.53320  3.871883  0.000000
  1.978022  0.378113  0.726351  17.49991  3.934032  0.000000
  2.032967  0.378719  0.747143  18.48475  3.996181  0.000000
  2.087912  0.379325  0.767969  19.48741  4.058330  0.000000
  2.142857  0.379930  0.788827  20.50756  4.120479  0.000000
  2.197802  0.380536  0.809719  21.54493  4.182628  0.000000
  2.252747  0.381142  0.830644  22.59921  4.244777  0.000000
  2.307692  0.381748  0.851603  23.67016  4.306926  0.000000
  2.362637  0.382354  0.872595  24.75750  4.369075  0.000000
  2.417582  0.382959  0.893620  25.86101  4.431224  0.000000
  2.472527  0.383565  0.914678  26.98044  4.493373  0.000000
  2.500000  0.383868  0.925220  28.11557  4.524447  0.000000
  END FTABLE  5
  FTABLE      8
   47    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.530190  0.000000  0.000000
  0.055055  0.529885  0.005743  0.000000
  0.110110  0.529140  0.011494  0.000000
  0.165165  0.528394  0.017254  0.000000
  0.220220  0.527649  0.023023  0.005158
  0.275275  0.526903  0.028800  0.012156
  0.330330  0.526158  0.034586  0.023384
  0.385385  0.525412  0.040381  0.039524
  0.440440  0.524667  0.046184  0.061171
  0.495495  0.523922  0.051995  0.088860
  0.550549  0.523176  0.057816  0.123079
  0.605604  0.522431  0.063645  0.164284
  0.660659  0.521685  0.069482  0.212901
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  0.715714  0.520940  0.075329  0.220515
  0.770769  0.520194  0.087038  0.269837
  0.825824  0.519449  0.098765  0.311102
  0.880879  0.518704  0.110509  0.347296
  0.935934  0.517958  0.122271  0.379924
  0.990989  0.517213  0.134049  0.409872
  1.046044  0.516468  0.145845  0.437709
  1.101099  0.515722  0.157658  0.463831
  1.156154  0.514977  0.169488  0.488521
  1.211209  0.514231  0.181336  0.511994
  1.266264  0.513486  0.193201  0.534416
  1.321319  0.512741  0.205083  0.555918
  1.376374  0.511995  0.216982  0.576605
  1.431429  0.511250  0.228898  0.596566
  1.486484  0.510505  0.240832  0.615874
  1.541538  0.509759  0.252641  0.634590
  1.596593  0.509014  0.264466  0.652767
  1.651648  0.508269  0.276309  0.670450
  1.706703  0.507523  0.288169  0.687680
  1.761758  0.506778  0.300046  0.704492
  1.816813  0.506033  0.311940  0.720916
  1.871868  0.505288  0.323850  0.736982
  1.926923  0.504542  0.335778  0.752714
  1.981978  0.503797  0.347723  0.768136
  2.037033  0.503052  0.359685  0.783270
  2.092088  0.502306  0.371664  0.798138
  2.147143  0.501561  0.383660  0.812761
  2.202198  0.500816  0.395673  0.827162
  2.257253  0.500071  0.407703  0.841367
  2.312308  0.499325  0.419750  0.855414
  2.367363  0.498580  0.431814  0.869364
  2.422418  0.497835  0.443896  0.883361
  2.477473  0.497090  0.455994  0.916529
  2.500000  0.496344  0.967993  0.921651
  END FTABLE  8
  FTABLE      7
   47    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.496344  0.000000  0.000000  0.921651  0.000000
  0.055055  0.530936  0.029210  0.000000  2.655533  0.000000
  0.110110  0.531681  0.058461  0.000000  2.749549  0.000000
  0.165165  0.532427  0.087753  0.000000  2.843565  0.000000
  0.220220  0.533172  0.117087  0.000000  2.937581  0.000000
  0.275275  0.533918  0.146461  0.000000  3.031597  0.000000
  0.330330  0.534663  0.175876  0.000000  3.125614  0.000000
  0.385385  0.535409  0.205333  0.000000  3.219630  0.000000
  0.440440  0.536154  0.234830  0.000000  3.313646  0.000000
  0.495495  0.536900  0.264369  0.000000  3.407662  0.000000
  0.550549  0.537645  0.293948  0.166028  3.501678  0.000000
  0.605604  0.538391  0.323569  0.501336  3.595694  0.000000
  0.660659  0.539136  0.353230  0.940729  3.689710  0.000000
  0.715714  0.539882  0.382933  1.463605  3.783726  0.000000
  0.770769  0.540628  0.412677  2.058281  3.877742  0.000000
  0.825824  0.541373  0.442461  2.716943  3.971759  0.000000
  0.880879  0.542119  0.472287  3.433890  4.065775  0.000000
  0.935934  0.542864  0.502154  4.204718  4.159791  0.000000
  0.990989  0.543610  0.532062  5.025894  4.253807  0.000000
  1.046044  0.544355  0.562011  5.894501  4.347823  0.000000
  1.101099  0.545101  0.592001  6.808078  4.441839  0.000000
  1.156154  0.545847  0.622032  7.764512  4.535855  0.000000
  1.211209  0.546592  0.652104  8.761961  4.629871  0.000000
  1.266264  0.547338  0.682217  9.798803  4.723888  0.000000
  1.321319  0.548083  0.712371  10.87360  4.817904  0.000000
  1.376374  0.548829  0.742566  11.98504  4.911920  0.000000
  1.431429  0.549575  0.772803  13.13197  5.005936  0.000000
  1.486484  0.550320  0.803080  14.31332  5.099952  0.000000
  1.541538  0.551066  0.833398  15.52811  5.193968  0.000000
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1.596593  0.551811  0.863758  16.77545  5.287984  0.000000
1.651648  0.552557  0.894158  18.05450  5.382000  0.000000
1.706703  0.553303  0.924600  19.36450  5.476016  0.000000
1.761758  0.554048  0.955082  20.70474  5.570033  0.000000
1.816813  0.554794  0.985606  22.07455  5.664049  0.000000
1.871868  0.555540  1.016171  23.47330  5.758065  0.000000
1.926923  0.556285  1.046776  24.90041  5.852081  0.000000
1.981978  0.557031  1.077423  26.35532  5.946097  0.000000
2.037033  0.557777  1.108111  27.83751  6.040113  0.000000
2.092088  0.558522  1.138840  29.34649  6.134129  0.000000
2.147143  0.559268  1.169610  30.88179  6.228145  0.000000
2.202198  0.560014  1.200421  32.44297  6.322161  0.000000
2.257253  0.560760  1.231273  34.02961  6.416178  0.000000
2.312308  0.561505  1.262166  35.64130  6.510194  0.000000
2.367363  0.562251  1.293100  37.27766  6.604210  0.000000
2.422418  0.562997  1.324076  38.93832  6.698226  0.000000
2.477473  0.563742  1.355092  40.62294  6.792242  0.000000
2.500000  0.564048  1.367795  42.33117  6.830712  0.000000
END FTABLE  7
FTABLE     10
 47    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.376015  0.000000  0.000000
0.055055  0.375760  0.004023  0.000000
0.110110  0.375136  0.008054  0.000000
0.165165  0.374512  0.012092  0.000000
0.220220  0.373888  0.016137  0.003613
0.275275  0.373264  0.020189  0.008515
0.330330  0.372640  0.024249  0.016380
0.385385  0.372016  0.028315  0.027687
0.440440  0.371392  0.032389  0.042850
0.495495  0.370768  0.036470  0.062246
0.550549  0.370144  0.040559  0.086216
0.605604  0.369521  0.044654  0.115080
0.660659  0.368897  0.052859  0.149136
0.715714  0.368273  0.061079  0.188667
0.770769  0.367649  0.069314  0.220515
0.825824  0.367025  0.077562  0.269837
0.880879  0.366401  0.085826  0.311102
0.935934  0.365777  0.094103  0.342726
0.990989  0.365153  0.102395  0.347296
1.046044  0.364529  0.110702  0.379924
1.101099  0.363906  0.119022  0.409872
1.156154  0.363282  0.127358  0.437709
1.211209  0.362658  0.135707  0.463831
1.266264  0.362034  0.144072  0.488521
1.321319  0.361410  0.152450  0.511994
1.376374  0.360786  0.160843  0.534416
1.431429  0.360162  0.169250  0.555918
1.486484  0.359539  0.177672  0.576605
1.541538  0.358915  0.186008  0.596566
1.596593  0.358291  0.194358  0.615874
1.651648  0.357667  0.202723  0.634590
1.706703  0.357043  0.211101  0.652767
1.761758  0.356420  0.219494  0.670450
1.816813  0.355796  0.227901  0.687680
1.871868  0.355172  0.236322  0.704492
1.926923  0.354548  0.244758  0.720916
1.981978  0.353924  0.253208  0.736982
2.037033  0.353301  0.261672  0.752714
2.092088  0.352677  0.270150  0.768136
2.147143  0.352053  0.278643  0.783270
2.202198  0.351429  0.287150  0.798138
2.257253  0.350806  0.295671  0.812761
2.312308  0.350182  0.304206  0.827162
2.367363  0.349558  0.312756  0.848534
2.422418  0.348934  0.321320  0.876465
2.477473  0.348311  0.329898  0.916529
2.500000  0.347687  0.700166  0.921651
```

```
  END FTABLE 10
  FTABLE      9
   47    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.347687  0.000000  0.000000  0.921651  0.000000
  0.055055  0.376639  0.020719  0.000000  1.860188  0.000000
  0.110110  0.377263  0.041472  0.000000  1.926046  0.000000
  0.165165  0.377887  0.062259  0.000000  1.991904  0.000000
  0.220220  0.378511  0.083081  0.000000  2.057762  0.000000
  0.275275  0.379135  0.103937  0.000000  2.123620  0.000000
  0.330330  0.379759  0.124827  0.000000  2.189477  0.000000
  0.385385  0.380383  0.145752  0.000000  2.255335  0.000000
  0.440440  0.381007  0.166711  0.000000  2.321193  0.000000
  0.495495  0.381631  0.187705  0.000000  2.387051  0.000000
  0.550549  0.382255  0.208733  0.221370  2.452909  0.000000
  0.605604  0.382879  0.229795  0.668448  2.518767  0.000000
  0.660659  0.383503  0.250892  1.254306  2.584624  0.000000
  0.715714  0.384127  0.272022  1.951474  2.650482  0.000000
  0.770769  0.384752  0.293188  2.744374  2.716340  0.000000
  0.825824  0.385376  0.314387  3.622591  2.782198  0.000000
  0.880879  0.386000  0.335621  4.578520  2.848056  0.000000
  0.935934  0.386624  0.356890  5.606290  2.913914  0.000000
  0.990989  0.387248  0.378193  6.701191  2.979771  0.000000
  1.046044  0.387872  0.399530  7.859334  3.045629  0.000000
  1.101099  0.388496  0.420901  9.077437  3.111487  0.000000
  1.156154  0.389120  0.442307  10.35268  3.177345  0.000000
  1.211209  0.389744  0.463747  11.68261  3.243203  0.000000
  1.266264  0.390368  0.485222  13.06507  3.309061  0.000000
  1.321319  0.390992  0.506730  14.49813  3.374919  0.000000
  1.376374  0.391616  0.528274  15.98006  3.440776  0.000000
  1.431429  0.392241  0.549851  17.50930  3.506634  0.000000
  1.486484  0.392865  0.571463  19.08443  3.572492  0.000000
  1.541538  0.393489  0.593110  20.70415  3.638350  0.000000
  1.596593  0.394113  0.614790  22.36726  3.704208  0.000000
  1.651648  0.394737  0.636505  24.07267  3.770066  0.000000
  1.706703  0.395361  0.658255  25.81934  3.835923  0.000000
  1.761758  0.395985  0.680038  27.60632  3.901781  0.000000
  1.816813  0.396610  0.701857  29.43273  3.967639  0.000000
  1.871868  0.397234  0.723709  31.29774  4.033497  0.000000
  1.926923  0.397858  0.745596  33.20054  4.099355  0.000000
  1.981978  0.398482  0.767517  35.14042  4.165213  0.000000
  2.037033  0.399106  0.789473  37.11668  4.231070  0.000000
  2.092088  0.399730  0.811463  39.12866  4.296928  0.000000
  2.147143  0.400355  0.833487  41.17573  4.362786  0.000000
  2.202198  0.400979  0.855546  43.25730  4.428644  0.000000
  2.257253  0.401603  0.877639  45.37281  4.494502  0.000000
  2.312308  0.402227  0.899766  47.52173  4.560360  0.000000
  2.367363  0.402851  0.921928  49.70354  4.626217  0.000000
  2.422418  0.403476  0.944124  51.91776  4.692075  0.000000
  2.477473  0.404100  0.966355  54.16392  4.757933  0.000000
  2.500000  0.404355  0.975461  56.44156  4.784881  0.000000
  END FTABLE  9
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.067          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.067          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.067          RCHRES   1     EXTNL  PREC
WDM      2 PREC     ENGL    1.067          RCHRES   3     EXTNL  PREC
WDM      2 PREC     ENGL    1.067          RCHRES   5     EXTNL  PREC
WDM      2 PREC     ENGL    1.067          RCHRES   7     EXTNL  PREC
WDM      2 PREC     ENGL    1.067          RCHRES   9     EXTNL  PREC
WDM      2 PREC     ENGL    1.067          RCHRES  11     EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.5             RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7             RCHRES   2     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5             RCHRES   3     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7             RCHRES   4     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5             RCHRES   5     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7             RCHRES   6     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5             RCHRES   7     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7             RCHRES   8     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.5             RCHRES   9     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7             RCHRES  10     EXTNL  POTEV
WDM      1 EVAP     ENGL    1               RCHRES  11     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES  11 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES  11 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     12.1      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       16
RCHRES     ROFLOW                         COPY           INPUT  MEAN
  END MASS-LINK   16

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1963/ 2/ 1  5: 0

RCHRES:    11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2         VOL
91 2.1431E+04 2.1737E+04 2.1864E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1963/ 2/ 1  5: 0

RCHRES:    11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
3.1276E+01 1.2201E+04 -1.732E+04    1.4140  1.4140E+00      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1963/11/20  1: 0

RCHRES:    11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2         VOL
91 2.1431E+04 2.1737E+04 2.6417E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1963/11/20  1: 0

RCHRES:    11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
3.1276E+01 1.2201E+04 -1.995E+05   15.714   1.5714E+01      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1967/ 1/21 20: 0

RCHRES:    11
```

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	3.1049E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1967/ 1/21 20: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-3.848E+05	29.329	2.9329E+01	4

ERROR/WARNING ID: 341 6

DATE/TIME: 1967/ 1/21 21: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	2.4499E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1967/ 1/21 21: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-1.227E+05	9.8104	9.8103E+00	3

ERROR/WARNING ID: 341 6

DATE/TIME: 1968/ 1/29 24: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	2.5089E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1968/ 1/29 24: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-1.463E+05	11.645	11.644	3

ERROR/WARNING ID: 341   6

DATE/TIME: 1969/ 1/24 24: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	2.3461E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1969/ 1/24 24: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-8.119E+04	6.5445	6.5445	3

ERROR/WARNING ID: 341   6

DATE/TIME: 1972/11/11 1: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	2.7155E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1972/11/11 1: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).

Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

```
A          B          C      RDEP1      RDEP2  COUNT
3.1276E+01 1.2201E+04 -2.290E+05   17.940     17.940        4
```

ERROR/WARNING ID: 341   6

DATE/TIME: 1972/11/14 1: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

```
NROWS         V1         V2        VOL
91 2.1431E+04 2.1737E+04 2.2039E+04
```

ERROR/WARNING ID: 341   5

DATE/TIME: 1972/11/14 1: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

```
A          B          C      RDEP1      RDEP2  COUNT
3.1276E+01 1.2201E+04 -2.431E+04    1.9819  1.9819E+00      3
```

ERROR/WARNING ID: 341   6

DATE/TIME: 1982/ 1/ 4 21: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

```
NROWS         V1         V2        VOL
91 2.1431E+04 2.1737E+04 2.3449E+04
```

ERROR/WARNING ID: 341   5

DATE/TIME: 1982/ 1/ 4 21: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

```
A          B          C      RDEP1      RDEP2  COUNT
3.1276E+01 1.2201E+04 -8.073E+04    6.5082  6.5081E+00      3
```

ERROR/WARNING ID: 341   6

DATE/TIME: 1982/ 1/ 4 22: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	2.3530E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1982/ 1/ 4 22: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-8.394E+04	6.7621	6.7621	3

ERROR/WARNING ID: 341   6

DATE/TIME: 1982/12/22 14: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	2.2108E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1982/12/22 14: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-2.708E+04	2.2073	2.2073E+00	3

ERROR/WARNING ID: 341   6

DATE/TIME: 1983/ 1/22 11: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

```
NROWS         V1         V2         VOL
91 2.1431E+04 2.1737E+04 2.3038E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1983/ 1/22 11: 0

RCHRES:    11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
3.1276E+01 1.2201E+04 -6.428E+04    5.1994  5.1994E+00      3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1983/ 1/24  2: 0

RCHRES:    11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2         VOL
91 2.1431E+04 2.1737E+04 2.3412E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1983/ 1/24  2: 0

RCHRES:    11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
3.1276E+01 1.2201E+04 -7.925E+04    6.3903     6.3903       3
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1983/ 4/28  5: 0

RCHRES:    11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2         VOL
91 2.1431E+04 2.1737E+04 2.3221E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1983/ 4/28  5: 0

RCHRES:    11
```

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-7.160E+04	5.7821	5.7821	3

ERROR/WARNING ID: 341   6

DATE/TIME: 1986/ 2/18 22: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	2.4026E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1986/ 2/18 22: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-1.038E+05	8.3281	8.3280E+00	3

ERROR/WARNING ID: 341   6

DATE/TIME: 1986/ 2/18 23: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	2.3706E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1986/ 2/18 23: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-9.101E+04	7.3214	7.3213E+00	3

ERROR/WARNING ID: 341   6

DATE/TIME: 1993/ 2/ 8 13: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	2.2081E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1993/ 2/ 8 13: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-2.600E+04	2.1198	2.1198E+00	3

ERROR/WARNING ID: 341   6

DATE/TIME: 1995/ 1/ 9 21: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS	V1	V2	VOL
91	2.1431E+04	2.1737E+04	2.2131E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1995/ 1/ 9 21: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
3.1276E+01	1.2201E+04	-2.800E+04	2.2815	2.2815E+00	3

ERROR/WARNING ID: 341   6

DATE/TIME: 1995/ 1/ 9 22: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the

simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS   V1   V2   VOL
91 2.1431E+04 2.1737E+04 2.4005E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1995/ 1/ 9 22: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A   B   C   RDEP1   RDEP2 COUNT
3.1276E+01 1.2201E+04 -1.030E+05   8.2641 8.2640E+00   3

ERROR/WARNING ID: 341   6

DATE/TIME: 1996/ 1/27 6: 0

RCHRES: 11

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB(). To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows. This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS   V1   V2   VOL
91 2.1431E+04 2.1737E+04 2.3970E+04

The count for the WARNING printed above has reached its maximum.

If the condition is encountered again the message will not be repeated.

ERROR/WARNING ID: 341   5

DATE/TIME: 1996/ 1/27 6: 0

RCHRES: 11

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A   B   C   RDEP1   RDEP2 COUNT
3.1276E+01 1.2201E+04 -1.016E+05   8.1535   8.1535   3

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APPENDIX F – HYDROMODIFICATION MANAGEMENT PLAN EXHIBIT

0 25 50 100
SCALE: 1"=50'

BIOSWALE

STREET A

BIO-CELL #5
BASIN EL. 482.0 ±
15,145 ± sq. ft.

DIVERSION STRUCTURE
(SEE DETAIL BELOW)

HIGH FLOW STORM DRAIN
(ABOVE 10-YR STORM HM TREATMENT FLOWS)

HM OVERFLOW
PIPE TO BASIN

TASSAJARA ROAD

HM BASIN
0.46 AC. FT. VOL. @ 4.2' DEPTH
(3,640 SQ. FT. BASIN FLOOR AREA)

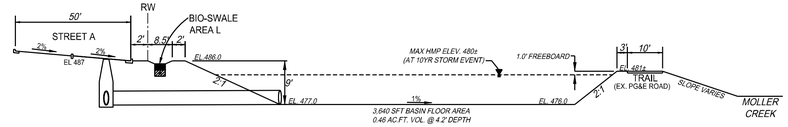
HM BASIN OUTFALL PIPE TO CREEK

HIGH FLOW OUTFALL PIPE TO CREEK

OUTFALL TO CREEK AT PROPOSED
TASSAJARA RD. CULVERT

Pool

Horse Trees

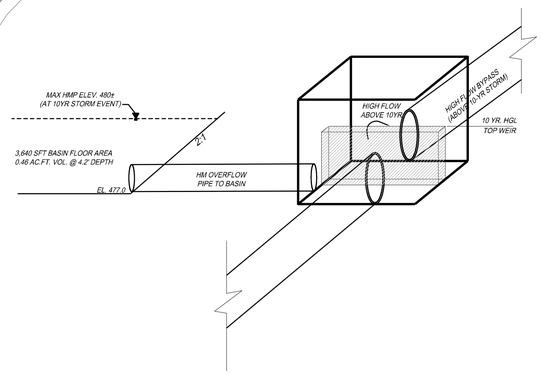


SECTION A-A

N.T.S.

HM BASIN

0.46 AC.FT. IN BASIN



HM BASIN & DIVERSION STRUCTURE DETAIL

N.T.S.

(LOOKING DOWNSTREAM ALONG STREET A)

0.46 AC.FT. IN BASIN

SHEET 1 OF 2

MOLLER RANCH
APPENDIX F
HYDROMODIFICATION EXHIBIT

CITY OF DUBLIN — CALIFORNIA

MACKAY & SOMPS
ENGINEERS PLANNERS SURVEYORS
5142B FRANKLIN DR, PLEASANTON, CA 94588 (925)225-0690

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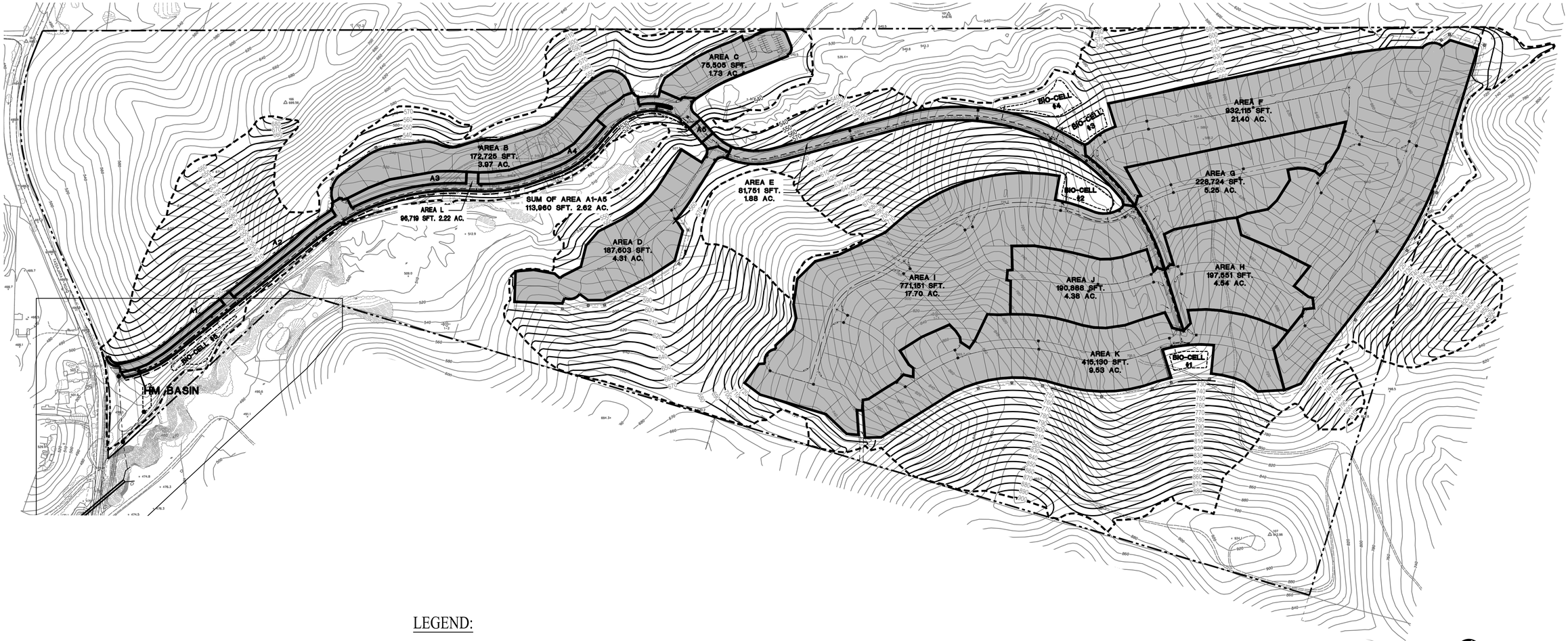
PLEASANTON	1" = 50'	6-26-2015	19569.010
OFFICE	SCALE	DATE	JOB NO.

06-26-2015 4:51pm Kim Reed P:\19569\HYDRO\APP-F-PRELIM-HM-EXHPG1&2-6-26-15.DWG



LEGEND:

TOTAL DEVELOPMENT AREA TREATED BY HYDROMODIFICATION BASIN (80AC.±)

0 100 200 400

SCALE:1"=200'

SHEET 2 OF 2

MOLLER RANCH
APPENDIX F
HYDROMODIFICATION EXHIBIT

CITY OF DUBLIN CALIFORNIA

MacKay & Somps
ENGINEERS PLANNERS SURVEYORS
5142B FRANKLIN DR, PLEASANTON, CA 94588 (925)225-0690

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OFFICE	SCALE	DATE	JOB NO.

06-26-2015 4:50pm Kim Reed P:\19569\HYDRO\APP-F-PRELIM-HM-EXHPG1&2-6-26-15.DWG

APPENDIX G – OPEN SPACE STORM DRAINAGE EXHIBIT

DISCHARGE OPEN SPACE RUNOFF BACK TO MOLLER CREEK AT BRIDGE CROSSING

DISCHARGE OPEN SPACE RUNOFF BACK TO MOLLER CREEK ALONG NEW EARTH SWALE

DISCHARGE OPEN SPACE RUNOFF INTO HIGH FLOW BYPASS STORM DRAIN AND BACK TO MOLLER CREEK

LEGEND:

- OPEN SPACE SHED DRAINS TO ACCESS/MAINT. BENCH, CONVEYED BY EARTH SWALE AND OPEN SPACE STORM DRAIN LINE TO DISCHARGE POINT AT NEW EARTH SWALE, BACK TO MOLLER CREEK
- OPEN SPACE SHEDS DRAIN TO ACCESS/MAINT. BENCH, CONVEYED BY EARTH SWALE AND OPEN SPACE STORM DRAIN LINE, ROUTED THROUGH DEVELOPMENT IN SEPARATE SDO LINE (SDO LINE SHOWN IN COLOR), DISCHARGED TO MOLLER CREEK AT NEW BRIDGE CROSSING
- OPEN SPACE SHEDS DRAIN TO ACCESS/MAINT. BENCH, CONVEYED BY EARTH SWALE AND OPEN SPACE STORM DRAIN LINE, ROUTED THROUGH DEVELOPMENT IN SEPARATE SDO LINE (SDO LINE SHOWN IN COLOR), DISCHARGED TO MOLLER CREEK AT NEW BRIDGE CROSSING
- OPEN SPACE SHED DRAINS TO EARTH SWALE AND OPEN SPACE STORM DRAIN ALONG TOE OF SLOPE DISCHARGE INTO HIGH FLOW BYPASS LINE AND BACK TO MOLLER CREEK AT NEW TASSAJARA RD. CULVERT

0 100 200 400
SCALE:1"=200'

SHEET 1 OF 1

MOLLER RANCH
APPENDIX G
OPEN SPACE STORM DRAIN EXHIBIT

CITY OF DUBLIN CALIFORNIA

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OFFICE	SCALE	DATE	JOB NO.

06-26-2015 4:54pm Kim Reed P:\19569\HYDRO\APP-G-OPENSPACE-STORMDRAIN-EXH-6-26-15.DWG

APPENDIX "L" – SOIL SPECIFICATIONS FOR BIOFILTRATION FACILITIES

Appendix



Soil Specifications

The regional biotreatment soil specifications, approved by the Regional Water Board on November 28, 2011, are provided on the following pages. The soil specifications are included in Attachment L of the Municipal Regional Stormwater Permit (MRP), as amended. Effective December 1, 2011, stormwater biotreatment measures are required to use the Water Board-approved specifications. Alternative biotreatment mixes that achieve a long-term infiltration rate of 5 to 10 inches per hour, and are suitable for plant health, may be used in accordance with the requirements described in the specifications, under the heading "Verification of Alternative Bioretention Soil Mixes".

ATTACHMENT L

Provision C.3.c.i.(1)(b)(vi)

Specification of soils for Biotreatment or Bioretention Facilities

Soils for biotreatment or bioretention areas shall meet two objectives:

- Be sufficiently permeable to infiltrate runoff at a minimum rate of 5" per hour during the life of the facility, and
- Have sufficient moisture retention to support healthy vegetation.

Achieving both objectives with an engineered soil mix requires careful specification of soil gradations and a substantial component of organic material (typically compost).

Local soil products suppliers have expressed interest in developing 'brand-name' mixes that meet these specifications. At their sole discretion, municipal construction inspectors may choose to accept test results and certification for a 'brand-name' mix from a soil supplier.

Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site.

Batch-specific test results and certification shall be required for projects installing more than 100 cubic yards of bioretention soil.

SOIL SPECIFICATIONS

Bioretention soils shall meet the following criteria. "Applicant" refers to the entity proposing the soil mixture for approval by a Permittee.

1. General Requirements – Bioretention soil shall:
   a. Achieve a long-term, in-place infiltration rate of at least 5 inches per hour.
   b. Support vigorous plant growth.
   c. Consist of the following mixture of fine sand and compost, measured on a volume basis:

      60%-70% Sand

      30%-40% Compost

2. Submittal Requirements – The applicant shall submit to the Permittee for approval:
   a. A sample of mixed bioretention soil.
   b. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.
   c. Grain size analysis results of the fine sand component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
   d. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in 4.

e. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".

f. Grain size analysis results of compost component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.

g. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.

h. Provide the name of the testing laboratory(s) and the following information:

(1) Contact person(s)

(2) Address(s)

(3) Phone contact(s)

(4) E-mail address(s)

(5) Qualifications of laboratory(s), and personnel including date of current certification by STA, ASTM, or approved equal

3. Sand for Bioretention Soil

a. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be nonplastic.

b. Sand for Bioretention Soils shall be analyzed by an accredited lab using #200, #100, #40, #30, #16. #8, #4, and 3/8 inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***
3/8 inch	100	100
No. 4	90	100
No. 8	70	100
No. 16	40	95
No. 30	15	70
No. 40	5	55
No. 100	0	15
No. 200	0	5

Note: all sands complying with ASTM C33 for fine aggregate comply with the above gradation requirements.

4. Composted Material

Compost shall be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials not including manure or biosolids meeting the standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).

a. Compost Quality Analysis – Before delivery of the soil, the supplier shall submit a copy of lab analysis performed by a laboratory that is enrolled in the US Composting Council's Compost Analysis Proficiency (CAP) program and using approved Test Methods for the Evaluation of Composting and Compost (TMECC). The lab report shall verify:

(1) Feedstock Materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues.

(2) Organic Matter Content: 35% - 75% by dry wt.

(3) Carbon and Nitrogen Ratio: C:N < 25:1 and C:N >15:1

(4) Maturity/Stability: shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120F) upon delivery or rewetting is not acceptable. In addition any one of the following is required to indicate stability:

(i) Oxygen Test < 1.3 O2 /unit TS /hr

(ii) Specific oxy. Test < 1.5 O2 / unit BVS /

(iii) Respiration test < 8 C / unit VS / day

(iv) Dewar test < 20 Temp. rise (°C) e.

(v) Solvita® > 5 Index value

(5) Toxicity: any one of the following measures is sufficient to indicate non-toxicity.

(i) NH4- : NO3-N < 3

(ii) Ammonium < 500 ppm, dry basis

(iii) Seed Germination > 80 % of control

(iv) Plant Trials > 80% of control

(v) Solvita® > 5 Index value

(6) Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.

(i) Total Nitrogen content 0.9% or above preferred.

(ii) Boron: Total shall be <80 ppm; Soluble shall be <2.5 ppm

(7) Salinity: Must be reported; < 6.0 mmhos/cm

(8) pH shall be between 6.5 and 8. May vary with plant species.

b. Compost for Bioretention Soil Texture – Compost for bioretention soils shall be analyzed by an accredited lab using #200, 1/4 inch, 1/2 inch, and 1 inch sieves ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)	
	Min	***Max***
1 inch	99	100
1/2 inch	90	100
1/4 inch	40	90
No. 200	2	10

c. Bulk density shall be between 500 and 1100 dry lbs/cubic yard

d. Moisture content shall be between 30% - 55% of dry solids.

e. Inerts – compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1 % by weight or volume.

f. Weed seed/pathogen destruction – provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C for 15 days with at least 5 turnings during that period.

g. Select Pathogens – Salmonella <3 MPN/4grams of TS, or Coliform Bacteria <10000 MPN/gram.

h. Trace Contaminants Metals (Lead, Mercury, Etc.) – Product must meet US EPA, 40 CFR 503 regulations.

i. Compost Testing – The compost supplier will test all compost products within 120 calendar days prior to application. Samples will be taken using the STA sample collection protocol. (The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741 Phone: 631-737-4931, www.compostingcouncil.org). The sample shall be sent to an independent STA Program approved lab. The compost supplier will pay for the test.

VERIFICATION OF ALTERNATIVE BIORETENTION SOIL MIXES

Bioretention soils not meeting the above criteria shall be evaluated on a case by case basis. Alternative bioretention soil shall meet the following specification: “Soils for bioretention facilities shall be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility, and provide sufficient retention of moisture and nutrients to support healthy vegetation.”

The following steps shall be followed by municipalities to verify that alternative soil mixes meet the specification:

1. General Requirements – Bioretention soil shall achieve a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall also support vigorous plant growth. The applicant refers to the entity proposing the soil mixture for approval.

   a. Submittals – The applicant must submit to the municipality for approval:

      (1) A sample of mixed bioretention soil.

      (2) Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.

      (3) Certification from an accredited geotechnical testing laboratory that the Bioretention Soil has an infiltration rate between 5 and 12 inches per hour as tested according to Section 1.b.(2)(ii).

      (4) Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".

      (5) Grain size analysis results of mixed bioretention soil performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.

      (6) A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.

      (7) The name of the testing laboratory(s) and the following information:

         (i) contact person(s)

         (ii) address(s)

         (iii) phone contact(s)

         (iv) e-mail address(s)

         (v) qualifications of laboratory(s), and personnel including date of current certification by STA, ASTM, or approved equal

   b. Bioretention Soil

      (1) Bioretention Soil Texture

      Bioretention Soils shall be analyzed by an accredited lab using #200, and 1/2" inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***
1/2 inch	97	100
No. 200	2	5

      (2) Bioretention Soil Permeability testing

      Bioretention Soils shall be analyzed by an accredited geotechnical lab for the following tests:

(i) Moisture – density relationships (compaction tests) shall be conducted on bioretention soil. Bioretention soil for the permeability test shall be compacted to 85 to 90 percent of the maximum dry density (ASTM D1557).

(ii) Constant head permeability testing in accordance with ASTM D2434 shall be conducted on a minimum of two samples with a 6-inch mold and vacuum saturation.

MULCH FOR BIORETENTION FACILITIES

Mulch is recommended for the purpose of retaining moisture, preventing erosion and minimizing weed growth. Projects subject to the State's Model Water Efficiency Landscaping Ordinance (or comparable local ordinance) will be required to provide at least two inches of mulch. Aged mulch, also called compost mulch, reduces the ability of weeds to establish, keeps soil moist, and replenishes soil nutrients. Aged mulch can be obtained through soil suppliers or directly from commercial recycling yards. It is recommended to apply 1" to 2" of composted mulch, once a YUear, preferably in June following weeding.



EXHIBIT H

TASSAJARA HILLS DEVELOPMENT
Riparian Mitigation and Monitoring Plan











H.T. HARVEY & ASSOCIATES
Ecological Consultants

Moller Ranch Residential Development and Tassajara Road Culvert Replacement Projects

Riparian Mitigation and Monitoring Plan

Project # 3313-03

Prepared for:

Braddock & Logan Services, Inc.
Contact: Mr. Jeff Lawrence
4155 Blackhawk Plaza Circle, Suite201
Danville, CA 94526-1076

Prepared by:

H. T. Harvey & Associates

24 September 2014

983 University Avenue, Building D • Los Gatos, CA 95032 • Ph: 408.458.3200 • F: 408.458.3210

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Section 1.0 Introduction and Responsible Parties

1.1 Purpose of this Riparian Mitigation & Monitoring Plan

Braddock & Logan, Inc. proposes to construct a residential housing development and a culvert replacement project along Tassajara Creek in Alameda County, California. The Moller Ranch Residential Development Project (the "Moller Ranch Project") and the Tassajara Road Culvert Replacement Project (the "Culvert Replacement Project"; hereafter, collectively, the "Project") are expected to impact a total of 1.21 acres (ac) of riparian habitat, 3.35 ac of wetlands, and 0.93 ac (8,913 linear feet [ln ft]) of drainages. In this Riparian Habitat Mitigation and Monitoring Plan (MMP), "riparian habitat" refers to woody vegetation growing within the bed and banks of creek channels and along the top of creek channel banks.

The purpose of this MMP is to provide the Regional Water Quality Control Board (RWQCB) and the California Department of Fish and Wildlife (CDFW) with sufficient information regarding the Project's proposed riparian habitat and drainage channel impacts and associated compensatory on-site mitigation such that these impacts can be evaluated by the Lake and Streambed Alteration Agreement and Clean Water Act Section 401 water quality certification that the Project has requested.

Mitigation for wetland impacts within USACE jurisdiction and additional riparian habitat mitigation is proposed at the Cayetano Creek Preserve and is described in the *Mitigation & Monitoring Plan for the Cayetano Creek Preserve* (Olberding Environmental, Inc. 2014)

All measures prescribed in this MMP shall be funded by the Applicant/Permittee identified below.

1.2 Responsible Parties

1.2.1 Applicant/Permittee

Braddock & Logan Services, Inc.
P. O. Box 5300
Danville, CA 94526-1076
Contact- Jeff Lawrence, Vice President
P: (925) 736-4000

1.2.2 Preparer of the Mitigation and Monitoring Plan

H. T. Harvey & Associates
983 University Avenue, Building D
Los Gatos, California 95032
Contact- Max Busnardo, M.S., Principal Restoration Ecologist
P: (408) 458-3222

1.2.3 Land Ownership

The Project's Riparian Restoration Area (described below) and Mitigation Swales/Channels are proposed on lands owned by Moller RE Investors, LLC.

Moller RE Investors, LLC
Contact - Jeff Lawrence, Vice President
4155 Blackhawk Plaza Circle, Suite 201
Danville, CA 94526
P: (925) 736-4000

Ownership of the portion to the Riparian Mitigation Area that falls within Alameda County, as well as the Mitigation Swales/Channels will be transferred to a Geologic Hazard Abatement District (GHAD) following Project completion. The GHAD will be responsible for protecting the Project's developments from geologic hazards.

1.2.4 Land Management

The Applicant/Permittee will be responsible for implementing the riparian mitigation and monitoring measures set forth in this MMP. After the Riparian Mitigation Areas and Mitigation Swales/ Channels meet the final success criteria described in this MMP, responsibility for management of the Riparian Restoration Area and Mitigation Swales/ Channels will be transferred to the Agricultural-Natural Resources Trust of Contra Costa County (hereafter, "the Trust"). The Trust will be responsible for the long-term management of the habitat in these areas in perpetuity (see Section 5.1.7).

Agricultural-Natural Resources Trust of Contra Costa County
Contact - Joe Ciolek, Executive Director
2366-A Stanwell Circle
Concord, CA 94520
P: (925) 588-5351

The GHAD will be responsible for notifying the Trust and obtaining all applicable environmental clearance approvals prior to any geologic hazard abatement work that impacts the Riparian Restoration Area and/or the Mitigation Swales/Channels.

Section 2.0 Project Requiring Mitigation

The Project information in this section is based on the Project's *California Environmental Protection Agency San Francisco Bay Regional Water Quality Control Board Application for 401 Water Quality Certification and/or Report of Waste Discharge* and *State of California Department of Fish and Wildlife Notification of Lake or Streambed Alteration* submitted under the project names, "Moller Ranch Project" and "Tassajara Road Culvert Replacement Project" and the Project's Biological Assessments *(H. T. Harvey & Associates 2013a; H. T. Harvey & Associates 2013b)*.

2.1 Location

The Moller Ranch Project is located within the northern area of the Eastern Extended Planning area of the City of Dublin within Alameda County (Figure 1). The Moller Ranch Project site is located on the east side of Tassajara Road and north of Fallon Crossing. The Alameda County boundary line with Contra Costa County forms the northerly boundary of the Moller Ranch Project site. The Moller Ranch Project site consists of 182.85 ac. The lands to the south, east, and north are primarily composed of public and private open spaces, including private conservation easements, grazing lands, and publicly owned regional parklands. Lands to the southwest and west comprise privately owned open spaces bordered by residential development.

The Culvert Replacement Project is located in Alameda County, approximately 4.3 miles (mi) northeast of the center of the City of Dublin along lower Moller Creek, just above its confluence with Tassajara Creek and just downstream of the Moller Ranch Project (Figure 1). The Culvert Replacement Project site consists of approximately 2.45 ac including Tassajara Road where it crosses Moller Creek, as well as Moller Creek and surrounding uplands extending approximately 250 feet (ft) upstream and 270 ft downstream of the existing culvert under Tassajara Road. The site is bordered on the east and south by residential areas, to the west by a ranchette, and to the north by the proposed Moller Ranch Project. The corridors of Moller Creek south of the Culvert Replacement Project site, and Tassajara Creek to the south of its confluence with Moller Creek, are currently undeveloped, and portions of Tassajara Creek and adjacent uplands southwest of the Culvert Replacement Project site fall within protected open space managed by the East Bay Regional Parks District.

2.2 Summary of Project

The Moller Ranch Project proposes the construction of up to 381 single-family homes on lots of various sizes, a neighborhood park, staging area and trails, transportation and utilities infrastructure (including a single crossing over Moller Creek), and a system of bio-retention cells for storm water pollution control. The Culvert Replacement Project entails the replacement of an existing, failing culvert, with an enlarged culvert that will allow for the eventual expansion of Tassajara Road from two to six lanes. The eventual replacement of the existing roadway will also help to protect a 20-inch diameter water distribution main located in

Tassajara Road that is owned and maintained by Dublin San Ramon Services District (DSRSD) and provides regional water supply between Dublin and Dougherty Valley.

2.3 Site Characteristics

The vegetation at the Moller Ranch Project site comprises primarily California annual grassland (173.82 ac), with some eucalyptus dominated riparian woodland (0.51 ac), seasonal wetland and seeps (3.47 ac), ephemeral and intermittent drainages (0.73 ac), perennial drainage (0.19 ac), and freshwater wetland/aquatic (0.01 ac). The site is primarily undeveloped and is used for livestock grazing. Moller Creek is an incised, intermittent drainage which flows through the Project site. Moller Creek is tributary to Tassajara Creek and is part of the Alameda Creek watershed.

The Culvert Replacement Project construction disturbance area extends along Moller Creek approximately 250 ft upstream and 270 ft downstream of Tassajara Road. Habitat types within the Culvert Replacement Project boundary include Tassajara Road (0.09 ac), the existing culvert (0.03 ac), California annual grassland (1.49 ac), valley oak (*Quercus lobata*)/ red willow (*Salix laevigata*) riparian woodland (0.70 ac), freshwater wetland/aquatic (0.17) and roadside coyote brush (*Baccharis pilularis*)/ valley oak woodland (0.06 ac).

2.4 Riparian Woodland Habitat Impacts

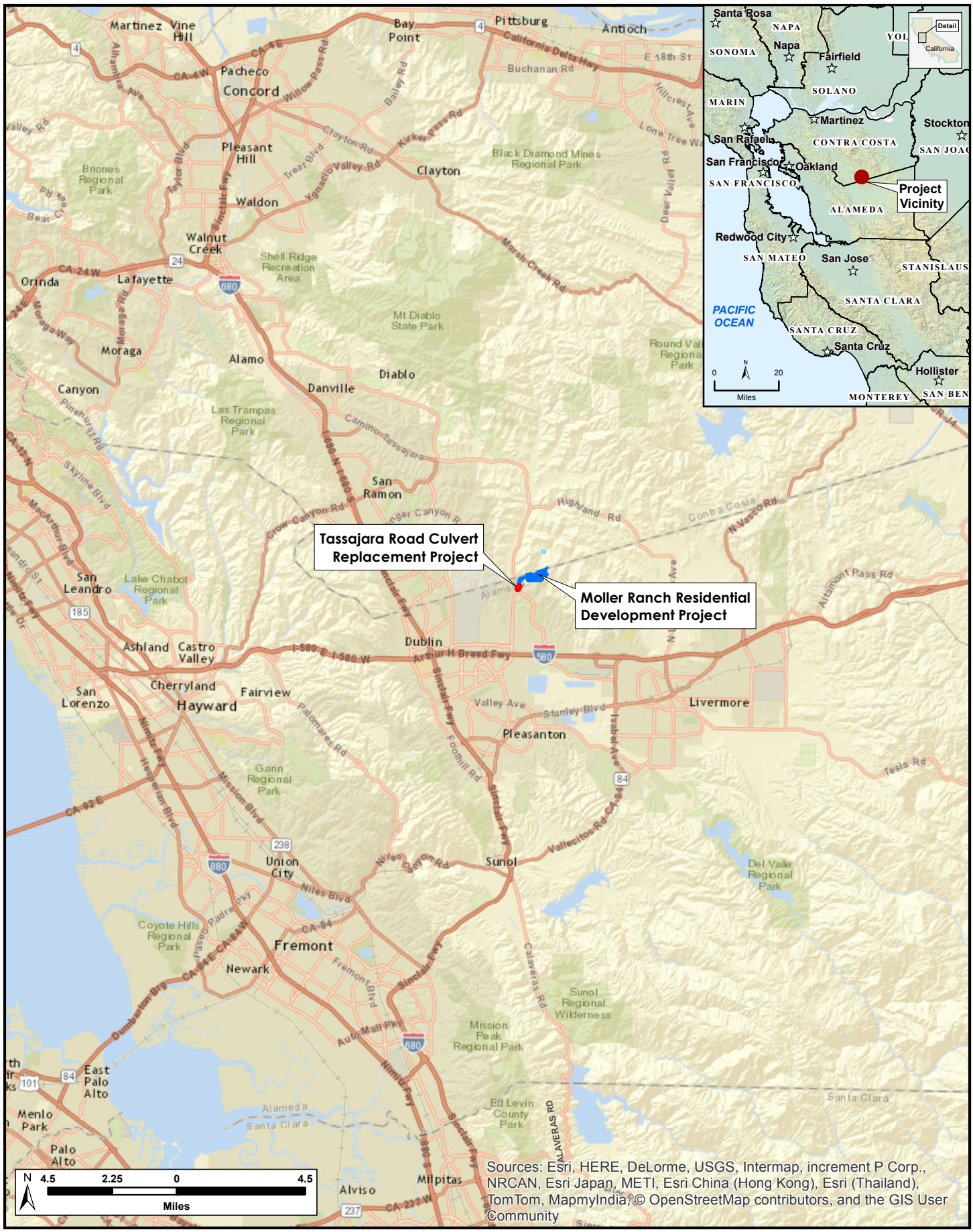
The Moller Ranch Project will permanently impact 0.51 ac of riparian habitat. This consists, primarily, of eucalyptus (*Eucalyptus sp.*) dominated riparian woodland (non-native) located in two patches along Moller Creek (Figure 2). The eucalyptus patches have no understory and provide low quality habitat for nesting birds and small mammals (H. T. Harvey & Associates 2013c). A small portion of the riparian corridor along lower Moller Creek near Tassajara Road will also be impacted. Riparian woodland in this area is dominated by valley oak and red willow (native), with an understory comprised mostly by non-native annual grasses and forbs, coyote brush and poison oak (*Toxicodendron diversilobum*).

The Culvert Replacement Project will permanently impact 0.70 ac of mature valley oak and red willow riparian habitat along Moller Creek (Figure 2) upstream and downstream of Tassajara Road. Moller Creek along the downstream portion of the riparian impact area is deeply incised. The riparian understory in the impact area is predominantly composed of non-native annual grasses (e.g., Italian ryegrass *(Festuca multiflorum*), wild oats (*Avena fatua*) and ripgut brome (*Bromus diandrus*), small patches of coyote brush, poison oak and mugwort (*Artemisia douglasiana*).

2.5 Drainage Channel Impacts

The Project will permanently impact/fill approximately 0.93 ac (8,913 ln ft) of drainage channel habitat, which constitute both Waters of the U. S. and State. Figure 2 shows the drainage channel impact locations. The majority of this impact will be due to the Moller Ranch Project and its associated mass grading plan. The

Moller Ranch Project will impact 0.92 ac (8,362 ln ft) of drainage channels, whereas the Culvert Replacement Project will permanently impact 0.01 ac (551 ln ft) of drainage channel habitat along Moller Creek. The drainages impacted by the Moller Ranch Project are tributaries to Moller Creek and exhibit flow regimes that are ephemeral (short flow duration after rain events) and intermittent (flow present during the rainy season). These drainages occur within the matrix of non-native grassland habitat and do not support riparian woodland habitat. This grassland is dominated by annual Mediterranean grasses such as wild oats, Italian ryegrass, and soft chess brome (*Bromus hordeaceus*) interspersed with a variety of native annual herbs such as hayfield tarweed (*Hemizonia congesta*) and small patches of non-native species such as yellow star thistle (*Centaurea solstitialis*) and sweet fennel (*Foeniculum vulgare*).



N:\Projects3300\3313-01\03\Reports\Riparian MMP\Fig 1 Vicinity Map.mxd

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Figure 1: Project Vicinity Map
Moller Ranch Residential Development Project (MRRDP) and Tassajara Road Culvert Replacement Project (TRCRP) MMP (3313-03)
September 2014

LEGEND

- Moller Ranch Residential Development Project (MRRDP)
- Tassajara Road Culvert Replacement Project (TRCRP)
- MRRDP Riparian Woodland Habitat Impacts (0.51 ac)
- TRCRP Riparian Woodland Habitat Impacts (0.70 ac)
- Drainage Channel Habitat Impacts (0.93 ac)

N 450 225 0 450
Feet

PG&E Station

Moller Creek

Camino Tassajara Rd

Tassajara Creek

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, Swisstopo, and the GIS User Community

Aerial Date: 05/10/2010

N:\Projects3300\3313-01\03\Reports\Riparian MMP\Fig 2 Riparian Habitat Impacts Map.mxd

H.T. HARVEY & ASSOCIATES
Ecological Consultants

Figure 2: Riparian Woodland and Drainage Channel Habitat Impacts Map
Moller Ranch Residential Development Project (MRRDP) and
Tassajara Road Culvert Replacement Project (TRCRP) MMP (3313-03)
September 2014

Section 3.0 Conceptual Riparian and Drainage Channel Mitigation Design

3.1 Proposed Habitat Mitigation for Project Impacts

The Moller Ranch project will mitigate for impacts to jurisdictional waters and for impacts to riparian woodland habitat through a combination of mitigation measures located both at the Moller Ranch, and at the Cayetano Creek Preserve. Table 1 summarizes the mitigation for those impacts, including specifying the location and type of mitigation proposed. The following sections of this document provide the specific management methodology for riparian and drainage channel mitigation provided at the Moller Ranch Project site.

Table 1. Summary of Mitigation for the Moller Ranch Residential Project

	Impact	Mitigation	Location	Mitigation Ratio	Mitigation Type
Wetland	3.18 ac	6.36 ac wetland creation	Cayetano Preserve	2:1	Off-site creation
Drainage Channels	0.92 ac	0.92 ac wetland creation	Cayetano Preserve	1:1	Off-site, out-of-kind creation
Riparian	0.51 ac	1.53 ac riparian enhancement	Moller Ranch	3:1	On-site creation
		1.53 ac riparian enhancement	Cayetano Preserve	3:1	Off-site creation
Drainage Channels	8,362 LF	7,256 LF creation	Moller Ranch	0.87:1	On-site creation
		710 LF enhancement	Moller Ranch	0.08:1	On-site enhancement
		2,812 LF riparian enhancement[1]	Moller Ranch	0.34:1	On-site enhancement
		3,798 LF riparian enhancement	Cayetano Preserve	0.45:1	Off-site enhancement
		34,830 LF channel preservation	Moller Ranch	4.17:1	On-site preservation

[1]*Represents length of Moller Creek Restoration within Alameda County*

The Tassajara Road Culvert Replacement project will mitigate for impacts to jurisdictional waters and for impacts to riparian woodland habitat through a combination of mitigation measures located both at the Moller Ranch Project site, and at the Cayetano Creek Preserve. Table 2 summarizes the mitigation for those impacts, including specifying the location and type of mitigation proposed. The following sections of this document provide the specific management methodology for riparian and drainage channel mitigation provided at the Moller Ranch Project site.

Table 2. Summary of Mitigation for Tassajara Road Culvert Project

	Impact	Mitigation	Location	Mitigation Ratio	Mitigation Type
Wetland	0.17 ac	0.34 ac wetland creation	Cayetano Preserve	2:1	Off-site creation[1]
Drainage Channel	0.01 ac	0.01 ac wetland creation	Cayetano Preserve	1:1	Off-site, out-of-kind creation
Riparian	0.70 ac	2.10 ac riparian enhancement	Moller Ranch	3:1	On-site creation
		2.10 ac riparian enhancement	Cayetano Preserve	3:1	Off-site creation
Drainage Channel	551 LF	2661 LF riparian enhancement[1]	Moller Ranch	4.83:1	Off-site enhancement

[1]*Represents length of Moller Creek Restoration within Contra Costa County*

3.2 Basis for Design

3.2.1 Riparian Mitigation Ratios and Surface Area

The applicant is proposing to mitigate for impacts to a total of 1.21 ac of mixed riparian woodland by active revegetation of at least 3.63 ac of riparian woodland (Table 3). This mitigation proposed herein will compensate for lost riparian habitat functions and is intended to meet the requirements of the Clean Water Act and Section 1600 of the CDFW code. The mitigation ratio proposed (Table 1) is also consistent with the requirements of the Project's *Final Supplemental Environmental Impact Report* (Haag 2012).

Table 3. Surface Area of Riparian Habitat Impacts and Proposed On-site Mitigation

Impact Type	Impact Area (ac)	Mitigation Ratio (Mitigation Area: Impact Area)	Mitigation Area (ac) Required [1]
Permanent Loss of Red Willow/ Valley Oak and Eucalyptus Riparian Canopy	1.21	3:1	3.63 ac

[1] Riparian impacts are per the Moller Ranch Residential Development Project (0.51 ac) and Tassajara Road Culvert Replacement Project (0.70 ac)

3.2.2 Riparian Mitigation Opportunities and Goals

Figure 3 presents the proposed location of the "Riparian Restoration Area" along Moller Creek. The Riparian Restoration Area comprises active riparian revegetation areas (the "Riparian Mitigation Area") interspersed with a larger "Riparian Enhancement Area" which will be managed to reduce erosion and improve Moller Creek water quality. Cattle exclusion fencing will be installed approximately 20 feet from the top-of-bank along Moller Creek to protect the entire Riparian Restoration Area from cattle grazing (Figure 3).

The Riparian Restoration Area extends upstream and downstream of the proposed crossing of Moller Creek (Figure 3). The lower half of the Riparian Restoration Area is in Alameda County. The upper half of the Riparian Restoration Area is in Contra Costa County and the proposed Moller Ranch Conservation Area. The location of the Riparian Restoration Area does not overlap with the tributary channel enhancements or site grading proposed in the Moller Ranch Project area (ENGEO 2013).

The Riparian Restoration Area (Figure 3) offers the opportunity to restore a mosaic of high-quality riparian habitat along a 5,473 linear foot (ln ft) stretch of Moller Creek. Intensive and prolonged cattle grazing, a lack of existing native woody propagule sources, and a dry climate have resulted in a lack of woody vegetation within the Riparian Restoration Area (H. T. Harvey & Associates 2014). A detailed investigation of soils in the proposed Riparian Mitigation Areas relative to reference sites (Appendix A) and hydrology studies (Appendix B), confirm that a mosaic of riparian willow, valley oak and scrub/oak plant associations can be established in the Riparian Mitigation Areas. For example, salinity and boron levels in the proposed Riparian Mitigation Areas are below levels seen in other successful riparian mitigation sites in the Dublin area (Appendix A). Furthermore, analysis of the site's water budget determined that sufficient water is available to support the acreage and composition of plantings in the Riparian Mitigation Areas (Appendix B).

The overall goal of the MMP is to provide a relatively contiguous 5,473-foot wooded riparian corridor that connects to a downstream riparian reference area. The riparian restoration proposed in this MMP is not specifically intended to enhance habitat for special-status species. The more specific riparian mitigation goals are described below and the riparian enhancement goals in the next section.

3.2.2.1 Riparian Mitigation Goals

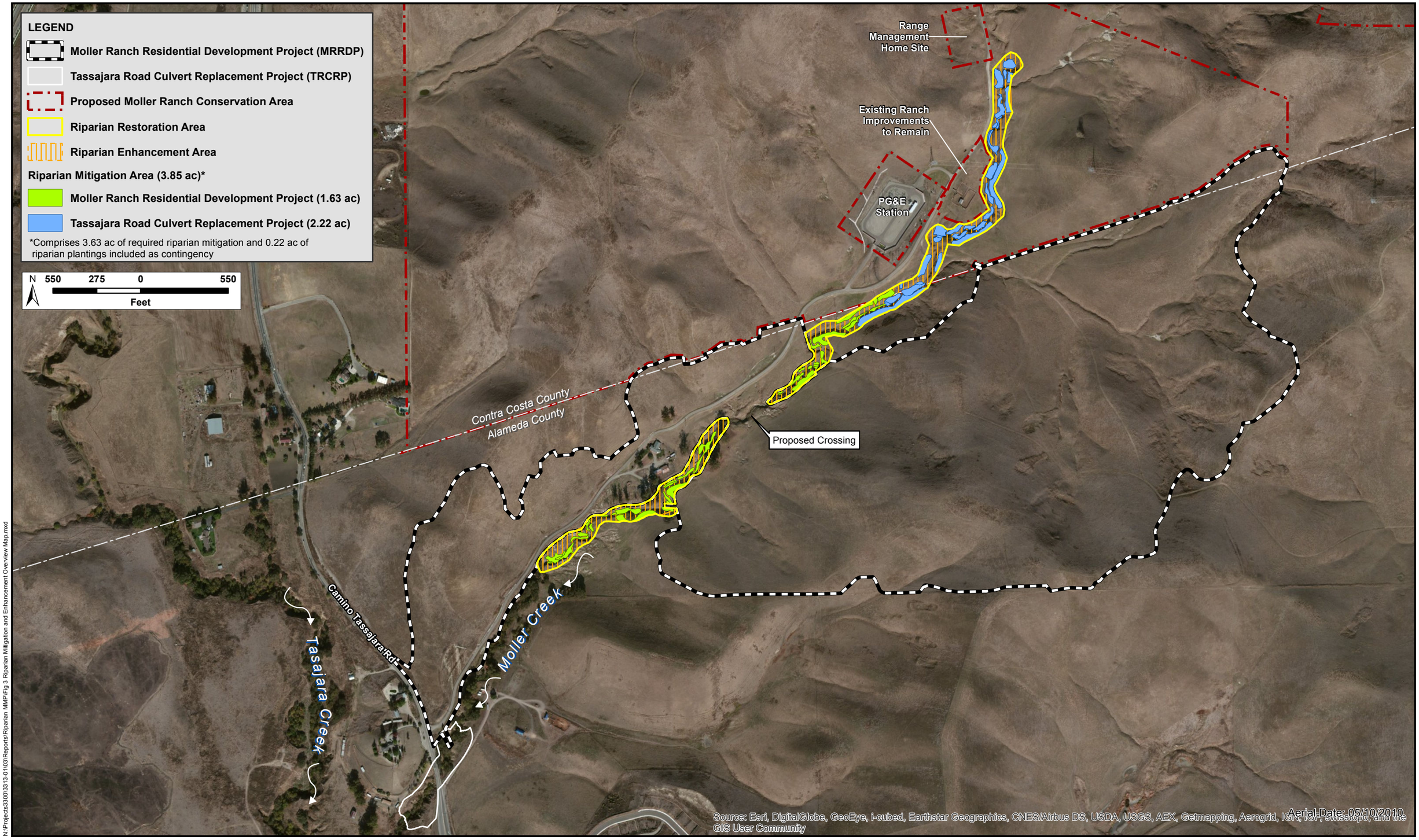
The goal of the riparian mitigation is to restore a minimum of 3.63 ac of native tree and shrub dominated riparian habitat to mitigate for lost functions of the mature red willow/ valley oak and eucalyptus riparian woodland habitats impacted by the Project. Ample suitable area is available in a mosaic of patches within the Riparian Restoration Area to meet this mitigation goal. The Riparian Mitigation Area surface area is shown in Figure 3, totals 3.85 ac, and provides a 5% acreage contingency above the 3.63 ac of required mitigation. Under the proposed layout of Riparian Mitigation Areas, the Moller Ranch Project riparian impacts will be mitigated by 1.63 ac and the Culvert Replacement Project will be mitigated by 2.22 ac of riparian mitigation (Figure 3). The mitigation work will restore a relatively contiguous riparian habitat corridor connected to the existing riparian habitat along Moller Creek just upstream of the Tassajara Road crossing, more than doubling the length of riparian habitat along Moller Creek (Figure 3). Riparian revegetation within the Riparian Mitigation Areas will create wooded riparian areas beneficial for wildlife and increase channel and bank stability relative to the current condition.

These goals will be accomplished by a combination of cattle exclusion (via fence installation) and active revegetation. Active revegetation includes a combination of plant installation and maintenance, irrigation and weed control. A variety of riparian trees, shrubs and forbs will be revegetated. Within the Riparian Mitigation Areas, valley oaks, shrubs and forbs will be revegetated on suitable terraces and slopes within the creek. A

mix of oak and shrub species will be revegetated along the top of the creek bank, where topography and soils are favorable. A small proportion of the Riparian Mitigation Areas' floodplains will be revegetated with willows (*Salix* spp.) where hydrology and soils are suitable.

3.2.2.2 Riparian Enhancement Goals

The goal of the riparian enhancement is to decrease soil erosion and improve the local creek water quality along 5,473 linear feet (6.81 ac) of riparian habitat along Moller Creek; a secondary long-term goal is to facilitate the gradual establishment of woody riparian habitat through natural recruitment. This area is shown as the Riparian Enhancement Area on Figure 3.



N:\Projects3300\3313-01103\Reports\Riparian MMP\Fig 3 Riparian Mitigation and Enhancement Overview Map.mxd

H.T. HARVEY & ASSOCIATES
Ecological Consultants

Figure 3: Riparian Mitigation and Enhancement Overview Map
Moller Ranch Residential Development Project (MRRDP) and Tassajara Road Culvert Replacement Project (TRCRP) MMP (3313-03)
September 2014

These goals will be achieved by installing and maintaining cattle exclusion fencing and by controlling noxious weeds during a 5 year vegetation maintenance period (H. T. Harvey & Associates 2014). No active revegetation is proposed in the Riparian Enhancement Area because slope steepness and/or soil chemistry (salinity and boron concentrations) are not suitable for woody riparian revegetation (Appendix A). However, cattle exclusion will quickly lead to greater herbaceous vegetation cover and height compared to the current condition and may also result in the gradual, long-term establishment of woody riparian habitat patches via natural recruitment. Moreover, cattle exclusion will eliminate trampling within the creek bed and banks and reduce fecal matter inputs to the creek. These improvements are intended to decrease soil erosion and improve creek water quality.

3.3 Riparian Mitigation-Site Selection

The Riparian Restoration Area was selected to be located as close to the riparian habitat impacts as possible. H. T. Harvey & Associates' restoration ecologists conducted a detailed field investigation of soils, hydrology, and vegetation to determine specific locations suitable for woody riparian revegetation (e.g. for the Riparian Mitigation Areas) within the Riparian Restoration Area. Soils in the vicinity of the Riparian Restoration Area can have elevated salinity and boron; a condition that reduces plant vigor and growth, and could preclude woody riparian vegetation establishment in extreme cases (H. T. Harvey & Associates 2014). Therefore, H. T. Harvey & Associates sampled soil in existing (reference) valley oak and willow habitat along Moller Creek, reviewed performance of willow and oak trees planted in boron laden or saline soils from other riparian mitigation projects in the area, and reviewed salinity and boron tolerance limits in the literature to establish soil chemistry criteria for the specific plant associations within the Riparian Mitigation Areas. The methods and results of this study are provided in Appendix A; key results are presented below.

Based on our investigation, three target plant associations were identified as suitable for riparian mitigation: willow, valley oak and scrub/oak. These associations were identified based on soil chemistry, landscape position, and vegetation/hydrology; and then mapped with a mapping grade Trimble GPS unit. Together, these plant associations provide sufficient acreage to meet the goal of providing no less than 3.63 ac of riparian mitigation.

The following criteria were used to select Riparian Mitigation Area plant associations (Appendix A):

Willow Plant Associations

- Boron less than 3.0 parts per million (ppm) and salinity less than 3.0 parts per thousand (ppt).
- Landscape position characterized by floodplain terraces near the creek channel bottom and ponded areas downstream of head cuts.
- Vegetated with predominantly obligate wetland species (e.g., yerba mansa, spikerush, cattail [*Typha sp*]).

Valley Oak Plant Associations

- Boron less than 1.5 ppm and salinity less than 2.0 ppt.
- Landscape position characterized by floodplain terraces approximately 3-5 ft above the channel and creek bank slopes.
- Vegetated with, predominantly, facultative or upland grasses and forbs (e.g., foxtail [*Hordium murinum*], coastal heron's bill (*Erodium cicutarium*) and bearded ryegrass [*Elymus triticoides*]).

Scrub/Oak Plant Associations

- Boron less than 1.5 ppm and salinity less than 2.0 ppt.
- Located within approximately 20 ft of the top-of-bank.
- Vegetated with, upland grasses and forbs (e.g., foxtail, coastal heron's bill, and wild oats [*Avena fatua*].

3.4 Existing and Proposed Riparian Restoration Area Functions and Values

These sections present existing conditions in the proposed Riparian Restoration Area and describe how riparian mitigation and enhancement will affect hydrology, soils, vegetation, wildlife and land use.

3.4.1 Hydrology/Topography

Moller Creek is tributary to Tassajara Creek within the Alameda Creek watershed. Moller Creek is incised and shows evidence of flashy winter flows, including eroded cut banks and high wrack lines. The creek supports a mosaic of wetlands and pools scattered throughout the length of the drainage. The pools range in depth from approximately 0.5 ft to 3 ft or more. Aside from a small number of perennial pools, Moller Creek does not retain notable amounts of standing or flowing water in summer months.

Water quality in Moller Creek is currently degraded by cattle grazing which increases streambed and bank erosion, sediment loads, nutrient levels, and fecal coliform counts. Head and bank cuts along the Riparian Restoration Area further degrade water quality. Fencing and the establishment of riparian woodland habitat will improve Moller Creek water quality by excluding cattle and helping to stabilize head and bank cuts (Appendix B). Cessation of grazing will increase vegetation cover on creek banks, leading to increased filtration of sediment and pollutants from lateral sources.

ENGEO assessed water requirements of the proposed Riparian Mitigation Areas. Following an initial 3 year vegetation establishment period in which plantings will receive supplemental irrigation, Moller Creek groundwater and seeps will be sufficient to support the proposed willow association plantings. Rain water will be sufficient to sustain the valley oak and scrub/oak plant associations (Appendix B). In addition to modeled rainfall and groundwater flows assessed by ENGEO, sub-drains will deliver nuisance flows to the Riparian

Restoration Area (ENGEO 2013). As a result, flows from sub-drains will likely benefit riparian mitigation plantings, especially during summer months.

3.4.2 Soils

The United States Department of Agriculture National Resource Conservation Service (USDA/NRCS) classifies soils in the Riparian Restoration Area as Pescadero clay loam (poorly drained). Soil sampling in the Riparian Mitigation Areas determined that soil texture ranged from sandy loam to clay in areas suitable for willow revegetation (Appendix A). Soil texture in the oak and scrub/oak target revegetation areas were generally sandy loam or sandy clay loam.

Targeted soil sampling by H. T. Harvey & Associates in the Riparian Restoration Area found that soil salinity and boron were generally low along the top-of-bank and on elevated terraces within Moller Creek. Scrub/ oak and valley oak plant associations (respectively) are proposed in these areas. Areas proposed for willow restoration generally had higher salinity and boron. Potential mitigation areas with salinity or boron values exceeding the tolerance limits determined from reference site and literature review were excluded from the mitigation plan. Table 4 summarizes the boron and salinity of soils in the riparian references sites relative to proposed and excluded Riparian Mitigation Areas by target plant association.

Table 4. Summary of Soil Characteristics in the Riparian Reference and Potential Mitigation Areas

Target Plant Association	Soil Variable	Soil Sample Location		
		Approximate Upper limit based on Reference Sites and Literature Review1	Average (± S.E.) in Proposed Mitigation Planting Area	Average (± S.E.) in Area Excluded from Mitigation Planting
Willow	Salinity (ppt)	3.0 ppt	2.1 ± 0.6 (n = 6)	5.3 ± 1.5 (n = 3)
	Boron (ppm)	3.0 ppt	2.4 ± 0.5 (n = 6)	5.6 ± 3.1 (n = 3)
Valley Oak	Salinity (ppt)	2.0 ppt	0.6 ± 0.2 (n = 7)	2.6 ± 1.7 (n = 2)
	Boron (ppm)	1.5 ppm	0.5 ± 0.1 (n = 7)	2.4 ± 0.8 (n = 2)
Oak/ Scrub	Salinity (ppt)	2.0 ppt	0.8 ± 0.3 (n = 3)	1.2 (n = 1)
	Boron (ppm)	1.5 ppm	0.6 ± 0.5 (n = 3)	4.6 (n = 1)

[1] See Appendix A

3.4.3 Vegetation

General biotic assessments of Moller Ranch, including portions of the proposed Riparian Restoration Area, were conducted in 1993, 2002, and 2006 (Wallace Roberts and Todd 1992, WRA 2002, Haag 2006). Rare plants surveys were conducted in 2003 and 2006 by WRA. In addition, H. T. Harvey & Associates conducted surveys on several dates from October to early December 2011 and in April 2014 to further document biological resources within the Project footprint, including the Riparian Restoration Area.

Currently, the Riparian Restoration Area is nearly devoid of woody vegetation. The Riparian Restoration Area is dominated by non-native grassland habitat interspersed with pockets of seasonally wet areas in the bed of Moller Creek supporting yerba mansa (*Anemopsis californica*), Mexican rush (*Juncus mexicanus*), spike rush (*Eleocharis marcostachya*), and saltgrass (*Distichlis spicata*). In a few places with longer-duration pooling in Moller Creek, cattails and hardstem bulrush (*Schoenoplectus acutus*) are established in the standing water. Outside of perennially wetted areas, much of the proposed restoration areas are dominated by non-native grassland habitat (e.g., wild oats, soft chess brome, fox tail, rip gut brome and Italian ryegrass) interspersed with non-native forbs (e.g., coastal heron's bill, black mustard) and native grasses and forbs (e.g., beardless ryegrass, California buttercup [*Ranunculus californicus*] and annual lupine [*Lupinus bicolor*]).

Riparian mitigation vegetation along Moller Creek will comprise willow, oak and shrubs, similar to the existing oak/willow riparian woodland immediately downstream of the mitigation area. As interconnected mitigation plantings mature, in-fill and expand, a mosaic of native, oak/willow riparian woodland areas will establish interspersed by non-native grassland. The mosaic of revegetated riparian habitat will form a relatively contiguous wooded riparian corridor connected to that of the downstream riparian reference area (Figure 3).

3.4.3.1 Special-Status Plant Species

Special-status plant species may be present in or immediately adjacent to the Riparian Restoration Area. Protocol-level plant surveys conducted by WRA in 2003 and 2006 observed two plant species ranked as 1B by the California Rare Plant Ranks: San Joaquin spearscale *(Atriplex joaquiniana*) and Congdon's tarplant (*Centromadia parryi ssp. congdonii*) within the Moller Ranch Conservation Area. The *Moller Ranch & Culvert Replacement Project Final Supplemental Enviornmental Impact Report* (hereafter, "EIR") reports the presence of both species in or near the Riparian Restoration Areas (Haag 2012). These species and their potential to be impacted by riparian mitigation actions are described below.

San Joaquin Spearscale. San Joaquin spearscale is an annual herb in the goosefoot family (Chenopodiaceae) that blooms from April to October. It is found in alkaline soils in chenopod scrublands, meadows and seeps, playas, and valley and foothill grasslands from 3 to 2740 ft elevation. Surveys performed in 2003 observed 305 individuals of San Joaquin spearscale in "highly alkali wetlands" within the Moller Ranch Project area (Haag 2012; WRA 2003a). Maps in the EIR show San Joaquin spearscale patches occurred in 2003 either in or near the proposed Riparian Restoration Area (Haag 2012). Avoidance and minimization measures (described below) will be sufficient to avoid impacts to San Joaquin spearscale during the installation of the Riparian Restoration Area and Riparian Mitigation Areas. Excluding cattle from the proposed Riparian Enhancement Area may enhance San Joaquin spearscale habitat in alkali wetlands within Moller Creek by reducing disturbance (e.g., trampling).

Congdon's Tarplant. Congdon's tarplant is an annual herb in the composite family (Asteraceae) that has a variable blooming period extending from June through November. It occurs in valley and foothill grasslands, particularly those with alkaline substrates, and in slumps or disturbed areas where water collects in lower

elevation wetlands below approximately 760 ft. During a 2003 survey, approximately 1,100 Congdon's tarplant individuals were observed "in alkaline wetlands and adjacent uplands, and in Moller Creek" (Haag 2012). A rare plant survey within the Moller Ranch Property Boundary in 2006, by contrast, found 216 Congdon's tarplant individuals outside of the proposed Riparian Restoration Area (WRA 2006). If Congdon's tarplant is currently present in the proposed Riparian Restoration Area, the avoidance and minimization measures (described below) will be sufficient to avoid impacts to Congdon's tarplant.

No other special status plant species are likely to be in the Riparian Restoration Area (H. T. Harvey & Associates 2012a).

3.4.3.2 Invasive Plant Species

Black mustard is abundant along the disturbed edges of Moller Creek, particularly in areas near the access road and former developed areas. Black mustard is an invasive forb considered to have a "moderate" impact on native ecosystems (Calflora.org 2014). Black mustard will be controlled in the Riparian Restoration Area to prevent competition with native riparian plantings. No other non-native weeds are currently abundant in the Riparian Restoration Area. This MMP outlines measures to control invasive plants in the Riparian Restoration Area below (see Maintenance Plan Section).

3.4.4 Wildlife

General biotic assessments of the Project sites and Moller Ranch Conservation Area, including the Riparian Restoration Area, were conducted in 1992, 2002, and 2006 (Wallace Roberts and Todd 1992, WRA 2002, Haag 2006), and site assessments, focused surveys for the California red-legged frog (*Rana draytonii*) and California tiger salamander (*Ambystoma californiense*) were conducted in 2003 (WRA 2003b and c). In addition, H. T. Harvey & Associates wildlife biologists conducted reconnaissance-level wildlife surveys of the Moller/Tassajara Conservation Area in 2011. The purpose of these surveys was to identify the potential of the proposed conservation lands to support state and federally listed species, as well as other special-status species, and to identify potential wildlife conservation opportunities provided by the proposed mitigation lands.

Wildlife species commonly found in grassland habitats adjacent to Moller Creek include the western fence lizard (*Sceloporus occidentalis*), western skink (*Eumeces skiltonianus*), gopher snake (*Pituophis catenifer*), and racer (*Coluber constrictor*). Several species of birds use these grassland habitats throughout the year. Western meadowlarks (*Sturnella neglecta*) may build their nests directly on the ground in these grasslands and seeds produced by annual and perennial grasses provide food for migrating and wintering songbirds, such as lesser goldfinches (*Carduelis psaltria*) and white-crowned sparrows (*Zonotrichia leucophrys*). California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), and California vole (*Microtus californicus*) burrows are scattered throughout the grasslands. These small mammals attract predators such as the red-tailed hawk (*Buteo jamaicensis*), coyote (*Canis latrans*), and American badger (*Taxidea taxus*). Moller Creek provides habitat

for amphibians such as the Sierran chorus frog (*Pseudacris regilla*) and several fish species as well as special status species (described below).

Decades of livestock grazing has degraded wildlife habitat quality by reducing diversity in vegetation structure and composition in grassland habitat in the Riparian Restoration Area. Installation of cattle exclusion fencing around the Riparian Restoration Area will enhance conditions for wildlife by allowing vegetation to re-establish. In addition, the proposed riparian plantings will restore a mosaic of high-quality riparian habitat along Moller Creek, increasing habitat quality for a variety of wildlife species. Riparian habitats in California, with their high structural and vegetation diversity and presence of moisture through much of the year, often support exceptionally rich animal communities and contribute disproportionately to landscape-level plant and animal diversity. However, this habitat type currently makes up only a tiny fraction of Moller Creek and the ephemeral drainages that feed it lack any woody riparian vegetation. Therefore, the restoration of riparian canopy will enhance the value of Moller Creek for wildlife.

3.4.4.1 Special-Status Wildlife Species

Numerous special-status species are likely to occur on or immediately adjacent to the Riparian Restoration Area. California species of special concern, such as the golden eagle (*Aquila chrysaetos*), northern harrier (*Circus cyaneus*), burrowing owl (*Athene cunicularia*), loggerhead shrike (*Lanius ludovicianus*), and American badger, as well as the state fully-protected white-tailed kite (*Elanus leucurus*), may breed and/or forage in the uplands adjacent to Moller Creek. Moller Creek also provides suitable aquatic habitat for the western pond turtle (*Actinemys marmorata*), a California species of special concern, and the surrounding uplands provide nesting and dispersal habitat for this species.

In addition, the Riparian Restoration Area provides habitat for three federal and/or state listed species, the California red-legged frog, California tiger salamander, and the San Joaquin kit fox (*Vulpes macrotis mutica*).

California Red-legged Frog. The California red-legged frog was listed as threatened throughout its entire range by the USFWS on 23 May 1996 (USFWS 1996). A recovery plan addressing the California red-legged frog was approved on 28 May 2002 (USFWS 2002), and revised critical habitat was designated on 17 March 2010 (USFWS 2010). The Project, including the Riparian Restoration Area, fall within California red-legged frog critical habitat unit CCS 2. California red-legged frogs have been recorded in Moller Creek within the proposed Riparian Restoration Area (CNDDB 2014) and the deepest in-channel pools represent suitable breeding habitat for the species. The remaining portions of the creek provide suitable non-breeding aquatic habitat. In addition, the uplands adjacent to the creek provide suitable dispersal and refugial habitat for this species.

California Tiger Salamander. The USFWS listed the California tiger salamander as threatened throughout its range in 2004 (USFWS 2004). Critical habitat for the species was designated in 2005 (USFWS 2005). The Project is not within designated critical habitat for this species. The California tiger salamander was listed as threatened under the California Endangered Species Act (CESA) in 2010. California tiger salamanders are

known to occur in the vicinity of the Moller Ranch Project and to breed in ponds within dispersal distance of the Riparian Restoration Area (H. T. Harvey & Associates 2012b, CNDDB 2014). Upland habitat throughout the Riparian Restoration Area currently provides suitable dispersal and dry season refugia (e.g., ground squirrel [*Spermophilus beecheyi*] burrows] for this species.

San Joaquin Kit Fox. The San Joaquin kit fox was listed as endangered by the U.S. Department of the Interior in 1967 (USFWS 1967) and was listed as threatened by the State of California in 1971. The Project sites are located on the extreme northwestern edge of the current range of the kit fox, and extensive surveys of lands to the east and west of the Project sites have failed to find any positive indication of occupancy by kit foxes (H. T. Harvey & Associates 2007). Nevertheless, the San Joaquin kit fox is predicted to occur on the Project sites and in surrounding areas by the East Alameda County Conservation Strategy (EACCS) habitat model for the species (ICF Jones & Stokes 2010). The Project sites and surrounding lands, including the Riparian Restoration Area, offer moderately suitable habitat for kit foxes; the heavy clay soil characteristic of the area is difficult for these animals to dig burrows into, and populations of coyotes (*Canis latrans*), a natural predator of kit foxes, are high in the area. The Riparian Restoration Area offers suitable foraging habitat for dispersing or commuting individuals, as they are contiguous with large areas of annual grasslands that fall within the range of the species. However, the lack of recent records in the general vicinity suggests that the probability of San Joaquin kit fox utilizing the Riparian Restoration Area is extremely low.

Special-status species expected to occur in the Riparian Restoration Area described in more detail in the *Moller Ranch Biological Resources Update Report* (H. T. Harvey & Associates 2012a) and the *Moller Ranch/Moller Creek Culvert Replacement Project Final Supplemental Environmental Impact Report* (Haag 2012). Species listed under the Federal Endangered Species Act (FESA) and the California Endangered Species Act (CESA), including the California tiger salamander, California red-legged frog, and San Joaquin kit fox, are described in additional detail in the Biological Assessment and Incidental Take Permit application prepared for the Moller Ranch Project (H. T. Harvey & Associates 2012b-c) and the Biological Assessment and Incidental Take Permit application prepared for the Tassajara Road Culvert Replacement Project (H. T. Harvey & Associates 2012d-e).

3.4.5 Riparian Restoration Area Land Use

Historically, cattle grazing was the sole land use on the Riparian Restoration Area. Decades of continuous cattle grazing has degraded the restoration area by decreasing wetland vegetation cover, limiting the growth and establishment of certain woody and herbaceous plant species, eroding creek banks, and incising the creek channel bed. This MMP proposes to exclude cattle from the riparian restoration area.

The Moller Ranch Residential Development and the proposed Moller Ranch Conservation Area will border the riparian restoration area following implementation of the Project (Figure 3). The Moller Ranch Residential Development will be a mixed use housing development. Cattle grazing will continue in the Moller Ranch Conservation Area (H. T. Harvey & Associates 2014b)

3.5 Mitigation Swales/Channels- Basis of Design

Permanent drainage channel impacts will be mitigated via a combination of Mitigation Swales/Channels (located on-site), on-site riparian habitat enhancement along Moller Creek (described above), on-site channel preservation, and off-site riparian habitat enhancement at the Cayetano Creek Preserve. This section summarizes the basis of design for the Mitigation Swales/Channels. The on-site channel preservation is described in the *Moller Ranch Conservation Area and Tassajara Road Project Conservation Area Habitat Mitigation and Management Plan* (H. T. Harvey & Associates. 2014b) and the off-site riparian habitat enhancement is presented in the *Mitigation & Monitoring Plan for the Cayetano Creek Preserve* (Olberding Environmental, Inc. 2014).

The Moller Ranch Project will construct approximately 7,966 ln ft of Mitigation Swales/Channels. ENGEO prepared the conceptual design for the created channels which is included herein as Appendix C. The goal of the on-site created channel mitigation is to convey runoff from undeveloped lands (upslope of the proposed Moller Ranch Project) around the Moller Ranch Project perimeter to Moller Creek via stable, earthen channels. Therefore, these channels located around the periphery of the proposed residential development and associated roadway infrastructure. The flow regime within the created channels will be ephemeral/intermittent, similar to the existing condition. Moreover, the created channels will provide ecological functions similar to the existing drainages to be impacted. These functions will include:

- flood water conveyance to Moller Creek in dynamically stable, primarily earthen channels;
- erosion control and associated protection of topsoil, groundwater levels, and downstream water quality, and;
- dense cover of non-native grassland habitat that will assist with erosion control and provide wildlife habitat for common non-native grassland species.

Section 4.0 Implementation Plan

4.1 Riparian Mitigation and Riparian Enhancement

The following section presents the implementation plan for the Project's riparian mitigation and riparian enhancement. The general layout of these restoration areas is shown in Figure 3.

Riparian mitigation and enhancement implementation will comprise of the following actions:

- **Invasive Plant Species Control.** Without control, invasive species may compete with native riparian plantings, reduce species diversity, and degrade the quality of the Riparian Restoration Area. Therefore, all invasive plant species rated by the California Invasive Plant Council as having a "moderate" or "high" impact on native ecosystems shall be controlled in the Riparian Restoration Area. Currently, numerous patches of black mustard are present throughout the Riparian Restoration Area, particularly in disturbed areas on creek bank slopes and along the top-of-bank where infrastructure has been removed.
- **Install Cattle Exclusion Fencing.** Cattle fencing typical of the region will be installed to protect the Riparian Restoration Area from cattle grazing. The conceptual fencing plan is provided in Section 4.3.
- **Provide Irrigation.** The planted riparian trees and shrubs will be manually irrigated during a three year establishment period, or until adequately established, as described in section 4.4.
- **Install Mitigation Plantings.** Mitigation plantings will be installed per the conceptual planting plan in Section 4.5.

4.1.1 Avoidance and Minimization Measures

Riparian restoration actions will employ a number of avoidance and minimization measures to reduce impacts on special-status plant and animal species. A qualified wildlife biologist will determine which of the measures referenced below are applicable to the restoration project at the time of construction. This includes all of the Generalized Avoidance and Minimization Measure to Reduce Effects on Focal Species as described in Table 3-2 of the EACCS, Species-Specific Avoidance and Minimization Measures described in Table 3-3 of the EACCS, avoidance and minimization measures stipulated by the Biological Opinion, and avoidance and minimization measures stipulated in the 2012 *Moller Ranch/Moller Creek Culvert Replacement Project Final Supplemental Environmental Impact Report* (Haag 2012).

These measures are provided in detail in Appendix C and include:

- Pre-construction surveys by a qualified biologist for special-status plants and animals that may occur within the riparian mitigation areas prior to cattle exclusion fence installation and mitigation planting
- Construction monitoring by a qualified biologist during fence installation and mitigation plant installation
- A worker education program given by a qualified biologist to the revegetation construction crew prior to the start of work.

4.1.2 Conceptual Fencing Plan

Fencing typical of the region will be installed to exclude cattle from the Riparian Restoration Area. The proposed fencing alignment is shown in Figure 4. Gates will be installed to allow access to the Riparian Restoration Area for site maintenance in locations to be determined in collaboration with the land owner (Moller RE Investors, LLC) and the long-term land manager (the Trust). Following attainment of the final success criteria in this MMP, fencing will be maintained in perpetuity by the Trust.

4.1.3 Conceptual Irrigation Plan

All planted riparian trees and shrubs will be manually irrigated for 3 growing seasons, or until adequately established, as determined by the monitoring restoration ecologist.

4.1.4 Conceptual Planting Plan

Figure 4 shows the approximate plan view layout of the Riparian Mitigation Area plant associations. Figure 5 shows the distribution of the Riparian Mitigation Area plant associations relative to a typical cross section of Moller Creek within the Riparian Restoration Area. This layout is approximate and may be modified based on site conditions at the time of construction. The planting layout is intended to establish plant associations in locations with appropriate soil chemistry, landscape position/slope (slopes $\geq$ 2H:1V), and suitable hydrology (described above). The planting plan was laid out to facilitate connectivity between the Riparian Mitigation Areas and existing downstream riparian habitat. The Riparian Mitigation Areas will be revegetated with the following three plant associations:

- Willow Plant Association on low floodplains with perennial soil moisture close to the surface
- Valley Oak Plant Association on drier floodplains and slopes
- Scrub/ Oak Plant Association along the top-of-bank

4.1.4.1 Plant Palette Rationale

Soil moisture in the Riparian Mitigation Areas decreases with elevation gain from the channel (where soil moisture is higher) to above the top-of-bank (where soil moisture is lower) (Figure 5). Therefore, the planting plan distributes increasingly drought tolerant plant associations from low to high elevations within the Riparian Mitigation Areas. Some species were included in more than one plant association because soil

Legend

- Moller Ranch Residential Development Project (MRRDP)
- Thalweg
- Cattle Exclusion Fence
- Riparian Restoration Area
- Riparian Enhancement Area

Riparian Mitigation Area Plant Association

- Scrub/Oak (1.80 ac)
- Valley Oak (1.81 ac)
- Willow (0.24 ac)

Moller Creek

Matchline

Source: Esri, DigitalGl
GIS User Commun

200 100 0 200
Feet

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics,

N 0 500 1000
Feet

PG&E Station

Existing Ranch Improvements to Remain

Matchline

Moller Creek

Source: Esri, DigitalGl
GIS User Commun

200 100 0 200
Feet

N:\Projects3300\3313-01\03\Reports\Riparian MMP\Fig 4 Riparian Mitigation Conceptual Planting Layout Map.mxd

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Ecological Consultants

Figure 4: Riparian Mitigation Conceptual Planting Layout Map and Cattle Exclusion Fencing Plan
Moller Ranch Residential Development Project (MRRDP) and
Tassajara Road Culvert Replacement Project (TRCRP) MMP (3313-03)
September 2014

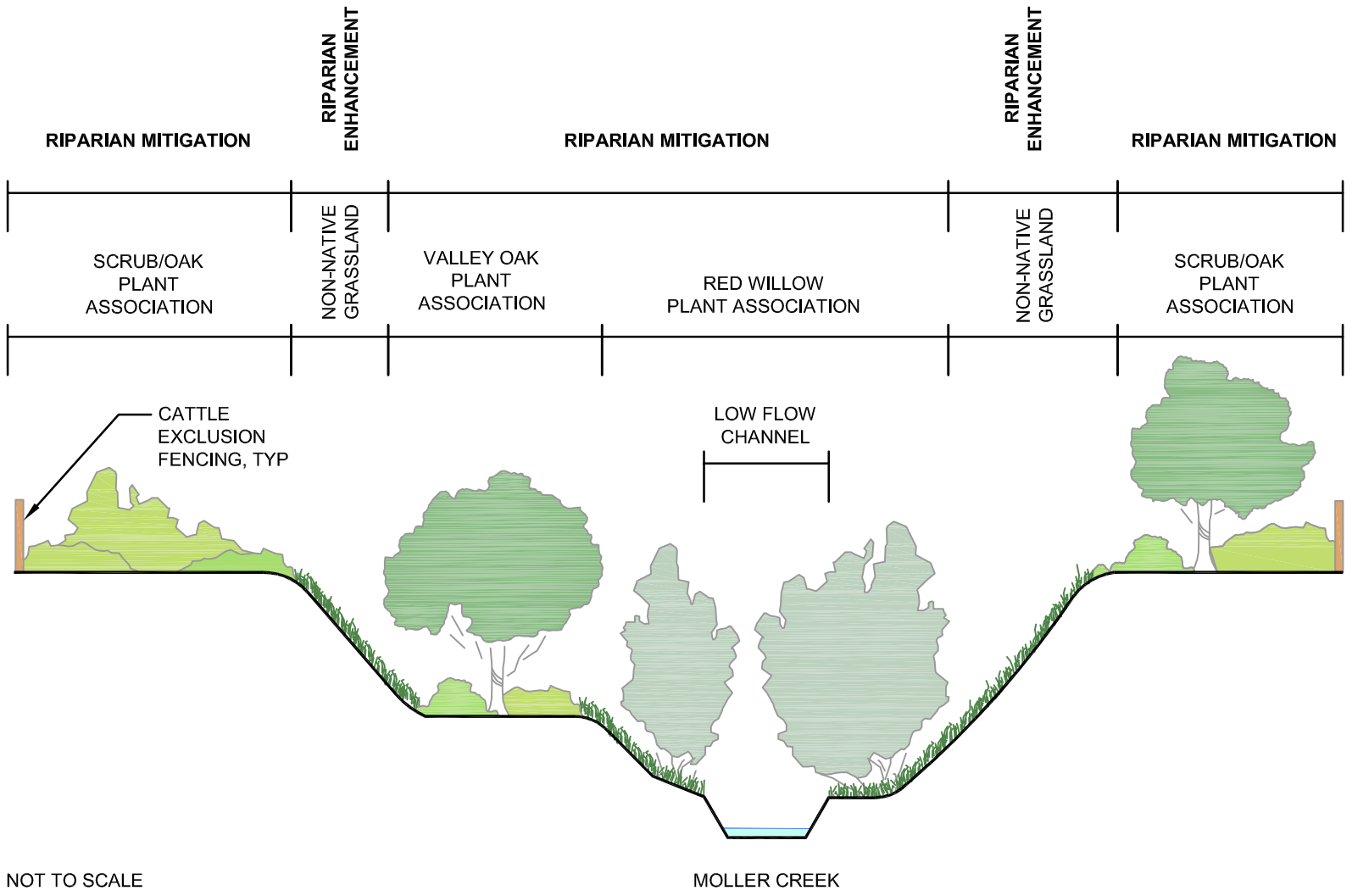

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Figure 5: Riparian Mitigation and Enhancement Areas - Typical Cross Section

moisture levels overlap between neighboring plant associations (e.g., a small percentage of red willows are included in the valley oak plant association because minor portions of some oak terraces are low/moist enough for red willows). The dominant plant species in each association were chosen to mimic the composition of the riparian habitat located immediately downstream of the proposed Riparian Restoration Area along Moller Creek. However, native species diversity is probably lower than historic conditions in the reference reach because of anthropogenic influences. Therefore, we selected additional species typical of riparian habitats in the Tassajara Creek watershed to increase native species diversity in each plant association.

4.1.4.2 Willow, Valley Oak and Scrub/Oak Plant Palette and Spacing

Willow plant association and valley oak plant association plantings will be installed per the on-center spacing described below. Trees will be installed per the on-center spacing to cover the entirety of their respective plant association areas. However, shrubs will be installed in dense multi-species "planting clusters" per the on-center spacing prescribed below; shrub planting clusters will occupy approximately 50% of the valley oak and scrub/oak plant association planting areas. Planting clusters are intended to form relatively dense, weed resistant patches of understory riparian vegetation over the 10-year monitoring period. Shrub planting clusters are also intended to facilitate moisture retention in this relatively xeric landscape. The plant spacing and planting cluster layout equates to approximately 8 ft on-center triangular spacing across the Riparian Mitigation Areas, or approximately 780 plants/acre.

Tables 5, 6, and 7 provide the plant species palettes for the riparian mitigation willow, valley oak and scrub/oak plant associations.

Table 5. Willow Plant Association

Common Name	Scientific Name	Percent Composition	On-Center Spacing (ft)[1]	Propagule Type/ Container Size[2]	Quantity
Fremont cottonwood	Populus fremontii	10	10	treepot 4	12
Red willow	Salix laevigata	50	8	cuttings	94
Arroyo willow	Salix laseolepis	40	8	cuttings	75
	Total	100			181

[1] On-center spacing refers to the triangular spacing within the willow plant association area.

2 treepot = 4 inch by 4 inch square by 14 inch long planting container; cuttings = 3-4 ft long by 3/4 – 2 inch diameter live stakes

Table 6. Valley Oak Plant Association

Common Name	Scientific Name	Percent Composition	On-Center Spacing (ft) [1]	Propagule Type/ Container Size[2]	Quantity
Trees					
Box elder	*Acer negundo*	15	14	treepot 4	69
California buckeye	*Aesculus californica*	15	10	treepot 4	136

Common Name	Scientific Name	Percent Composition	On-Center Spacing (ft) [1]	Propagule Type/ Container Size[2]	Quantity
Valley oak	*Quercus lobata*	60	16	treepot 4	213
Red willow	*Salix laevigata*	10	10	cuttings	91
	Tree Total	100			509
Shrubs/Perennial Forbs					
Mugwort	*Artemisia douglasiana*	5	6	deepot	50
Mexican whorled milkweed	*Asclepias fascicularis*	10	6	deepot	101
Big saltbush	*Atriplex lentiformis*	15	6	deepot	151
Coyote brush	*Baccharis pilularis*	20	6	deepot	201
Goldenrod	*Euthamia occidentalis*	5	6	deepot	50
Bush lupine	*Lupinus albifrons*	10	6	deepot	101
California rose	*Rosa california*	15	6	deepot	151
Blue elderberry	*Sambucus nigra*	20	8	deepot	91
	Shrubs/Perennial Forbs Total	100			896
	Total				1405

[1] On-center spacing refers to the triangular spacing within the valley oak plant association area for trees and within planting clusters for shrubs/perennial forbs. Planting clusters will cover approximately 50% of the valley oak plant association area.
[2] treepot = 4 inch by 4 inch square by 14 inch long planting container; depot = 2.5 inch diameter by 10 inch long planting container; cuttings = 3-4 ft long by 3/4 – 2 inch diameter live stakes

Table 7. Shrub/ Oak Plant Association

Common Name	Scientific Name	Percent Composition	On-Center Spacing (ft) [1]	Container Size[2]	Quantity
Trees					
Coast live oak	*Quercus agrifolia*	30	25	treepot 4	43
Valley oak	*Quercus lobata*	70	25	treepot 4	101
	Tree Total	100			144
Shrubs					
California sage brush	*Artemisia californica*	10	6	deepot	118
Big saltbush	*Atriplex lentiformis*	10	6	deepot	118
Coyote brush	*Baccharis pilularis*	25	5	deepot	107
Toyon	*Heteromeles arbutifolia*	5	8	deepot	447

Common Name	Scientific Name	Percent Composition	On-Center Spacing (ft) [1]	Container Size[2]	Quantity
Deerweed	*Lotus scoparius*	5	5	deepot	31
Bush lupine	*Lupinus albifrons*	10	6	deepot	83
Holly leaf cherry	*Prunus ilicifolia*	5	8	deepot	121
Coffeeberry	*Rhamnus californica*	10	6	deepot	28
California rose	*Rosa californica*	10	6	deepot	118
Black sage	*Salvia mellifera*	10	6	deepot	118
	Shrub Total	100			1289
	Total				1433

[1] On-center spacing refers to the triangular spacing within the shrub/oak plant association area for trees and within planting clusters for shrubs. Planting clusters will cover approximately 50% of the shrub/oak plant association area.

[2] treepot = 4 inch by 4 inch square by 14 inch long planting container; depot = 2.5 inch diameter by 10 inch long planting container.

4.1.4.3 Source of Propagules

All propagules for container stock and willow cuttings will be obtained from populations originating within the Tassajara Creek Watershed to help ensure the plant material is adapted to the climatic conditions of the mitigation site. Plant propagules will be derived from as close to the mitigation site as feasible in sites with similar soils and elevations. If adequate propagules are unavailable from the Tassajara Creek Watershed, then they will originate from the Alameda Creek Watershed from areas that exhibit similar environmental conditions to those found at the mitigation site.

4.1.5 Planting Installation Methods

4.1.5.1 Container Stock.

Riparian trees and shrubs and forbs will be installed between October 1 and December 31, after the onset of the winter rains. Planting holes for tree and shrub container stock will be 1 ft in diameter by 2 ft deep. Forb species (i.e., Mexican whorled milkweed and goldenrod) will be installed in holes that are 4-6 inches wide and at least equal to the depth of the container. All rocks greater than 3 inches in diameter will be removed from the excavated soils. The sides of the holes will be scarified to eliminate glazing. All plants will be installed so that their root crowns are at or slightly above (up to ½ inch) grade following soil settlement that may occur after initial irrigation. All plants will also be installed so their root crowns are at the highest position within the irrigation basin. This will minimize standing water at the root crown and reduce the potential for root disease. The holes will be backfilled around the rootball with amended site soil (see below soil amendment section) and lightly compacted to remove air voids and provide good root to soil contact.

4.1.5.2 Irrigation basin and wood chip mulch installation.

A 2 to 3-ft diameter irrigation basin with a 4-inch high, 4-inch wide earthen berm will be constructed around each tree and shrub. The basin will help conserve water use by each plant and will be kept weed free during the 3-yr plant establishment period to reduce plant competition. A 3-inch thick layer of coarse wood chip mulch will be spread throughout the bottom of each irrigation basin. Mulch will be derived from wood chips and will be free of salt, leaves, soil clods, sticks, rocks, weeds, or weed seeds. Wood chips used for mulch will be derived from material and locations that are free of sudden oak death infestation.

Willow Cuttings

Willow cuttings that are approximately 3-4 ft long and 3/4 inch-2 inch diameter will be harvested from existing willows along Moller Creek or Tassajara Creek. Cuttings will be harvested over the period December through February after the trees have dropped their leaves. Cuttings will be harvested from numerous trees to obtain a diversity of genetic material and no more than 10% of the canopy will be impacted by cutting. The cuttings will be transported and stored in fresh water and installed within 48 hours of harvest. Cuttings will be installed so that the lower 3/4 (2-3 ft) of the cutting is buried. Pilot holes will be drilled in the soil for each cutting and the soil will be compacted firmly around the cutting to eliminate voids between the soil and cutting. Cuttings will not be driven into the ground using a hammer or mallet.

Irrigation basin and rice straw mulch installation. A ~2-ft diameter irrigation basin will be constructed around each cutting, and the irrigation basins will be surrounded by 4-inch high, 4-inch wide berms. A 3-inch thick layer of rice straw will be spread within the bottom of each irrigation basin to reduce weed competition and conserve moisture.

4.1.5.3 Planting Hole Soil Amendments

Oak and shrub/oak planting area soils had low soil organic matter relative to reference sites (Appendix A). Therefore, a composted organic matter amendment will be thoroughly mixed into the backfill of individual planting holes to a depth of 12 inches. Table 8 describes the type and quantity of amendment to be used.

Two cups of native soil collected from directly beneath the leaf litter layer of valley oak trees free of sudden oak death will be mixed into the soil backfill of each planted valley oak and coast live oak tree. This will inoculate the root zone with beneficial mycorrhizae. Mycorrhizae are symbiotic fungi that, among other functions, help oak trees tolerate drought conditions. Aerial photos show that riparian habitat has not been present within the proposed riparian mitigation areas in recent decades. Therefore mycorrhizae are not likely to be present without inoculation. Native soil for inoculation will be collected from the existing valley oak riparian habitat along Moller Creek.

Table 8. Planting Hole Soil Amendment

Amendment	Amount Per Planting Hole by Volume
composted organic matter	1 part compost : 5 parts soils backfill

4.2 Created Mitigation Swales/Channels

4.2.1 Earthwork

Appendix C provides the conceptual grading plan for the Created Mitigation Swales/Channels.

4.2.2 Surface Soil Preparation

Surface soils will be prepared during finish grading to facilitate herbaceous vegetation establishment. The relative compaction within the upper 1 vertical ft of the surface soil profile across the created swale and channel cross-sections will be ≤ 90%. Moreover, the upper 1 vertical ft of the soil profile will meet the following soil horticultural criteria:

- average percent organic matter = 3-6% (dry weight organic matter/dry weight soil);
- average salinity ≤ 1.5 ppt (saturation extract method);
- average boron concentration ≤1.5 ppm (saturation extract method; dry weight basis);
- average pH = 5.0-8.0, and;
- calcium: magnesium ratio ≥ 2:1.

The monitoring restoration ecologist will sample and test the surface soil for these constituents and make feasible soil salvage/replacement or amendment recommendations to the project engineer to ensure these criteria are met.

4.2.3 Revegetation

The Mitigation Swales/Channels will be hydroseeded with the seed mix and application rates provided in Table 9. Seed should originate from San Francisco Bay Area ecotypes. Hydroseed will be applied in a one-step process prior to installation of erosion control fabric. The one-step hydroseed application will consist of wood fiber (700 lbs/acre), non-asphaltic tackifier (120 lbs/acre), and seed.

Table 9. Mitigation Swale/Channel Hydroseed Mix[1]

Common Name	Scientific Name	Seeding Rate
three-week fescue	*Festuca microstachys*	10 lbs/ac pure live seed
meadow barley var-Salt	*Hordeum brachyantherum*	20 lbs/ac pure live seed
California brome	*Bromus californicus*	20 lbs/ac pure live seed
blue wild rye	*Elymus glaucus*	10 lbs/ac pure live seed
arroyo lupine	*Lupinus succulentus*	6 lbs/ac pure live seed
California poppy	*Eschscholzia californica*	2 lbs/ac pure live seed

[1]Note- This hydroseed mix supersedes that shown in Appendix C (Table 3).

Coyote brush and coast live oak will be installed from container stock along the created swales/channels in accordance with Table 10. These plants will be installed using the same Container Stock and Irrigation Basin/Wood Chip Mulch methods presented above in Section 4.1.5 (Plant Installation Methods). Container stock will originate from propagules collected within the Tassajara Creek Watershed to help ensure the plant

material is adapted to the climatic conditions of the mitigation site. Plant propagules will be derived from as close to the mitigation site as feasible in sites with similar soils and elevations. If adequate propagules are unavailable from the Tassajara Creek Watershed, then they will originate from the Alameda Creek Watershed from areas that exhibit similar environmental conditions to those found at the mitigation site.

Table 10. Created Mitigation Swale/Channel Container Plant Palette[1]

Creates Swales/Channels	Common Name	Scientific Name	Average On-center Spacing (ft)	Layout Concept	Container Size[2]
A,B,Upper D, E, F, G, H, I, J, K, L	coyote brush	*Baccharis pilularis*	20	Located on both sides of swale banks with spacing varying from 10-30 ft between individuals along the swale profile to achieve a natural configuration with an average spacing of 20 ft.	deepot
Lower D	coast live oak	*Quercus agrifolia*	50	Located on the north facing slope of the swale/channel with spacing varying from 30-70 ft between individuals along the swale profile to achieve a natural configuration with an average spacing of 50 ft.	treepot 4
	coyote brush	*Baccharis pilularis*	8	Located on both sides of swale banks with spacing varying from 6-10 ft between individuals to achieve the average spacing of 8 ft.	deepot
C, M, N	coyote brush	*Baccharis pilularis*	8	Located on both sides of swale banks with spacing varying from 6-10 ft between individuals to achieve the average spacing of 8 ft.	deepot

[1]Note- This planting plan supersedes that shown in Appendix C (Table 3).
[2] treepot = 4 inch by 4 inch square by 14 inch long planting container; depot = 2.5 inch diameter by 10 inch long planting container.

4.3 Schedule

The riparian mitigation plantings will be installed during the same year as the Culvert Replacement Project impacts. The approximate schedule implementing the riparian mitigation and enhancement measures is detailed in Table 11.

Table 11. Riparian Mitigation Approximate Implementation Schedule

Activity	Schedule
Invasive species control	March – April
Install cattle exclusion fencing	Prior to Riparian plant installation
Riparian plant installation	October – January; after the onset of the rainy season
Invasive species control plantings	October – January; after the onset of the rainy season

The Mitigation Swales/Channels will be constructed during the same year as the mass grading for the residential development. Table 12 provides the schedule for implementation of this work.

Table 12. Mitigation Swales/Channels- Approximate Implementation Schedule

Activity	Schedule
earthwork	Anytime in dry season- 15 April – 15 October
hydroseeding	September- October
container plant installation	October – January; after the onset of the rainy season

Section 5.0 Maintenance Plan

This section outlines maintenance required in the Riparian Restoration Area and in the Mitigation Swales/Channels. The planted trees and shrubs will require maintenance during the first 5 years following installation (i.e., during the plant establishment period) to increase the likelihood they will successfully establish and become self-sustaining. Maintenance will include dead plant replacement, irrigation, mulch replenishment, and weed control. If performance criteria are met (see Monitoring Plan section), then plant replacement and irrigation will cease after 3 years. Weed control activities will be conducted for 5 years. Monitoring data (as outlined by requirements discussed in the Monitoring Plan section below) collected by a qualified ecologist will be used to evaluate the success of the Riparian Mitigation Areas and Mitigation Swales/Channels. Monitoring results will be used to guide maintenance and help ensure the goals of this MMP are achieved.

5.1 Maintenance Activities

5.1.1 Dead Plant Replacement

All dead tree and shrub plantings will be replaced in the first 2 years. Moreover all dead tree and shrub plantings will be replaced in Year-3, if the percent survival falls below 80% in Year-3. This will facilitate rapid establishment of the target habitat. Survival rates of the installed plants will be assessed to determine which, if any, of the plantings require replacement (see Monitoring Plan section below). Species which are well-suited to the site as reflected in their health and vigor will be used to replace dead plants at the discretion of the monitoring restoration ecologist (see Monitoring Plan and Success Criteria Section below). Replacement plants will be field tagged with the date they were installed to facilitate measurement of the percent survival of the initially installed plants (see the Monitoring Plan Section below).

5.1.2 Irrigation

The planted riparian tree and shrub seedlings will be manually irrigated during the first 3 years or until adequately established, as determined by the monitoring restoration ecologist. Irrigation water will be supplied to the site via a water truck. Each plant's irrigation basin will be hose watered with each irrigation event providing sufficient water (~10 gallons/plant) to encourage vigorous root growth deep into the soil profile. Appropriate flow rates will be used such that water delivery does not cause soil erosion. The site will not be spray or sprinkler irrigated to avoid amplifying weed growth between the irrigation basins. Plants will be irrigated with adequate frequency to avoid visible signs of drought stress; the frequency of irrigation will be tailored to the rainfall pattern/quantity each year and the corresponding health and vigor of the plantings. The irrigation frequency will be gradually reduced during this 3 year period to encourage plant acclimation to the site's natural moisture regime. In Yr-1, the plantings will be irrigated approximately 2 to 3 times/month over the period March through October. The irrigation schedule in Yr-2 will be based on the overall health and vigor of the plants, but should be substantially less (i.e., one to 2 times/month) compared to Yr-1.

Further reduction (zero to one time/month) in watering frequency should occur in Yr-3. The irrigation schedule can be adjusted to reflect seasonal and inter-annual differences in weather patterns to ensure vigorous growth.

5.1.3 Mulch

The mulch around each riparian planting will be replenished, as needed, to ensure that a 3-inch deep by 3-ft diameter volume layer of mulch is present around each riparian planting. Willow stakes will also be mulched. Mulch will be replenished throughout the first 5 years after plant installation.

5.1.4 Weed and Invasive Plant Control

The following weed and invasive plant control work will occur throughout the first 5 years following plant installation.

Riparian Mitigation Areas. All weeds (grasses and forbs) within the Riparian Mitigation Areas will be controlled around and between each installed planting. Control refers to maintaining all weeds to a maximum height of 2 ft throughout the site (via weed whacking). All non-native, woody species will be prohibited from establishing within the Riparian Mitigation Areas. Care will be exercised during weeding to not inflict damage to the stem and roots of the mitigation plantings. Each irrigation basin will be maintained free of weeds by manually removing all weeds that become established. Weeding should occur in the late spring or early summer while the ground is still moist and before the maturation and natural dispersal of weed seeds.

Invasion of the Riparian Mitigation Areas by non-native plant species, both herbaceous and woody, is a significant obstacle to native riparian habitat establishment. Therefore, invasive plant species with a "moderate" or higher ecosystem impact rating by the California Invasive Plant Council (Cal-IPC) will be actively monitored and controlled. A qualified ecologist will assess the type, distribution and abundance of invasive plant species and, when warranted, recommend effective control measures. The applicant will then be responsible for controlling plant species that could negatively affect site performance.

Riparian Enhancement Area and Mitigation Swales/Channels. Invasive, non-native plant species with a "moderate" or higher ecosystem impact rating by the Cal-IPC will be controlled within the Riparian Enhancement Area. Control of invasive weeds will likely consist of a combination of mechanical removal (e.g., mowing, hand-pulling) and herbicide treatment.

Care will be exercised during weeding to not inflict damage to the stem and roots of the coyote brush and coast live oak plantings within the Mitigation Swales/Channels. Also, within the Mitigation Swales/Channels, each container plant irrigation basin will be maintained free of weeds by manually removing all weeds that become established.

5.1.5 Natural Recruitment

Native woody plant species which naturally establish in the Riparian Restoration Area will be identified and avoided during weed control activities.

5.1.6 Maintenance Schedule

The Riparian Mitigation Areas and Mitigation Swales/Channels will be maintained as described above during the 5-yr plant establishment period (the "maintenance period"). During the first 3 years, maintenance activities will occur approximately 2 times per month during the growing season (March through October), and approximately one time per month from November through February.

During Years 4 and 5, maintenance activities will be limited to mulch replenishment and weed control, assuming that performance criteria are met. The frequency of maintenance activities in Years 4 and 5 will be reduced to approximately once every other month. Maintenance activities will be informed by regular maintenance monitoring visits conducted by a restoration ecologist (see "Maintenance Monitoring" section below).

5.1.7 Long-Term Management

"Long term-management" begins after the Riparian Mitigation Areas and Mitigation Swales/Channels meet the final success criteria described in this MMP. At that time, management of the entire Riparian Restoration Area and all Mitigation Swales/Channels will be transferred to the Trust. The Trust will be responsible for carrying out the long-term management tasks listed in Table 13 in perpetuity. These tasks are necessary to meet the habitat mitigation goals in this MMP. The long-term management tasks in Table 13 will be funded by an endowment established by the Project applicant (Braddock & Logan Services, Inc.).

Table 13. Long-Term Management Tasks

Long-Term Management Task	Description	Applicable Mitigation Area
Maintain cattle exclusion fencing	Maintain and repair cattle exclusion fencing. Replace cattle exclusion fencing as required based on the life-cycle of the fence.	Riparian Restoration Area
Control invasive plants that threaten native riparian trees	Control invasive plants which can out-compete native riparian trees or prevent native riparian tree for establishing in the Riparian Restoration Area. Examples of invasive plants that should be controlled are eucalyptus trees (e.g. *Eucalyptus globulus*), acacia trees (e.g., *Acacia melanoxylon*), tree of heaven (*Ailanthus altissima*) and giant reed (*Arundo donax*).	Riparian Restoration Area
Remove trash and debris	Remove trash and anthropogenic debris.	Riparian Restoration Area and Mitigation Swales/Channels
Communicate with the GHAD	Notify the GHAD regarding the timing of these tasks. Respond to notifications of geomorphic stabilization work in the Riparian Restoration Area initiated by the GHAD.	Riparian Restoration Area and Mitigation Swales/Channels

Section 6.0 Monitoring Plan and Success Criteria

6.1 Riparian Restoration Goals and Monitoring Plan Overview

6.1.1 Riparian Mitigation Areas

The long-term goal of the Riparian Mitigation Areas is to establish at least 3.63 ac of high-quality, tree and shrub dominated riparian habitat. To help ensure this goal is met, 3.85 acres of riparian plantings will be installed and maintained within the proposed 5,473 lf ft Riparian Restoration Area; the planting area is 0.22 acre greater than the minimum mitigation acreage requirement to provide a contingency. At maturity (i.e, 30+ years after installation) the Riparian Mitigation Areas will consist of a moderately dense valley oak and native shrub dominated riparian canopy interspersed with patches of willow trees. The long-term goal of the Riparian Enhancement Area is to decrease soil erosion and improve water quality; a secondary long-term goal is to facilitate the gradual establishment of woody riparian habitat through natural recruitment. This monitoring plan defines the objective, measurable success criteria that will be used to determine if the Riparian Mitigation Areas and the Riparian Enhancement Area are on a trajectory towards meeting the long-term habitat goals. Monitoring data will be collected and compared to stipulated success criteria to evaluate the success of the mitigation. Results from the monitoring program will also provide feedback to inform maintenance to ensure successful habitat establishment. The Riparian Mitigation Areas will be monitored and maintained for 10 years (in Years 1, 2, 3, 4, 6, 8 and 10). The duration monitoring in the Riparian Mitigation Areas is necessary because of the naturally slow growth rate of many of the planted trees and shrubs. The Riparian Enhancement Area will be monitored and maintained for the same duration.

6.1.2 Mitigation Swales/Channels

The long-term goal of the Mitigation Swales/Channels is to convey runoff from undeveloped lands (upslope of the proposed Moller Ranch Project) around the Moller Ranch Project perimeter to Moller Creek via stable, earthen channels. The created channels will provide ecological functions similar to the existing ephemeral/intermittent drainages to be impacted. These functions will include flood water conveyance to Moller Creek in dynamically stable, primarily earthen channels that demonstrate geomorphic stability during average rainfall years. The created swales/channels will also provide erosion control, protection of downstream water quality, and provision of a dense cover of non-native grassland habitat that will assist with erosion control and provide wildlife habitat for common grassland animal species.

We anticipate that dense grassland vegetation cover will establish rapidly within the first 3 years following construction and that 5 years is an ample duration to determine whether the channels are geomorphically stable during average rainfall years. Therefore, the Mitigation Swales/Channels will be monitoring annually for 5 years to assess performance relative to the below performance and final success criteria.

6.2 Construction Monitoring

A restoration ecologist will monitor the timing and extent of Project impacts to riparian habitats with sufficient frequency to determine whether riparian impacts are consistent with those outlined in this document. A restoration ecologist will also monitor the installation of the Riparian Restoration Area (e.g., fence installation, plant installation) and Created Mitigations Swales/Channels with sufficient frequency to document whether the riparian and created swale/channel mitigation measures are installed as described in this plan. Site visit reports will be generated after all inspections.

Permanent photo-documentation points will be established to document the Riparian Mitigation Areas and Mitigation Swales/Channels before and after implementation.

6.3 Maintenance Monitoring

Site visits will be made once every 3 months, on average, during the maintenance period. Qualitative assessments of the site will be made and reported during these visits. The purpose of monitoring during the growing season is to assess the adequacy of vegetation maintenance and provide maintenance recommendations, as needed, to help achieve the below performance criteria. Assessment of the following factors will be made during maintenance monitoring site visits:

- Vegetation establishment with special attention paid to areas lacking vegetation
- Mortality of planted shrubs and trees
- Plant species composition
- Irrigation and maintenance of planted trees and shrubs
- Invasion of the restoration sites by invasive, non-native weeds
- Erosion that could threaten riparian mitigation success

6.4 Riparian Habitat Performance and Final Success Criteria

This section sets forth the performance and final success criteria for the Riparian Mitigation Areas and the Riparian Enhancement Area. Quantitative measurements will be compared to the criteria outlined below to determine the extent to which the Riparian Mitigation Areas is developing riparian functions and values on a trajectory toward meeting the riparian mitigation goals.

6.4.1 Performance Criteria for the Riparian Mitigation Areas

Percent Tree and Shrub Survival Performance Standard. The percent survival performance standard is utilized primarily to trigger replanting and guide species adjustments during the plant establishment period. Thus, although the performance standard for trees and shrubs (combined) is 100% in Years 1 and 2 and 80% in Yr-3, if those levels are not met it should not be interpreted as site failure. The Yr-3, 80% performance criterion pertains to the percent survival of the initially installed trees and shrubs (combined). Achieving

100% survival is unlikely on any but the most ideal sites, nevertheless, such a high standard is a useful trigger for aggressive replanting need. Percent survival will be measured by species and all dead plants up to the performance standard will be replaced in-kind unless a restoration ecologist determines that site performance would be enhanced by substitution with another species that exhibits vigorous growth on the site.

Performance and success criteria after Yr-3 are based on response variables that measure plant growth and habitat development such as percent cover and plant height.

Percent Cover Native Trees and Shrubs. Average percent cover of native riparian tree and shrub species in the Riparian Mitigation Area shall exhibit an increasing trend over time with a positive slope that will attain the final success criterion.

Percent Cover Invasive Plant Species. Average percent cover of invasive plant species shall be less than 5% throughout the 10 year monitoring period. Invasive plant species are defined as non-native species with a "moderate" or "high" impact invasive by the California Invasive Plant Council.

Tree Height. The average height of each tree species installed in the Riparian Mitigation Area shall exhibit an increasing trend over time with a positive slope that will attain the final success criterion.

6.4.2 Final Success Criteria for the Riparian Mitigation Areas

Percent Cover Native Trees and Shrubs. The Riparian Mitigation Areas shall have an average percent cover of native woody species of at least 35% in Yr-10, within an area measuring at least 3.63 ac.

Percent Cover Invasive Plant Species. Average percent cover of invasive plant species shall be less than 5% in Yr-10, within an area measuring at least 3.63 ac.

Tree Height. Table 14 below provides the Yr-10 final success criteria for average height by tree species representative of each of the three plant associations in the Riparian Mitigation Areas.

Table 14. Tree Height Final Success Criteria

Common Name	Scientific Name	Tree Height Final Goal (ft)
Coast live oak	*Quercus agrifolia*	6
Valley oak	*Quercus lobata*	8
Red willow	*Salix laevigata*	10
Arroyo willow	*Salix laseolepis*	10

Riparian Mitigation Surface Area. At least 3.63 ac of riparian habitat will be restored. This criterion will be achieved in any monitoring year when the average percent cover success criterion is met in an area of 3.63 ac or more.

6.4.3 Performance and Final Success Criteria for the Riparian Restoration Area

Cattle Exclusion Fencing. Cattle exclusion fencing shall function to exclude cattle from the Riparian Restoration Area.

Percent Cover Invasive Plant Species. Average percent cover of invasive plant species shall be less than 5% in the Riparian Restoration Area throughout the 10 year monitoring period.

6.5 Mitigation Swales/Channels Performance and Final Success Criteria

6.5.1 Swale/Channel Geomorphic Stability Performance and Success Criteria

The geomorphic stability performance and final success criteria are presented in Table 15.

Table 15. Geomorphic Stability Monitoring Tasks, Performance and Final Success Criteria, and Conceptual Remedial Actions[1]

Area	Monitoring Task	Performance Criteria (Years 1-4)	Final Success Criteria (Year-5)	Maintenance Protocol
Channel Performance and Longitudinal Profile	Monitor evidence of channel bed incision, which includes documenting any knickpoints/headcuts and the initiation and/or growth of gullies	The longitudinal profile of the creek system should remain fairly consistent, without excessive scour, erosion or deposition. The longitudinal slope of 1 percent should be maintained between structures.	Performance criteria attained for 3 consecutive years.	Any significant deviation from the design channel slope should be reported and addressed by maintenance as necessary.
Bank Performance	Monitor the banks for obvious signs of vertical and horizontal displacements, seepage or erosion caused by high creek levels.	Significant displacement, seepage or erosion should not occur along the channel banks.	Performance criteria attained for 3 consecutive years.	Any excessive slope displacement, seepage or erosion should be reported and addressed by maintenance as necessary. Both an Engineering Geologist and a Geotechnical Engineer should be consulted on significant bank repairs.

Area	Monitoring Task	Performance Criteria (Years 1-4)	Final Success Criteria (Year-5)	Maintenance Protocol
Rock Energy Dissipation Structures	Monitor dissipation structures for structural integrity and stability including the extent of any erosion taking place around the edges of the rock aprons, as well as immediately downstream of the rock installations.	Structures should remain in the approximate locations and configurations originally constructed.	Performance criteria attained for 3 consecutive years.	Irregularities should be reported in the monitoring report and repairs coordinated with the Geotechnical engineer.
Sediment Movement	Monitor evidence of excessive deposition in channel including active channel depth to width ratios.	The channel width:depth ratio is to be monitored for changes that could affect the creek function or the structural integrity of the drop structures.	Performance criteria attained for 3 consecutive years.	Any excessive deposition or erosion in the creek channel causing channel width:depth ration to change by more than 10 percent should be reported and addressed by maintenance as necessary. Both an Engineering Geologist and a Geotechnical Engineer should be consulted on significant channel repairs.
Vegetation Obstructions of Flood Flows	Creek channel and banks will be monitored for vegetation that could obstruct flood flows.	Vegetation does not obstruct flood flows in the creek areas.	Vegetation does not obstruct flood flows in the creek areas.	Portions of vegetation that are obstructing channel flow should be trimmed or removed as necessary to allow creek function for conveying storm runoff.
Debris Accumulation	Creek channel and banks will be monitored for flow obstructing trash or debris.	Trash or debris does not obstruct flood flow in the creek areas.	Trash or debris does not obstruct flood flow in the creek areas.	Trash and other undesirable debris obstructing flow should be removed from the creek areas.

[1]Note-The content of this table was prepared by ENGEO.

6.5.2 Vegetation Criteria

Performance Criteria- Percent Tree and Shrub Survival. The coyote brush and coast live oak plantings are an enhancement measure, and are not being installed within the Mitigation Swales/Channels to mitigate the loss of woody riparian habitat. Thus, although the performance standard for trees and shrubs is 100% in Years 1 and 2 and 80% in Yr-3, if those levels are not met it should not be interpreted as site failure. The percent survival performance standard is utilized to trigger replanting and guide species adjustments during the plant establishment period to facilitate establishment of the enhancement plantings. Achieving 100% survival is unlikely on any but the most ideal sites, nevertheless, such a high standard is a useful trigger for aggressive replanting need. Percent survival will be measured by species and all dead plants up to the performance standard will be replaced in-kind unless a restoration ecologist determines that site performance would be enhanced by substitution with another species that exhibits vigorous growth on the site.

Performance and final success criteria after Yr-3 are based on percent cover in order to assess plant growth and habitat development.

Performance Criteria-Percent Vegetation Cover. The average percent vegetation cover (all species combined) will equal or exceed the following by monitoring year:

- Year-1: 20%
- Year-2: 35%
- Year-3: 50%
- Year-4: 60%

Final Success Criteria-Percent Vegetation Cover. The average percent vegetation cover (all species combined) will be greater than or equal to 70%.

6.6 Mitigation Monitoring Methods

6.6.1 Riparian Mitigation Areas

Plant Survival. The survivorship of riparian plant associations will be determined by field counts of all trees and shrubs installed in Years 1, 2 and 3. Percent survival will be calculated by species as follows: Percent Survival of Species A = (number of individuals of species A alive during monitoring period / total number of species A alive at installation) * 100.

Plant survival in Year-3 will be measured not only for all plants installed, but also for the plants initially installed. The percent survival (in Year-3) of the initially installed plants will be compared to the 80% performance criterion. Therefore, replacement plants will be field tagged with the date they were installed to facilitate measurement of the percent survival of the initially installed plants.

The percent survival of all planted tree species for the willow, valley oak and shrub/oak riparian plant association areas combined will be calculated and compared to the performance criteria.

Percent Cover. Percent cover will be determined for the Riparian Mitigation Areas using the line-intercept method after Bonham (1989); one of the standard, accepted methods in quantitative plant ecology for estimation of percent forest canopy cover. Fixed-length (100 ft), permanent transects will be established and marked with metal T-posts. Random, or stratified random, transect locations will be established in Yr-1. The number of transects will be evaluated on the variability of the site's vegetative cover, which itself will be determined by evaluating the average cover value obtained over increasing numbers of transects. The number of transects used will be the point where additional samples do not substantially change the average cover value obtained (Kershaw 1973).

The average percent cover of native riparian species (by species and for all species combined) will be calculated among the fixed length transects. The results will be compared to the percent cover final success criteria described above

Tree Height. The height of all planted trees within a 20 ft band along each monitoring transect will be measured using a measuring tape, telescopic pole, or clinometer. Average tree height will be calculated for each tree species sampled and compared to the tree height final success criterion described above.

Health and Vigor. A qualitative assessment of overall tree and shrub health and vigor will be made by considering health-related factors such as leaf color, bud development, new growth, herbivory, drought stress, fungal/insect infestation, and physical damage. Overall health and vigor will be quantified using the numerical and qualitative scale shown in Table 16. Plant health and vigor will be assessed for all trees and shrubs within a 20 ft band along each permanent monitoring transect. Health and vigor for each species will be calculated by averaging the numerical values for each species.

Table 16. Plant Health and Vigor Categories

Qualitative Value	Numerical Value	Observations
High health and vigor	1-3	67-100% healthy foliage
Medium health and vigor	4-6	34-66% healthy foliage
Low health and vigor	7-9	zero-33% healthy foliage

Photo-documentation. Photographs of the Riparian Mitigation Areas will be taken from fixed locations. Photographs will also be taken to record any event(s) with the potential to significantly affect the success of the mitigation, including flooding, fire, and general vandalism. The fixed photo-documentation locations will be established during construction monitoring.

6.6.2 Riparian Restoration Area

Creek Channel Stability. A qualified geomorphologist will visually assess creek channel stability within the Riparian Restoration Area during each monitoring year. The purpose of the assessment will be to identify whether any erosion occurs that would compromise attainment of the final success criteria described above.

Cattle Exclusion Fencing. A restoration ecologist will inspect the Cattle Exclusion Fence to verify the fence excludes cattle throughout the Riparian Restoration Area.

Invasive Plant Cover. A restoration ecologist will spatially map all "invasive plant patches" within the Riparian Restoration Area during annual vegetation monitoring. For this monitoring method, "invasive plant patches" are defined as patches of vegetation in which invasive plant cover (as defined above) constitutes ≥ 50% relative cover of the vegetation within the patch (as determined by a visual estimate) and which covers at least 20 square feet. The total area of all invasive plant patches will be divided by size of the Riparian Restoration Area reported in the As-built report to determine the percent cover of invasive plants in the Riparian Restoration Area.

6.6.3 Mitigation Swales/Channels

Geomorphic Stability. A qualified geomorphologist/hydrologist conduct a field assessment of creek channel stability within the Mitigation Swales/Channels in May during each monitoring year. The assessment will evaluate the performance criteria presented in Table 15. Survey equipment (e.g. laser level, GPS unit) will be used to assess the quantitative performance criteria (i.e., Channel Performance and Longitudinal Profile, Rock Energy Dissipaton Structures, Sediment Movement).

Plant Survival. The survivorship of coyote brush and coast live oak will be determined by field counts of all plants installed in Years 1, 2 and 3. Percent survival will be calculated by species as follows: Percent Survival of Species A = (number of individuals of species A alive during monitoring period / total number of species A alive at installation) * 100.

The percent survival of all planted coyote brush and coast live oak combined will be calculated and compared to the performance criteria.

Percent Cover. Herbaceous vegetation will dominate the plant community within the Mitigation Swales/Channels. Therefore, percent vegetation cover will be quantified using the quadrat method (Bonham 1989). Quadrats will comprise 1m^2 plots sampled at stratified random locations such that at least 0.5% of each Created Mitigation Swale/Channel area is sampled. The sample frame will be the swale/channel bed and banks. If the swale/channel bank blends uniformly into the adjacent upland slopes, then the sample frame will extent to upslope edge of the canopy of planted coyote brush and coast live oak. The percent plant cover of each species occurring within each quadrat will be visually estimated to the nearest 5%.

The number of quadrats will be evaluated based upon the variability of the site's vegetative cover, which itself will be determined by evaluating the average cover value obtained over increasing numbers of quadrats. The number of quadrats used will be the point where additional samples do not substantially change the average cover value obtained (Kershaw 1973).

The average percent cover of plant species combined will be calculated among the quadrats. The results will be compared to the percent cover criteria described above.

Section 7.0 Reporting

7.1 Habitat Mitigation As-built Report

The monitoring ecologist will prepare a Habitat Mitigation As-built Report documenting any significant deviations between the extent of Project impacts to riparian habitats, constructed condition of the mitigation site and the conceptual design presented herein. Deviations that will be documented include changes in the area of riparian impacts, site configuration, mitigation site surface area, plant species palette, among others. Future analysis of the site will be based on this report. The As-built Report will be submitted to the CDFW and RWQCB within 3 months of the completion of the mitigation construction. The Report will include photo-documentation of the constructed condition.

7.2 Monitoring Reports

Ecological monitoring reports will be submitted to the CDFW and RWQCB by 31 December of each monitoring year. Each report will describe the purpose and goals and the riparian restoration associated with the Project, evaluate the Riparian Restoration Area's overall performance relative to stipulated performance and success criteria, and provide maintenance recommendations. Maintenance and monitoring will cease upon the attainment of the final success criteria described in Section 6.4.2.

Section 8.0 Adaptive Management

Vegetation. If percent survival falls below the performance criterion for a given monitoring year, each dead plant will be replaced with an individual of the same species within 4 months of survival data collection (data will be collected in late summer/fall) to bring survival back up to the applicable annual percent survival criterion (i.e., 100% in years 1 and 2, 80% in year 3). If the site is deemed not conducive to the survival of a particular species, then another species that exhibits vigorous growth on the site will be substituted. A summary of species and quantities replanted will be included in the subsequent annual monitoring report. Replacement plantings shall be irrigated for three years or until adequately established, as determined by the monitoring restoration ecologist.

Erosion. If creek bank erosion occurs within the Riparian Mitigation Areas or Mitigation Swales/Channels that would compromise attainment of the success criteria, the Applicant will propose a remedial action plan for regulatory agency approval. The remedial action plan will include proposed location(s) for riparian mitigation plantings to replace, at minimum, the acreage of Riparian Mitigation Area lost to erosion. Replacement riparian mitigation plantings will be located within the Riparian Restoration Area, if feasible.

Section 9.0 Completion of Mitigation Responsibilities

The Applicant will submit a final monitoring report to the RWQCB and CDFW documenting that the final success criteria have been met. The applicant will be released from the mitigation obligation when the agencies issue written "sign-off" acknowledging that the mitigation success criteria have been met and that ecological monitoring and reporting can cease.

Section 10.0 References

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Appendix A Reference and Mitigation Site Soils Analysis

Appendix A.

REFERENCE AND MITIGATION SITE SOILS ANALYSIS

1.0 Introduction

This report documents the soil sampling, observations and literature review carried out by H. T. Harvey & Associates to select the Riparian Mitigation Areas proposed in *Riparian Mitigation and Monitoring Report* (MMP) for the Moller Ranch Residential Development and Tassajara Road Culvert Replacement Project (hereafter, "the Project") (H. T. Harvey & Associates 2014a).

2.0 Methods

2.1. Overview

Soils in the proposed Riparian Restoration Area can have high salinity and boron; a condition that reduces plant vigor and growth, and could preclude woody riparian vegetation establishment in extreme cases (H. T. Harvey & Associates 2014b). Therefore, to determine the upper limits of soil salinity and boron for red and arroyo willow (*Salix laevigata; S. laseolepis*) and valley oak growth (*Quercus lobata*), H. T. Harvey and Associates restoration ecologists:

- sampled soil within established red willow and valley oak riparian habitats along Moller Creek (i.e., the "Reference Sites") shown in Figure 1;
- reviewed performance of willow and oak trees planted in boron laden/ saline soils from other riparian mitigation projects; and,
- conducted a literature review of existing information on willow and oak tolerances of boron and salinity.

We then sampled soils and observed vegetation the within the proposed Riparian Restoration Area, an approximately 5,400 linear reach of Moller Creek shown in Figure 1. Based on the results of these surveys and our literature review, we selected and mapped areas within the proposed Riparian Restoration Area suitable for revegetation of willow, valley oak and scrub/oak plant associations (i.e., the Riparian Mitigation Areas). The resulting location and acreage of the proposed Riparian Mitigation Areas are presented in the MMP (H. T. Harvey & Associates 2014a).

LEGEND

- Moller Ranch Residential Development Project (MRRDP)
- Proposed Moller Ranch Conservation Area
- Thalweg
- Proposed Riparian Restoration Assessment Area (Reaches 1-8)

Reference Sites

- Valley Oak and Red Willows Below Reach 1 (BR1)
- Red Willows in Reach 6
- Red Willows at Brown Ranch

Soil Sample Points

- Oak Plant Association
- Willow Plant Association
- Scrub/Oak Plant Association at Top of Bank

N 400 200 0 400
Feet

PG&E Station

Reach 1
Reach 2
Reach 3
Reach 4
Reach 5
Reach 6
Reach 7
Reach 8

Camino Tassajara

Overview

Red Willows at Brown Ranch Reference Sites

PG&E Conservation Area

0 1100 2200
Feet

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

N:\Projects\3300\3313-01\03\Reports\Riparian MMP\Appendix A Reference and Mitigation Site Assessment Locations Map.mxd

H.T. HARVEY & ASSOCIATES
Ecological Consultants

Appendix A: Figure 1 Reference and Mitigation Site Soils Analysis

Moller Ranch Residential Development Project (MRRDP) and Tassajara Road Culvert Replacement Project (TRCRP) MMP (3313-03)

June 2014

2.2 Soil Sampling

H. T. Harvey & Associates' restoration ecologists, G. Archbald (M.S.) and M. Parsons (M.S.), collected soil samples from three willow reference sites and one valley oak reference site situated along Moller Creek in April 2014. These three reference sites are referred to as "Brown Ranch", "Reach 6" and "Below Reach 1" (hereafter, "BR1") and their locations with respect to the "Riparian Restoration Assessment Area" shown in Figure 1. At all reference sites, G. Archbald and M. Parsons sampled soil from 12- 36 inches in depth within the rooting zone of mature red willows and noted understory vegetation. At the BR1 reference site, soil was also sampled near mature valley oak trees and red willow trees from 0-12 inches in depth. Soil samples comprised 4 composited sub-samples from within each target habitat (e.g., oak or willow) and reference site in all cases; except for the willow rooting zone soil sample at Reach 6 which was collected from a single soil pit between the only two willow trees at the site.

Soil samples were also collected in April 2014 from the proposed Riparian Restoration Area (Figure 1; H. T. Harvey & Associates 2014a). The proposed Riparian Restoration Area was divided into 8 reaches (Figure 1). Within each reach, areas potentially suitable for willow, valley oak, and shrub/oak plant revegetation were sampled from a depth of 0-12 inches. Potential willow planting areas were located on floodplain terraces near the creek channel bottom, in ponded areas downstream of head cuts, and along bank-slump areas near the creek channel bottom and were vegetated with either obligate wetland species (e.g., yerba mansa (*Anemopsis californica*), creeping spike rush (*Eleocharis marcostachya*), cattail [*Typha* sp]) or saltgrass (*Distichlis spicata*). Potential valley oak planting areas were located on floodplain terraces approximately 3-5 ft above the channel and on creek banks with slopes less than 1V : 2H and vegetated with, predominantly, facultative or upland grasses and forbs (e.g., foxtail [*Hordium murinum*], coastal heron's bill (*Erodium cicutarium*) and bearded ryegrass [*Elymus triticoides*]). Potential scrub/oak planting areas were located within approximately 20 ft of the top-of-bank and were either vegetated with, upland grasses and forbs (e.g., foxtail, coastal heron's bill, and wild oats [*Avena fatua*] or located in mostly bare, scald areas.

Soil samples were analyzed for texture and horticultural suitability by Soil and Plant Laboratory, Inc. (Anaheim, CA).

2.3 Literature Review and Off-site References

We reviewed literature regarding salinity and boron tolerance of oak and willow trees, including a review of soil properties and success of valley oak and red willow trees planted the Northern Drainage, a ten year-old riparian mitigation site with relatively high salinity and boron (H. T. Harvey & Associates 2013); and reviewed willow planting success at Wrigley Creek, a three year-old mitigation site planted in soils known to have high boron (Harvey & Associates 2014c). The Northern Drainage riparian mitigation site is located less than a mile to the south of Moller Creek in Dublin, CA. The Wrigley Creek riparian mitigation site is located in Milpitas, CA.

3.0 Results & Discussion

3.1 Salinity and Boron in Reference Site Soils

Boron is required for plant growth but is toxic at elevated levels (Nable al. 1997). Toxicity levels are species specific. As a rule of thumb, boron can be problematic for plants in concentrations ranging from 1 – 2 ppm. However, many crop and horticultural species are known to be tolerant of boron up to 10 ppm (USDA/AARS 2014). Salinity tolerance is also species specific.

Soil salinity and boron levels in reference oak and willow habitats are presented in Table 1. Soil salinity in Moller Creek reference sites ranged from 0.7 to 2.0 ppt and boron ranged from 0.27 to 1.69 ppm. Complete soil lab reports from Moller Creek reference sites (and the Riparian Restoration Area) are included in Attachment 1. Reference sites along Moller Creek were either sandy loam or sandy clay loam soils and pH ranged from 7.2 to 8.2 across oak and willow habitat types.

Our review of soil properties at other riparian mitigation sites show that willow and oaks can tolerate considerably higher salinity and boron levels than found in the Moller Creek reference sites. In the Northern Drainage riparian mitigation site, after 10 years red willow cover was 26.9% in spite of relatively high boron and salinity (Table 1). At the Wrigley Ford riparian mitigation site, planting survival was high (above 86%) and health and vigor of red and arroyo willow plantings was "fair" or "good" in areas of relatively high boron and moderate salinity (Table 1). Valley and coast live oak trees have been successfully planted in soils with boron from 3 – 5 ppm according to the Las Pilitas Nursery (2014). A prior assessment by H. T. Harvey & Associates based on literature review and direct observation determined that valley oak and coast live oak species can tolerate soil salinity up to 2 ppt while willow trees might tolerate up to 3 ppt (H. T. Harvey & Associates 2008). These findings are summarized in Table 1, below.

Table 1. Reference Site and Literature Soil Characteristics

HABITAT	REFERENCE SITE or LITERATURE SOURCE	SOIL SALINITY (PPT)	SOIL BORON (PPM)
Red Willow	Brown Ranch [1]	0.4	0.27
	Reach 6 [1]	2.0	0.97
	BR1[1] (12-36 inches)	0.7	0.74
	BR1[1] (0-12 inches)	0.7	1.69
	Northern Drainage [2]	4.6	2.70
	Wrigley Creek [3]	1.3	4.30
	H. T. Harvey & Associates 2008	3.0	N/A
Valley Oak	BR1 [1]	0.3	0.56
	H. T. Harvey & Associates 2008	2.0	N/A
	Las Pilitas Nursury 2014	N/A	3-5

[1] Located in Moller Creek (see Figure 1)
[2] Located approximately 1 mile south of Moller Creek in Dublin, CA
[3] Located in Milpitas, CA.

3.2 Riparian Restoration Area Soils

Soil salinity and boron were low in most reaches within the potential valley oak and scrub/oak planting areas (Figure 1; Attachment 1). Exceptions to this were the scalded areas along the top-of-bank in reaches 1 and 2, bank slopes in reach 2 and terraces in reach 5 which had either elevated salinity, boron or both (Table 2). Soil texture in the oak and scrub/oak target revegetation areas were generally sandy loam or sandy clay loam.

In the potential willow planting areas, salinity and boron values were generally higher than the areas targeted for oak and scrub/oak revegetation (Table 2). Salinity and boron values were lowest in reaches 1, 2 and 4. Salinity and boron were highest in saltgrass-dominated bank slump areas in reach 1. Soil texture ranged from sandy loam to clay along the Moller Creek channel in areas considered for willow revegetation (Appendix A).

Table 2. Restoration Area Site Soil Characteristics

TARGET PLANT ASSOCIATION	SUB-HABITAT	REACH	SOIL SALINITY (PPT)	SOIL BORON (PPM)
Red Willow	Terrace	1	1.3	2.38
	Slump	1	8.3	11.70
	Terrace and Slump	2	2.3	2.43
		3	3.6	3.26
		4	0.3	0.26
		5	4.0	1.74
		6	4.6	2.12
		7	3.0	3.99
		8	1.3	3.21
Valley Oak	Terrace	1	0.3	0.24
		2	0.8	0.55
	Slope	2	0.9	1.62
	Terrace and Slope	3	0.3	0.22
		4	0.4	0.46
		5	4.2	3.14
		6	0.4	0.42
		7	1.7	1.33
		8	0.3	0.40
Scrub/Oak	Scald Areas	1,2	1.2	4.64
	No Scald	1,2	1.3	1.53
		3,4,5	0.5	0.13
		6,7,8	0.5	0.16

3.3 Selection of Riparian Mitigation Areas

Table 3 summarizes the boron and salinity criteria that H. T. Harvey & Associates developed to select and exclude Riparian Mitigation Areas by target plant association. We based these criteria upon the tolerance limits determined from our reference site assessment and literature review for each target plantings

association. The resulting planting plan is provided in the Project MMP (H. T. Harvey & Associates 2014a). Potential Riparian Mitigation Areas with salinity or boron values exceeding the tolerance limits determined from reference site and literature review were excluded from the mitigation plan with the following exception: in spite of salinity and/or boron values exceeding criteria in reaches 6, 7 and 8, three areas totaling 0.04 ac were identified for willow revegetation across reaches 6, 7 and 8. These were selected because we observed wetland vegetation (specifically, mature red willow trees in reach 6 and cattails in reaches 7 and 8) and ponding that indicated these areas had lower salinity/boron then the surrounding wetland areas which were dominated by salt-tolerant vegetation (e.g., yerba mansa and saltgrass).

Table 3 Summary of Soil Characteristics in the Riparian Reference and Proposed Riparian Mitigation Areas

TARGET PLANT ASSOCIATION	SOIL VARIABLE	SOIL SAMPLE LOCATION		
		Approximate Upper limit based on Reference Sites and Literature Review1	Average (± S.E.) in Proposed Mitigation Planting Area	Average (± S.E.) in Area Excluded from Mitigation Planting
Willow	Salinity (ppt)	3.0 ppt	2.1 ± 0.6 (n = 6)	5.3 ± 1.5 (n = 3)
	Boron (ppm)	3.0 ppm	2.4 ± 0.5 (n = 6)	5.6 ± 3.1 (n = 3)
Valley Oak	Salinity (ppt)	2.0 ppt	0.6 ± 0.2 (n = 7)	2.6 ± 1.7 (n = 2)
	Boron (ppm)	1.5 ppm	0.5 ± 0.1 (n = 7)	2.4 ± 0.8 (n = 2)
Oak/ Scrub	Salinity (ppt)	2.0 ppt	0.8 ± 0.3 (n = 3)	1.2 (n = 1)
	Boron (ppm)	1.5 ppm	0.6 ± 0.5 (n = 3)	4.6 (n = 1)

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Attachment 1. Soil and Plant Laboratory Report

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Soil & Plant Laboratory, Inc.
Leaders in Soil & Plant Testing Since 1946
4741 E. Hunter Ave, Suite A Anaheim, CA 92807 714-282-8777 (phone) 714-282-8575 (fax)
www.soilandplantlaboratory.com

Project : Moller Ranch, Dublin
Job #3313-03

COMPREHENSIVE SOIL ANALYSIS

Report No : **14-099-0055**
Purchase Order :
Date Recd : 04/09/2014
Date Printed : 04/14/2014

Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
				Sufficiency Factors											
Reach 1 Oak	19	7.4	0.4	2	5	10	55	2273	226	1.7	0.6	6	28	0.9	26325
	133	Low		0.2		0.4	0.3	1.0	0.8	1.0	0.1	0.4	0.4		
Reach 1 Willow	19	7.9	2.0	1	4	12	87	1159	339	2.0	0.7	11	47	1.1	26326
	104	Low		0.1		0.5	0.6	0.7	1.5	1.5	0.1	1.0	0.9		
Reach 1 Willow Disp/Slump	22	9.0	12.9	1	2	10	42	306	264	2.2	0.6	36	38	1.1	26327
	76	Low		0.1		0.4	0.3	0.2	1.5	2.2	0.2	4.3	1.0		
Reach 2 Oak Slope	34	6.8	1.4	93	10	93	779	3859	779	3.2	8.8	14	77	10.5	26328
	275	None		1.5		2.3	2.3	0.9	1.3	0.9	0.6	0.5	0.6		
Reach 2 Willow	24	8.2	3.6	2	8	18	115	1110	568	2.6	0.6	30	56	0.9	26329
	135	Low		0.2		0.6	0.6	0.5	1.9	1.5	0.1	2.0	0.9		
Reach 2 Oak Terrace	25	7.1	1.2	81	19	53	176	2199	429	2.6	2.4	16	55	2.8	26330
	151	Low		2.0		1.7	0.9	0.9	1.3	1.3	0.3	1.0	0.7		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand			Silt	Clay		
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	.002-.05	0-.002		
2.3	0.8	1.2	0.2	0.24	0.6	0.9	0.7	1.8	1.2	3.9	60	18.6	16.1	Sandy Loam	26325
1.7	1.4	17.0	1.3	2.38	7.6	13.7	4.0	2.3	1.4	4.7	64	17.6	12.1	Sandy Loam	26326
1.7	4.3	134.0	0.6	11.70	55.6	77.4	0.1	0.5	0.7	2.6	60.8	23.6	12.1	Sandy Loam	26327
6.2	3.7	3.9	2.3	1.62	2.7	1.7	1.0	2.5	1.7	4.5	46.5	28.0	19.1	Sandy Loam	26328
2.2	2.0	30.5	0.4	2.43	13.7	21.2	0.6	0.5	0.5	1.3	56.3	21.6	20.1	Sandy Clay Loam	26329
5.9	2.3	4.5	0.6	0.55	2.0	2.2	0	0.7	0.2	1.6	59.3	20.6	18.1	Sandy Loam	26330

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

* LOW , SUFFICIENT , HIGH

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Project : Moller Ranch, Dublin
Job #3313-03

COMPREHENSIVE SOIL ANALYSIS

Report No : **14-099-0055**
Purchase Order :
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Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
	Sufficiency Factors														
Reach 3 Oak (Terrace?)	26	7.3	0.4	3	6	10	96	2777	355	3.1	0.7	6	35	2.2	26331
	169	Low		0.2		0.3	0.4	1.0	1.0	1.4	0.1	0.3	0.4		
Reach 3 Willow	29	8.0	5.7	2	7	25	130	1361	596	3.9	0.8	21	44	1.4	26332
	155	Low		0.2		0.7	0.6	0.5	1.7	1.9	0.1	1.2	0.6		
Reach 4 Oak	30	7.4	0.6	2	9	17	179	2743	938	3.1	0.5	9	36	1.8	26333
	223	None		0.2		0.5	0.6	0.8	1.9	1.1	0	0.4	0.3		
Reach 4 Willow	27	7.4	0.5	2	8	8	107	2944	565	3.0	0.5	6	27	1.8	26334
	199	None		0.2		0.3	0.4	0.9	1.3	1.2	0.1	0.3	0.3		
Reach 5 Oak	29	7.9	6.5	4	7	31	141	1567	653	3.4	0.6	12	39	1.8	26335
	171	Low		0.2		0.9	0.6	0.6	1.7	1.5	0.1	0.6	0.5		
Reach 5 Willow	26	8.0	6.2	2	5	11	85	1276	986	4.5	0.6	21	60	1.4	26336
	182	Low		0.1		0.3	0.4	0.4	2.5	1.9	0.1	1.0	0.7		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand			Silt	Clay		
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	.002-.05	0-.002		
2.3	0.9	0.9	0.2	0.22	0.6	0.7	0.4	1.2	0.4	3.1	57.6	18.6	20.1	Sandy Clay Loam	26331
3.7	4.4	46.7	0.5	3.26	23.0	23.3	0.1	0.5	0.8	2.0	48.3	24.6	24.1	Sandy Clay Loam	26332
1.8	1.6	2.9	0.2	0.46	1.2	2.2	0.3	3.5	0.3	0.9	42.9	24.6	31.1	Clay Loam	26333
2.0	1.0	2.2	0.2	0.26	0.8	1.8	0.1	1.0	0.2	0.8	50.2	27.3	21.4	Sandy Clay Loam	26334
5.8	6.3	55.3	0.7	3.14	29.6	22.5	0.2	0.5	0.6	1.8	46.7	34.6	16.1	Loam	26335
5.1	8.6	53.3	0.4	1.74	33.6	20.4	0.4	1.0	1.0	2.6	49.5	23.6	23.1	Sandy Clay Loam	26336

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

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Project : Moller Ranch, Dublin
Job #3313-03

COMPREHENSIVE SOIL ANALYSIS

Report No : **14-099-0055**
Purchase Order :
Date Recd : 04/09/2014
Date Printed : 04/14/2014

Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
				Sufficiency Factors											
Reach 6 Oak	28	7.4	0.7	4	8	18	155	2960	524	2.9	0.8	7	33	2.1	26337
	200	None		0.2		0.5	0.6	0.9	1.2	1.1	0.1	0.3	0.3		
Reach 6 Willow	31	8.0	6.6	1	7	14	79	1352	1266	3.2	0.6	18	40	1.4	26338
	216	Low		0.1		0.4	0.3	0.4	2.7	1.2	0.1	0.8	0.4		
Reach 7 Oak	28	7.6	2.6	3	6	11	92	2507	687	2.8	0.5	6	25	1.8	26339
	212	Low		0.2		0.3	0.3	0.7	1.5	1.0	0.1	0.2	0.2		
Reach 7 Willow	27	8.1	4.7	1	4	13	111	1512	743	3.7	0.6	15	38	1.2	26340
	178	Low		0.1		0.4	0.5	0.5	1.9	1.6	0.1	0.8	0.4		
Reach 8 Oak	26	7.4	0.5	1	7	7	117	3137	460	2.2	0.5	5	23	1.8	26341
	200	None		0.2		0.2	0.5	1.0	1.1	0.8	0.1	0.2	0.2		
Reach 8 Willow	33	8.4	2.1	1	5	20	120	1615	533	3.6	0.7	48	100	1.9	26342
	158	None		0.1		0.5	0.5	0.6	1.5	1.8	0.1	2.8	1.3		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand			Silt	Clay		
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	.002-.05	0-.002		
2.0	1.3	3.4	0.2	0.42	1.5	2.7	0.3	0.5	0.5	1.5	46.1	35.6	16.1	Loam	26337
4.6	7.5	50.4	0.5	2.12	35.6	20.5	0.3	0.4	0.6	1.5	45	24.6	28.1	Sandy Clay Loam	26338
3.5	2.5	19.8	0.4	1.33	15.1	11.4	0	0.2	0.4	1.6	44.1	24.6	29.1	Sandy Clay Loam	26339
3.3	4.0	40.8	0.4	3.99	35.1	21.4	0.2	0.4	0.6	2.3	38.2	26.6	32.1	Clay Loam	26340
1.8	0.9	2.1	0.2	0.40	1.2	1.8	0	0.2	0.3	2.1	48.7	25.6	23.1	Sandy Clay Loam	26341
1.1	0.8	16.6	0.5	3.21	10.9	17.3	0.7	1.2	1.6	3.7	42.8	25.6	26.1	Sandy Clay Loam	26342

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

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Project : Moller Ranch, Dublin
Job #3313-03

COMPREHENSIVE SOIL ANALYSIS

Report No : **14-099-0055**
Purchase Order :
Date Recd : 04/09/2014
Date Printed : 04/14/2014

Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
				Sufficiency Factors											
Reach 9 Oak	23	7.5	0.5	1	6	5	101	2849	373	2.0	0.5	5	33	2.0	26343
	176	None		0.2		0.2	0.5	1.0	1.0	0.9	0.1	0.2	0.4		
Reach 10 Oak	27	7.5	4.5	1	7	14	183	3083	604	2.7	0.8	8	33	2.6	26344
	217	None		0.1		0.4	0.7	0.9	1.3	1.0	0.1	0.3	0.3		
Ref BR1 Oak	33	7.2	0.5	2	6	21	228	2787	580	2.7	1.9	11	40	3.8	26345
	190	None		0.1		0.5	0.9	0.9	1.4	1.1	0.2	0.5	0.4		
Ref BR1 Willow	22	7.9	1.1	1	5	21	133	1556	448	2.5	1.2	10	32	2.0	26346
	127	Low		0.1		0.8	0.8	0.7	1.6	1.5	0.2	0.7	0.5		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand			Silt	Clay		
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	.002-.05	0-.002		
2.3	0.9	1.6	0.3	0.25	0.8	1.2	0	0.3	0.7	3.5	47.9	24.6	23.1	Sandy Clay Loam	26343
17.9	9.0	29.8	0.6	2.19	50.5	8.1	0	0.1	0.3	1.0	46.2	23.8	28.6	Sandy Clay Loam	26344
2.9	2.0	1.1	0.5	0.56	1.4	0.7	0	1.0	1.4	4.0	46.4	24.4	23.6	Sandy Clay Loam	26345
1.6	1.1	7.4	0.6	1.69	3.0	6.4	0.4	0.5	1.1	4.2	55.8	24.6	14.1	Sandy Loam	26346

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

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Project : Moller Drainage
Dublin
Job # 3313-03

COMPREHENSIVE SOIL ANALYSIS

Report No : **14-105-0050**
Purchase Order : 14-1800
Date Recd : 04/15/2014
Date Printed : 04/21/2014

Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
				Sufficiency Factors											
Top Of Bank Reaches 5,4,3	27	7.2	0.8	2	5	19	358	2793	706	2.2	6.2	14	34	2.2	26372
	213	None		0.1		0.6	1.3	0.8	1.5	0.8	0.6	0.6	0.3		
Top Of Bank Reaches 8,7,6	29	7.0	0.7	3	7	8	167	3154	1867	2.0	0.8	11	40	2.5	26373
	328	None		0.2		0.2	0.4	0.6	2.8	0.5	0.1	0.3	0.3		
Top Of Bank Reaches 1,2 Scalds	37	8.5	1.8	7	4	9	106	1422	576	2.1	0.4	9	30	1.7	26374
	148	None		0.2		0.2	0.4	0.6	1.7	1.1	0.1	0.5	0.4		
Top Of Bank Reaches 1,2	26	7.8	2.0	7	4	45	796	2169	854	2.3	12.5	9	41	3.4	26375
	223	None		0.2		1.4	2.9	0.6	1.8	0.8	1.1	0.4	0.4		
Reference Brown Willows Rooting Zone	19	7.9	0.7	3	3	3	45	2580	429	1.5	0.7	28	36	1.1	26376
	174	Low		0.2		0.1	0.2	1.0	1.3	0.7	0.1	1.6	0.5		
Reference BR1 Willows Rooting Zone	18	8.2	1.1	1	3	4	65	1468	514	1.9	0.5	11	42	1.3	26377
	128	Low		0.1		0.2	0.4	0.7	1.9	1.2	0.1	0.8	0.7		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand						
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
1.7	1.1	3.3	0.8	0.13	3.3	2.8	0	0.4	0.8	1.8	38.5	32.4	26.3	Loam	26372
1.8	1.2	3.6	0.3	0.16	0.7	3.0	0	0.1	0.2	0.7	41.2	28.4	29.3	Clay Loam	26373
0.9	0.5	13.9	0.1	4.64	8.8	16.2	0	0	0.3	0.4	40.4	26.4	32.3	Clay Loam	26374
2.4	1.6	13.5	1.0	1.53	6.3	9.5	1.3	0.1	0.6	1.1	41.4	28.4	28.3	Clay Loam	26375
1.3	0.7	4.5	0.1	0.27	3.1	4.5	1.1	4.2	4.8	11.2	55.1	15.4	13.3	Sandy Loam	26376
1.2	0.7	6.9	0.1	0.74	5.3	7.1	0.8	1.3	1.3	3.4	57.4	25.4	12.3	Sandy Loam	26377

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

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Project : Moller Drainage
Dublin
Job # 3313-03

COMPREHENSIVE SOIL ANALYSIS

Report No : **14-105-0050**
Purchase Order : 14-1800
Date Recd : 04/15/2014
Date Printed : 04/21/2014

Sample Description - Sample ID	Half Sat %	pH	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
	TEC	Qual Lime		Sufficiency Factors											
Reference Reach 6 Willows Rooting Zone	29	8.3	3.1	1	3	8	87	1515	934	2.7	1.2	38	49	1.1	26378
	181	Low		0.1		0.2	0.4	0.5	2.4	1.2	0.1	1.9	0.6		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Sand Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
2.7	2.5	21.8	0.1	0.97	18.9	13.4	0	0.3	0.6	1.7	45.8	24.4	27.3	Sandy Clay Loam	26378

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

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Appendix B Water Availability Analysis (by ENGEO)

Project No.
5661.000.001

May 12, 2014
Revised May 28, 2014

Mr. Jeff Lawrence
Braddock & Logan Services, Inc.
4155 Blackhawk Plaza, Suite 201
Danville, CA 94506

Subject: Moller Ranch Project
Dublin, California

WATER AVAILABILITY ANALYSIS

Dear Mr. Lawrence:

We have completed our water availability analysis for the proposed Moller Creek riparian mitigation area located within the Moller Ranch project in Dublin, California. As shown on the Riparian Mitigation & Monitoring Plan for the project prepared by HT Harvey & Associates, the mitigation area consists of approximately 5,400 L.F. of Moller Creek, which has been historically grazed and will be revegetated as part of the Moller Ranch Residential Development and Tassajara Road Culvert Replacement Projects.

The first purpose of this analysis was to develop an understanding of the typical flow volumes that could be expected in the reach of Moller Creek channel where planting is proposed. The flow-volume results of the analysis were then used to develop an estimate of available water to sustain the various vegetation communities proposed for the channel as part of the mitigation area design.

HYDROLOGIC SETTING

Published hydrologic mapping of the area prepared by the Contra Costa County Public Works Department indicates that approximately 17 inches of annual precipitation occurs per year in the area of the creek watershed located within Contra Costa County based on precipitation records collected between 1879 and 1973. Mapping prepared by the Alameda County Flood Control and Water Conservation District indicate approximately 16 inches of annual precipitation in the Alameda County portion of the watershed. The area generally exhibits a mild, Mediterranean-type climate with warm, dry summers and cool, wet winters.

The existing watershed in both counties is estimated to contain approximately 2.0 square miles contributing to the creek at the southerly downstream end of the proposed restoration area as shown on Figure 1.

GEOLOGY

The Moller Creek watershed is located in Tassajara Valley within the Mount Diablo fold-and-thrust belt on the south flank of the Mount Diablo uplift. The bedrock formations in the area south of Mount Diablo and north of the Livermore Valley have been folded and cut by thrust faults that typically dip toward the north, according to recent geologic mapping by Crane (1995) and Graymer, et al. (1996). The site is underlain by Pliocene non-marine sedimentary rock consisting of weakly indurated claystone, siltstone and thin beds of sandstone and pebble conglomerate.

Soil mapping of the watershed prepared by the National Resource Conservation Service (NRCS) indicates that surficial soil materials are primarily comprised of montmorillonitic clay soils with a hydrologic group rating of 'D.' Group 'D' soils are defined as having a very slow infiltration rate when thoroughly saturated. As a result, the watershed is characterized by rapid run-off characteristics after saturation has occurred. Groundwater is estimated at approximately 20 feet in depth or less along the creek corridor by ENGEO for areas south of the county line based on the geotechnical exploration performed.

CLIMATE

This study uses the average monthly data to determine the water balance of the studied system. ENGEO is unaware of any current or historic precipitation study performed at or near the site that could be used to estimate the mean monthly precipitation amounts for the site. Therefore, data from a weather station located at the Livermore Municipal Airport, which is approximately 6 miles from the site, was utilized to estimate the values shown in Table 1. Historical daily precipitation data for water years 1998 to present were obtained from the Livermore Municipal Airport weather station from the joint National Oceanic and Atmospheric Administration (NOAA) and National Climatic Data Center (NCDC) website (NOAA and NCDC, 2010); this website identifies this weather station as Weather Station Number 724927. The site has approximately the same precipitation and temperature characteristics as the Livermore Municipal Airport, in terms of annual expected rainfall and temperature intensities. Table 1 summarizes the mean monthly precipitation amounts for the site.

TABLE 1
Monthly Mean Precipitation (inches)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2.48	2.91	1.65	1.04	0.48	0.04	0.01	0.00	0.10	0.96	1.34	2.66

Source: Livermore Municipal Airport Station (NOAA and NCDC, 2010)

WATER BUDGET

The water budget defines and quantifies the important input and output parameters, such as precipitation, evapotranspiration, and infiltration into or out of a given body of water. Each of these parameters is analyzed individually to develop expected numerical value flux estimates,

and the sum of the parts provides an estimate of available water at a given time step. For the referenced project, this summation analysis provides an approximation of the volumes of available surface water expected to flow through the creek corridor each month.

As illustrated in Diagram 1 below, the water availability analysis that is used in this report is expressed mathematically as:

$$\Delta S / \Delta t = R_{in} + DP - ET - R_{out} - G_{out}$$

Where,

$\Delta S/\Delta t$: Change in storage over time
R_{in}: Surface Inflow (including upstream runon in acre-ft/month)
DP: Direct Precipitation (in acre-ft/month)
ET: Evapotranspiration (in acre-ft/month)
R_{out}: Surface Outflow (in acre-ft/month)
G_{out}: Subsurface Infiltration (in ac-ft/month)

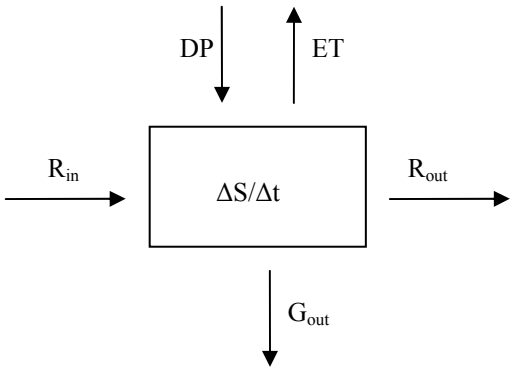


DIAGRAM 1
Water Balance Model

An estimate of the amount of water available to the proposed plant communities is considered separately in this document.

Inflow Parameters

For the water budget, we quantified several sources of inflow to the project. Inflow components included direct precipitation falling on areas within the restored creek and predicted run-on from Moller Creek upstream of the proposed restoration project. We calculated these inflows using published precipitation data, approximate project watershed areas, and typical hydrologic calculations to estimate runoff from developed sites.

- For purposes of this analysis, we estimate that 10% of the total volume of rainfall occurring within the upstream Moller Creek watershed will be transformed into rainfall runoff and enter the creek channel as surface flow in the study area for an average month. The 10%

overall estimate of total rainfall volume entering the stream channel as rainfall runoff corresponds with United States Geologic Survey estimates for the area according to a study by Rantz (1974) and with rainfall-runoff transformation estimates used by the California Stormwater Quality Association (2003). The 10% estimate considers seasonal variations in rainfall intensity and the nature of clay soils in the watershed which often retain considerable water in the early rainfall season. The estimate is thus somewhat conservative in the spring after watershed saturation occurs and water requirements of plantings are higher.

- The upstream watershed area for the restoration project is estimated by ENGEO as 1,093 acres at the Contra Costa County/Alameda County line. We are using this as the estimated upstream watershed area of the project which slightly over estimates flows north of the county line, and slight under estimates flows at the lower end of the project.

- 100% of direct precipitation based on average monthly rainfall is also included in the analysis over the total project area as a hydrologic input.

- Table 2 below summarizes the results of the monthly water inflows for Moller Creek.

TABLE 2
Monthly Water Inflows for Moller Creek

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average Monthly Precipitation (in.)	2.48	2.91	1.65	1.04	0.48	0.04	0.01	0.00	0.10	0.96	1.34	2.66	
Upstream Watershed (Ac)	1093.0	1093.0	1093.0	1093.0	1093.0	1093.0	1093.0	1093.0	1093.0	1093.0	1093.0	1093.0	
(10%) Upstream Inflows (Ac-ft)	22.6	26.5	15.0	9.5	4.4	0.4	0.1	0.0	0.9	8.7	12.2	24.2	
Study Area Watershed (Ac)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	
(100%) Study Area Direct Rainfall (Ac-ft)	0.8	0.9	0.5	0.3	0.2	0.0	0.0	0.0	0.0	0.3	0.4	0.8	

Outflow Parameters

The outflow components of our water balance consisted of evapotranspiration and groundwater infiltration, and we calculated these using both published data and approximations. Several of these assumptions are listed as follows:

- Groundwater infiltration is difficult to estimate in ephemeral channels in semiarid and arid regions such as Moller Creek, because periods of stream flow are unpredictable and typically of short duration, and because seepage losses are unsteady in initially dry channels. Based on research conducted by Niswonger et al., we estimate losses to infiltration as being 5% of the total volume of stream flow entering the channel per reach, as an average, for purposes of this study.

- Evapotranspiration is estimated based on referenced evapotranspiration recorded since 2004 for Pleasanton, California, based on the plant palette associated with the project. The reduction of the evapotranspiration rates by a crop factor of 0.7 was used to account for the employment of native vegetation in the planting scheme. Therefore, the total evapotranspiration for the native plant palettes used in the study and inherent in the creek corridor is estimated as 70% of the evapotranspiration rate expected for referenced agricultural crops in conformance with recommendations from the California Irrigation Management Information System.

- The project reach does not contain significant areas of ponding. Evaporation is considered to be negligible during periods of stream flow.

Table 3 below summarizes the results of the monthly outflows for Moller Creek.

TABLE 3
Monthly Water Outflow for Moller Creek

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly Evapo-transpiration (inches)	0.8	1.5	2.9	4.4	5.6	6.7	7.4	6.4	4.7	3.3	1.5	1.0	
Adusted Evapo-transpiration (inches)	0.6	1.0	2.0	3.1	3.9	4.7	5.2	4.4	3.3	2.3	1.1	0.7	
Study Area Watershed (ac)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	
Evapo-transpiration (ac-ft)	0.2	0.3	0.7	1.0	1.2	1.5	1.7	1.4	1.1	0.7	0.3	0.2	
Infiltration (5% of Inflow)	1.2	1.4	0.8	0.5	0.2	0.0	0.0	0.0	0.0	0.5	0.6	1.3	

For this project, this summation analysis approximates the volumes of available surface water expected to flow through, or be retained in, the Riparian Restoration Area each month.

Plant Available Water

In months with calculated inflow, the vegetation is assumed to evapotranspire available surface water up to the limit of maximum estimated evapotranspiration. In months with no inflow, the vegetation is assumed to rely on residual water found in perched groundwater sources. However, the total amount of plant available water should not exceed the planting requirements for the selected vegetation types as defined in Table 5, in order for the planting scheme to be considered sustainable.

Results of the study are summarized in Table 4 below:

TABLE 4
Monthly Water Balance for Moller Creek

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total Inflows (ac-ft)	23.4	27.4	15.6	9.8	4.5	0.4	0.1	0.0	0.9	9.1	12.6	25.1	
Evapo-transpiration (ac-ft)	0.2	0.3	0.7	1.0	1.2	1.5	1.7	1.4	1.1	0.7	0.3	0.2	
Plant Available Water (ac-ft)	**0.2**	**0.3**	**0.7**	**1.0**	**1.2**	**0.4**	**0.1**	**0.0**	**0.9**	**0.7**	**0.3**	**0.2**	**6.0**

Conclusions

As shown in Table 4 above, our analysis shows that the maximum moisture we expect to observe in the Moller creek channel should occur in February. We expect the creek channel to be dry for approximately 4 months out of the year between June and September, with very limited amounts of flow and residual moisture occurring in May and October. This is consistent with our observations in the channel since project planning commenced in 2005.

PLANTING PALETTE

Based on information furnished to us by the project biologist, HT Harvey & Associates, the following obligate riparian and facultative riparian planting palette is proposed for the project. Yearly water demand for these palettes has been estimated by the Department of Water Resources (DWR) after studying average drawdown in creek channels in Southern California by various native plant species in average rainfall years. Note that in the DWR study of the facultative riparian species such as oak species associations, the drawdown was estimated to be equal to the annual average rainfall in a clayey loam soil type, thus the consumptive use for the

facultative riparian community was reduced to equal the average annual rainfall for Dublin, California in this study. Yearly water demand is estimated in Table 5 below.

TABLE 5
Yearly Watering Requirements

Plant Community	Water Requirements (inches/year)	Study Area (acres)	Yearly Water Demand (ac-ft)
Willow Association	44	0.24	0.88
Scrub Oak Association	17	1.80	2.55
Valley Oak Association	17	1.81	2.56
Total		**3.85**	**5.99**

Table 5 indicates that the 5.99 acre-ft of total water required to sustain the proposed planting scheme is approximately equal but less than the 6.0 acre-ft of available water in the watershed shown at the bottom right of Table 4. Therefore, the planting scheme appears to be sustainable based on our analysis for an average rainfall year. Because the DWR studies examined established vegetation communities in an average rainfall year, we expect that the palette is sustainable through years of below and above average rainfall.

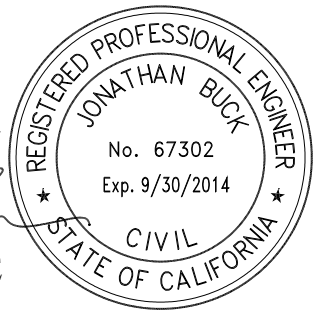
CONCLUSION

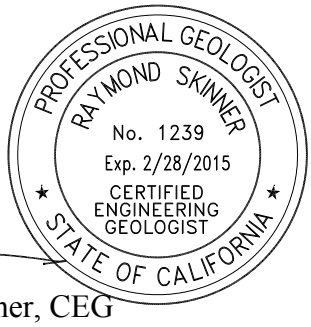
Based on the fact that the proposed planting palette consists of species that already occur within the watershed, the overall volume of water, combined with the temporal (season to season) availability, the proposed planting plan appears to be sustainable for an average water year.

We are pleased to be of service to you on this project and look forward to consulting further with you and your design team.

Very truly yours,

ENGEO Incorporated





Jonathan D. Buck, PE
jdb/rps/jf

Raymond P Skinner, CEG

Attachments: List of Selected References
Figure 1 – Moller Creek Restoration Location Map

SELECTED REFERENCES

1. ENGEO; Baseline Analysis Casamira Creek; January 20, 2006. Project No. 5661.1.500.01.

2. Contra Costa County Public Works Department; 1977. *Mean Seasonal Isohyets Compiled from Precipitation Records 1879-1973*. Drawing Number B-166. Revised January 1, 2010.

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4. Graymer, R. W. et al; Preliminary Geologic Map Emphasizing Bedrock Formations in Alameda County, California; Derived from the Digital Database Open-File 96-252, U.S. Geologic Survey; 1996.

5. National Conservation Resource Service; *www.websoilsurvey.com*, Dublin California, 2014.

6. Crane, R.; Geology of the Mount Diablo Region, in Geology of the Mount Diablo Region Guidebook, Northern California Geological Society; 1995.

7. ENGEO; Geotechnical Exploration, Moller Property, Dublin, California, November 29, 2012, Project No. 5661.000.001.

8. California Stormwater Quality Association. Stormwater Handbook, 2003.

9. Rantz, S.E., 1974, Mean annual runoff in the San Francisco Bay Region, California, -70. Miscellaneous Field Studies Map MF-613, Department of the Interior, States Geological Survey, prepared in cooperation with the California Department of Water Resources, San Francisco Bay Region Environment and Resources Planning Study, 24p. Pamphlet and map

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11. Niswonger et al.; Method for Estimating Spatially Variable Seepage Loss and Hydraulic Conductivity in Intermittent and Ephemeral Streams. Water Resources Research Vol 44. 2008.

12. H T. Harvey & Associates; Riparian Mitigation & Monitoring Plan for the Moller Ranch Residential Development and Tassajara Road Culvert Replacement Projects. May 2014.

13. Department of Water Resources, Use of Water in Native Vegetation, Bulletin No 50, 1942.

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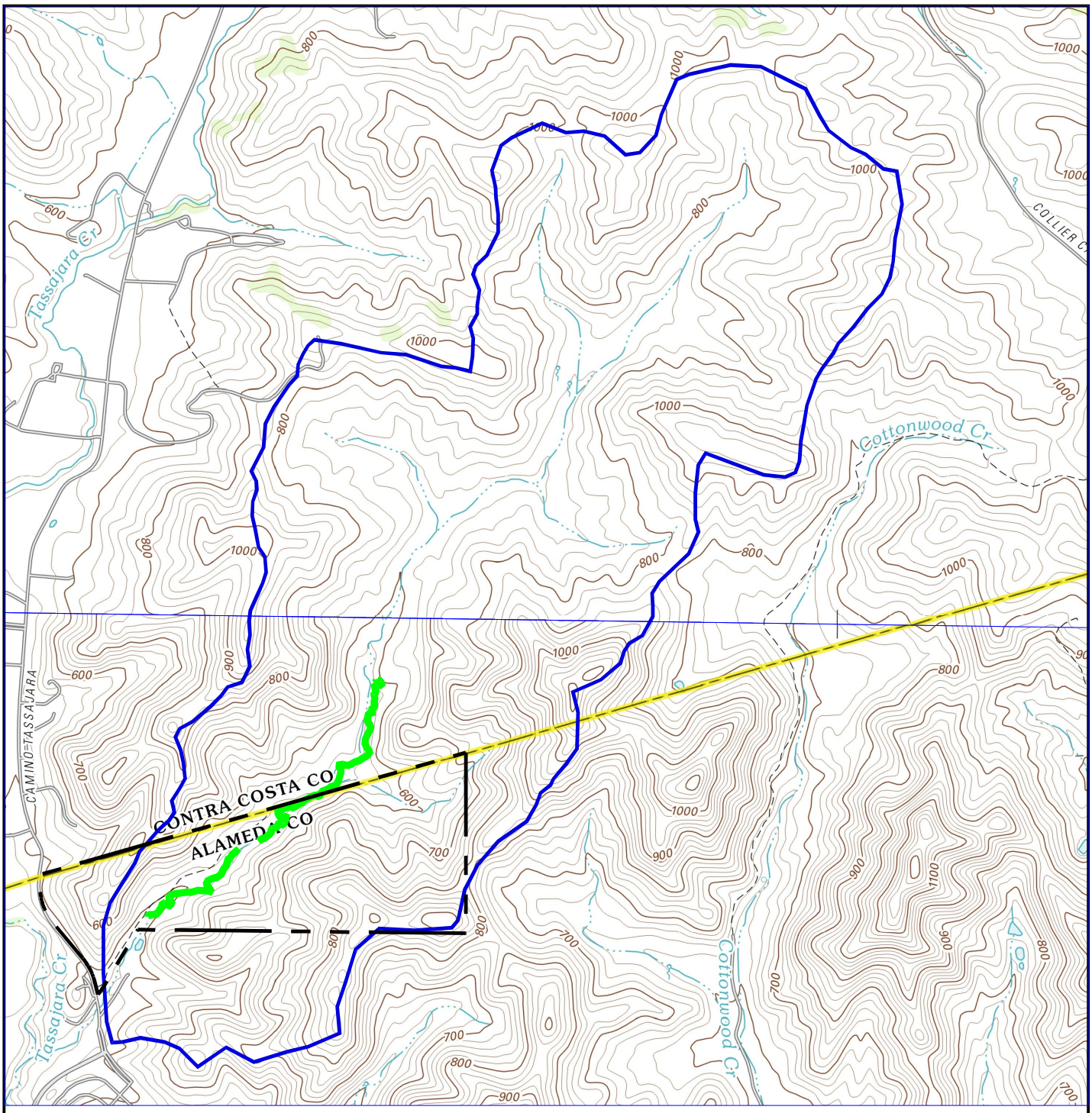


N

0 FEET 2000

0 METERS 1000

EXPLANATION

PROPOSED RIPARIAN RESTORATION

BASE MAP SOURCE: USGS, 2012

ENGEO Expect Excellence

MOLLER CREEK RESTORATION LOCATION MAP

MOLLER RANCH

DUBLIN, CALIFORNIA

PROJECT NO.: 5661.000.001		FIGURE NO. 1
SCALE: AS SHOWN		
DRAWN BY: PC	CHECKED BY: RS	

G:\Drafting\DRAFTING2_Dwg\5661\000\5661000001-1-RestorationMap-0514.dwg Plot Date: 5-06-14 pcrockett

ORIGINAL FIGURE PRINTED IN COLOR

Appendix C Tributary Channel Basis of Design Report (Prepared by ENGEO)

Project No.
5661.000.001

May 14, 2013
Revised August 2, 2013

Mr. Jeff Lawrence
Braddock & Logan Services, Inc.
4155 Blackhawk Plaza, Suite 201
Danville, CA 94506

Subject: Moller Ranch Project
Dublin, California

TRIBUTARY CHANNEL - BASIS OF DESIGN REPORT

References:

1. MacKay and Somps, Preliminary Stormwater and Hydrograph Modification Management Plan, Moller Ranch, Dublin, California, October 2012.
2. MacKay and Somps, Vesting Tentative Map, Moller Ranch Project, Dublin, California, January 2013.
3. United States Army Corps of Engineers; HEC-RAS Version 3.01, Hydraulic Reference Manual; Davis, California; 2003.
4. ENGEO; Corrective Grading Plan, Moller Ranch Project, Dublin California, June 2013.

Dear Mr. Lawrence:

As requested, we are providing this report at the request of the San Francisco Bay Regional Water Quality Control Board (RWQCB) regarding the creation and basis of design for several onsite channel systems located on your project in Dublin, California. We understand that several small drainage swales will be filled in as the result of grading activities at this project. However, given the re-contouring associated with final project finished grades, several new channels will be created to route open space water around the perimeter of the project and also to route open space along the frontage of several access roads. The purpose of this document is to describe the basis of design for the recreated channels in terms of geomorphic, hydrologic and hydraulic input as well as to outline a monitoring program acceptable to the RWQCB for channel monitoring after construction activities at the project have ceased.

GEOMORPHIC SETTING

According to the Baseline Hydrology Report prepared for the project by ENGEO, soil mapping of the watershed prepared by the National Resource Conservation Service (NRCS) indicates that surficial soil materials in the creek watershed are primarily comprised of Diablo

montmorillonitic materials with a hydrologic group rating of 'D.' Group 'D' soils are defined as having a very slow infiltration rate when thoroughly saturated. As a result, the watershed is characterized by rapid runoff characteristics after saturation has occurred. However, according to Reference 3, clay soils can withstand velocities up to 8 feet per second if lined with grass, making them substantially more stable than sandier materials.

The creeks, which are being filled by the project, are generally devoid of vegetation, hydrologically driven by seeps in areas of geotechnical instability, and have gradients as steep as 15% in some places. There are no developed floodplains or other complex geomorphic features in the existing creek systems. Also, the existing creeks onsite are located in areas that have been severely grazed by cattle, which often degrades the watershed by removal of vegetation and soil compaction. The mitigation creeks described herein will be designed to the maximum extent to mimic existing creek systems which will be filled, support vegetation, be geotechnically stable and be hydrologically driven through runoff from rain storm events on portions of the project which are not being developed.

GEOMORPHIC CRITERIA

Based on our experience in the San Francisco Bay Area, we have calculated equilibrium slope and stable channel dimensions for several other similar mitigation creeks with anticipated low peak flow rates such as the channels described in this report. In terms of fluvial geomorphology, the concept of an equilibrium slope is based on the experience that alluvial channels adjust their slope profile in response to changing sediment loads and hydrologic flow 'regimes'. If the created bed slope of the channel is too steep, velocities will be too high and erosion will develop. If the bed slope is too flat, aggradation of the bed slope is possible with sediment accumulation. Similarly, stable channel dimensions are based on "bankfull" channel dimensions, which attempt to mimic natural channel geomorphology with similar flow and sediment transport characteristics. If the channel is too narrow, shear stresses in the bed of the channel may develop which cause erosive forces that lead to bed downcutting. Similarly, if the channel is too wide, localized rills may form in the channel as water is not spread uniformly across the section.

For the channels described herein, we anticipate sediment transport processes to be negligible based on the small flow rates anticipated for the channels and the fact that the watershed is primarily composed of clay soil types. Therefore, we recommend that bed slopes for the recreated creek channels not exceed 2 percent in order to achieve equilibrium conditions in terms of sediment transport for channels with more than 10 cubic feet per second in required flow capacity. Smaller channels may have gradients up to 20 percent. Check dams or other grade controls should be provided in channels which exceed this criteria to flatten the slope of the channel below this criteria. A summary of proposed recreated channel enhancements is included in this report.

For the majority of creek channels, we recommend a minimum channel bottom width of 2 feet. Minimum side slopes of 2:1 (horizontal:vertical) for a minimum height of 1 foot should be included in areas of the channel in order to contain approximate 10-year recurrence interval discharges. Based on this geometry and bed slope, the channel should be able to convey up to

10 cfs of water, within the channel assuming conservatively that heavily established vegetation is present.

For the lower portion of Mitigation Creek D, which is located in the northeastern portion of the parcel, we recommend a minimum bottom width of four feet and minimum side slopes of 2.5:1 (horizontal:vertical) as the capacity of the channel is much larger. Based on our above criteria, the maximum longitudinal gradient of the channel should not exceed 2 percent.

A summary of the mitigation creeks shown on Figure 1 of this report is included in Table 1 below:

TABLE 1

Mitigation Swale	Location	Geomorphic Setting
A	Upslope of Lot 6	Recreated creek in proposed landslide debris removal to convey run-on water
B	Upslope of Lot 19	Recreated creek in proposed landslide debris removal to convey run-on water
C	Between 'A' Street and Moller Creek near County Line	Creation/Enhancement of existing swale along terrace adjacent to Moller Creek into Pool-Riffle sequence
D	North side of Keyway 20*	Recreated channel at edge of landslide debris removal and open space run-on convenyance channel in lower portion..
E	South side of Keyway 20*	Recreated channel at edge of landslide debris removal.
F	Upslope of Lot 163	Recreated creek in proposed landslide debris removal to convey run-on water
G	Upslope of Lot 179	Recreated creek in proposed landslide debris removal to convey run-on water
H	Upslope of Lot 185	Recreated creek in proposed landslide debris removal to convey run-on water
I	Upslope of Lot 234	Recreated creek in proposed landslide debris removal to convey run-on water
J	Downslope of Lot 323	Recreated creek on engineered fill slope.
K	Downslope of Lot 329	Recreated creek in proposed landslide debris removal to convey run-on water
L	Upslope of Lot 43	Recreated creek in proposed landslide debris removal to convey run-on water
M	Downslope of Lot 39	Creation/Enhancement of existing swale along terrace adjacent to Moller Creek into Pool-Riffle sequence
N	Downslope of Lot 49	Creation/Enhancement of existing swale along terrace adjacent to Moller Creek into Pool-Riffle sequence

* As shown on Corrective Grading Plan prepared by ENGEO (Reference 4)

HYDROLOGIC INPUTS

Peak flow hydrologic calculations for the Mitigation Creek D were performed using the 'rational method' methodology according to Western Alameda County (1989) guidelines as described by that agency and included in Appendix A of this report. Other mitigation creeks are conservatively estimated to contain 1.15 cfs per acre of tributary area based on our experience in the area.

We have included a summary of the calculations below.

TABLE 2

Mitigation Swale	Length (L.F.)	Tributary Watershed (ac)	Maximum 100-year flow rate (cfs)**
A	153	2.45	2.81
B	163	7.95	9.14
C	654	5.38	6.18
D	2358	74.5	105
E	716	23.45	26.97
F	319	9.44	10.86
G	276	0.95	1.09
H	181	3.08	3.54
I	552	4.49	5.16
J	461	2.52	2.90
K	578	2.10	2.42
L	437	2.68	3.08
M	710	15.77	18.13
N	408	3.24	3.73

SUMMARY OF PROPOSED ENHACEMENTS

The following table summarizes the proposed enhancements of the mitigation creeks in terms of geomorphic type.

TABLE 3
Proposed Enhancements

Geomorphic Class	Creeks	Stabilization	Vegetation*
High Gradient –Low Flow,	A,B, Upper D, E, F, G, H, I, J, K, L	Temporary erosion control fabric at time of construction. Construct Buried 25-lb rock check dams at 20 ft. on center in flow line.	Use Regreen Wheatgrass (*Triticum aestivum)* seed mix under erosion control mat. Plant Coyote Brush (*Baccharis Pilularis*) staggered each side at 20 feet on center.
Low Gradient – High Flow	Lower D	Temporary erosion control fabric at time of construction Place grade control structures as indicated on Figure 1.	Use Regreen Wheatgrass (*Triticum aestivum)* seed mix under erosion control mat. Plant mixture of California Wild Rose (*Rosa Californica*) and Coyote Brush (*Baccharis Pilularis*) staggered each side approximately at 5 feet on center. Plant Coast Live Oak (*Quercus agrifloia*) on north slope at approximately 50 feet on-center.
Low Gradient – Low Flow	C, M, N	Temporary erosion control fabric at time of construction. Place pool sequence in creek at 50 ft on center widening channel to 8 ft x 8ft.	Use Regreen Wheatgrass (*Triticum aestivum*) seed mix under erosion control mat. Plant mixture of California Wild Rose (*Rosa Californica*) and Coyote Brush (*Baccharis Pilularis*) staggered each side approximately at 5 feet on center.

*Vegetation recommendations are intended to provide minimum enhancement based on experience with similar creek channels in the general vicinity of the project but species may be appropriately substituted by the project biologist based on plant availability and vigor at the time of construction.

CHANNEL MONITORING

The following schedule for monitoring and maintenance is recommended. The schedule may be modified as needed when conditions change in order to fulfill the overall creek maintenance goals. Monitoring visits should be performed according to the following schedule:

TABLE 4
Monitoring Schedule

Schedule	Monitoring Type
Annually in May	Channel and Bank Monitoring; Sediment Movement; Energy Dissipation Structures; Vegetation Performance; Longitudinal Profile; Debris Accumulation.
After any storm greater or equal to the 10-year rainfall event as defined by the Alameda County Flood Control and Water Conservation District criteria for the Dublin area (a storm event generating approximately 3.2 inches of rainfall in a 24-hour period).	Channel and Bank Monitoring; Energy Dissipation Structures; Sediment Movement; Vegetation Performance; Longitudinal Profile; Debris Accumulation.

The following table summarizes the monitoring tasks, which should be performed at each scheduled monitoring event.

TABLE 5
Monitoring Tasks

Area	Monitoring Task	Performance Standard	Remedial Actions
Channel Performance and Longitudinal Profile	Monitor evidence of channel bed incision, which includes documenting any knickpoints/headcuts and the initiation and/or growth of gullies	The longitudinal profile of the creek system should remain fairly consistent, without excessive scour, erosion or deposition. The longitudinal slope of 1 percent should be maintained between structures.	Any significant deviation from the design channel slope should be reported and addressed by maintenance as necessary.
Bank Performance	The banks should be observed for obvious signs of vertical and horizontal displacements, seepage or erosion caused by high creek levels.	Significant displacement, seepage or erosion should not occur along the channel banks.	Any excessive slope displacement, seepage or erosion should be reported and addressed by maintenance as necessary. Both an Engineering Geologist and a Geotechnical Engineer should be consulted on significant bank repairs.
Rock Energy Dissipation Structures	Dissipation structures should be observed for structural integrity and stability including the extent of any erosion taking place around the edges of the rock aprons, as well as immediately downstream of the rock installations.	Structures should remain in the approximate locations and configurations originally constructed.	Irregularities should be reported in the monitoring report and repairs coordinated with the Geotechnical engineer.
Sediment Movement	Monitor evidence of excessive deposition in channel including active channel depth to width ratios.	The channel width:depth ratio is to be monitored for changes that could affect the creek function or the structural integrity of the drop structures.	Any excessive deposition or erosion in the creek channel causing channel width:depth ration to change by more than 10 percent should be reported and addressed by maintenance as necessary. Both an Engineering Geologist and a Geotechnical Engineer should be consulted on significant channel repairs.

Area	Monitoring Task	Performance Standard	Remedial Actions
Vegetation Performance	Creek channel and banks should be monitored for obstructing vegetation.	No vegetation should obstruct flow in the creek areas.	Portions of vegetation that are obstructing channel flow should be trimmed or removed as necessary to allow creek function for conveying storm runoff.
Debris Accumulation	Creek channel and banks should be monitored for obstructing trash or debris.	No trash or debris should obstruct flow in the creek areas.	Trash and other undesirable debris obstructing flow should be removed from the creek areas.

We recommend photodocumentation be performed on the channels annually at the locations shown on Figure 2.

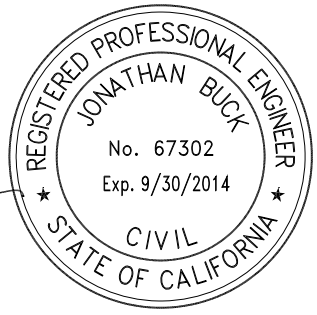
CLOSING

The created channels proposed on the project plans should perform adequately if constructed using the recommendations above. We understand that the project Geologic Hazard Abatement District (GHAD) will be responsible for long-term maintenance of the channels themselves. However, a conservation manager will be responsible for overseeing any maintenance activities as they relate to habitat management.

We appreciate the opportunity to prepare this report and look forward to working with you on this project. If you have any questions, please do not hesitate to contact us.

Sincerely,

ENGEO Incorporated



Jonathan Buck, PE

Raymond P. Skinner, CEG

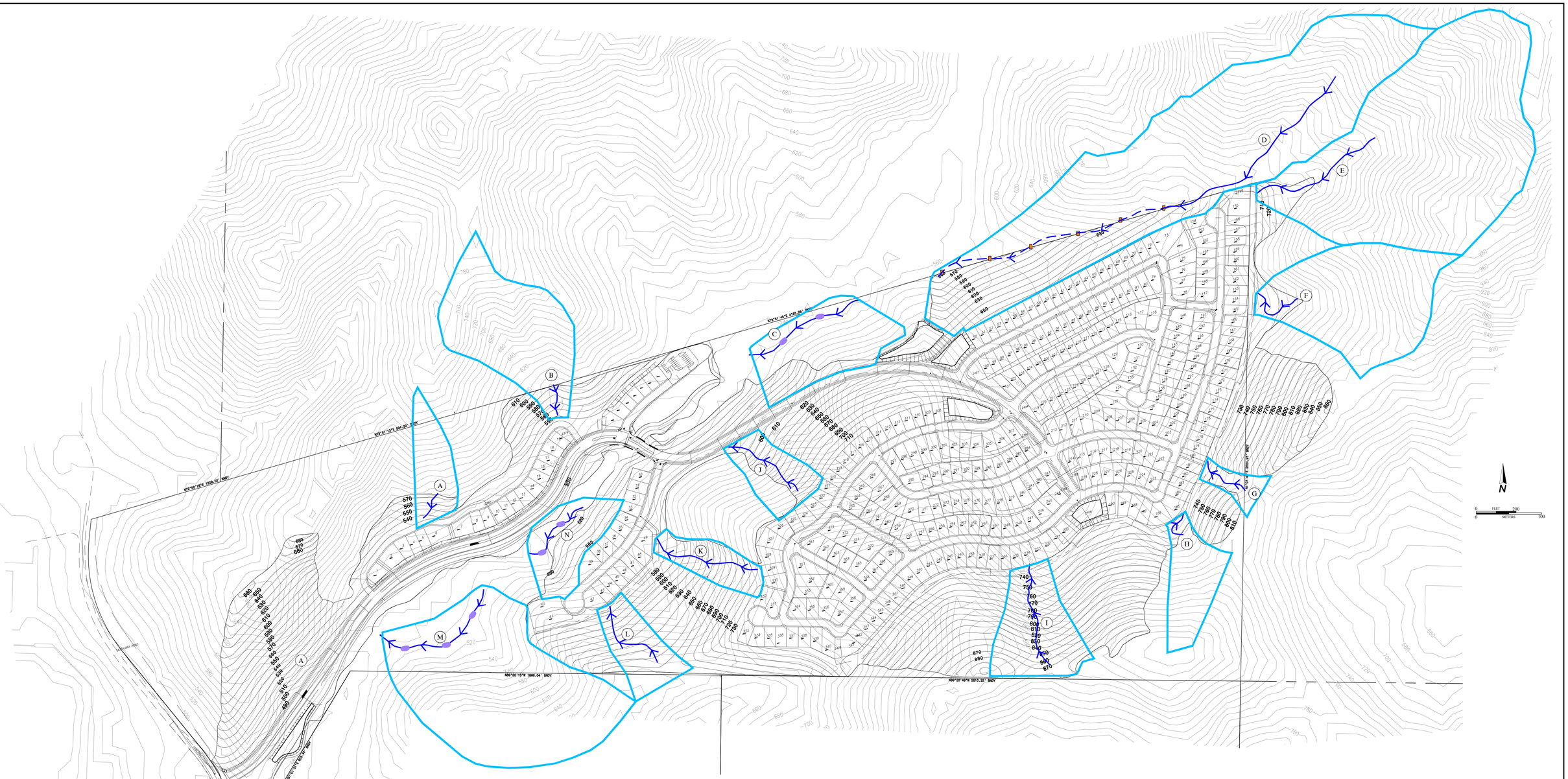
jb/rps/jf

Attachments: Figure 1
Appendix A – Hydrologic Calculations – Creek D

FIGURE

Figure 1 – Conceptual Surface Water Management Plans

5661.000.001
May 14, 2013
Revised August 2, 2013



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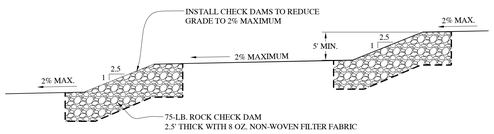
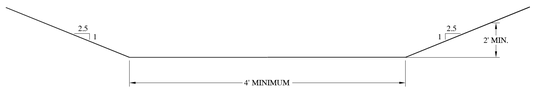
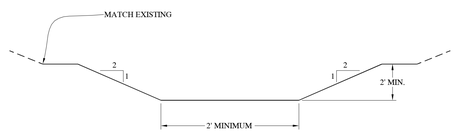


TYPICAL PROFILE TRIBUTARY CREEK 'G'
NO SCALE



MINIMUM CHANNEL DIMENSIONS TRIBUITARY CREEK 'G'
NO SCALE



MINIMUM CHANNEL DIMENSIONS ALL MITIGATION SWALE
NO SCALE

TABLE	LENGTH (L.F.)	TRIBUTARY AREA S.F.
A	153	106586
B	163	346329
C	654	234220
D	2358	1241726
E	716	1021619
F	319	411240
G	276	41356
H	181	134011
I	552	195559
J	461	109879
K	578	91491
L	437	116751
M	710	686833
N	408	141332
TOTAL	7966	

EXPLANATION

- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE (EARTH CHANNEL)
- APPROXIMATE LOCATION OF IMPROVED TRIBUTARY CREEK CHANNEL (EARTH AND ROCK CHANNEL)
- (A) MITIGATION CREEK SUBWATERSHED
- APPROXIMATE LOCATION OF GRADE CONTROL STRUCTURE CREEK 'G'
- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE WITH POOL-RIFFLE ENHANCEMENT

NOTE: SEE MACKAY & SOMPS EXHIBIT " MOLLER RANCH MITIGATION SWALES" FOR EXACT SWALE LOCATION AND LENGTH

BASE MAP SOURCE: UNKNOWN

ENGEO Expect Excellence

CONCEPTUAL SURFACE WATER MANAGEMENT PLANS
MOLLER RANCH
DUBLIN, CALIFORNIA

PROJECT NO.: 5661.000.001
SCALE: AS SHOWN
DRAWN BY: SRP
CHECKED BY: RPS

FIGURE NO. 1

ORIGINAL FIGURE PRINTED IN COLOR

APPENDIX A

Hydrologic Calculations – Creek D

5661.000.001
May 14, 2013
Revised August 2, 2013

Calculations Mitigation Creek D - Moller Ranch project. Alameda County Flood Control Method

1. Find Time of Concentration

Section	Segment Length (Feet)	Vertical Height (ft)	Slope	Slope (%)	Velocity (ft/sec)	Tc (min)
A (upper)	**1724**	**413.2**	**0.239675**	**23.96752**	**7**	4.1
B (storm drain)	**335**	**45**	**0.134328**	**13.43284**	**7**	0.8
C (engineered channel)	**1279**	**103**	**0.080532**	**8.053167**	**2**	10.7

Total Tc 15.6

2. Find Rainfall Intensity in in/hr

Per Alameda County 15.6 Minutes
100 year Unit rainfall intesity factor = 0.117
Rainfall Intensity I = 0.117 X Mean Annual Precipitation (in/hr)

Rainfall Intesity = 2.832 in/hr

3. Use USDA Type D soil for slopes over 8% since Alameda County does not Factor Slopes until over 20%

C = 0.5

4. Flow rate equal to C*I*A 105.492 ft/sec

Appendix D Avoidance and Minimization Measures

Appendix D

AVOIDANCE AND MINIMIZATION MEASURES

Riparian mitigation and enhancement actions associated with the Moller Ranch Residential Development and Tassajara Road Culvert Replacement Projects (hereafter, the Project) will employ all the general Generalized Avoidance and Minimization Measures to Reduce Effects on Focal Species as described in Table 3-2 of the East Alameda County Conservation Strategy (hereafter, EACCS; ICF International 2010). In addition, the Project will follow the Species-Specific Avoidance and Minimization Measures described in Table 3-3 of the EACCS that pertain to the Project. The applicable species-specific measures are provided below verbatim from the EACCS, and in some cases text has been added in italics and square brackets to indicate more specifically how the Project will implement the measure.

EACCS Measures for Amphibians

1. AMPH-1. If aquatic habitat is present, a qualified biologist will stake and flag an exclusion zone prior to activities. The exclusion zone will be fenced with orange construction zone and erosion control fencing (to be installed by construction crew). The exclusion zone will encompass the maximum practicable distance from the work site and at least 500 ft from the aquatic feature wet or dry. [*Because the proposed project includes the construction of a bridge over Moller Creek and impacts on other drainages and wetlands, the complete exclusion of activity within 500 ft of aquatic habitat is not feasible. However, in order to comply with this measure to the greatest extent practicable, the limits of project activities in and adjacent to aquatic habitats will be clearly marked, and construction fencing will prevent equipment from entering aquatic habitats outside the designated impact areas*.]

2. AMPH-2.
    - A qualified biologist will conduct pre-construction surveys prior to activities. If individuals are found, work will not begin until they are moved out of the construction zone to a Service/CDFW approved relocation site. [*For the California tiger salamander and California red-legged frog, the relocation site will be a suitable burrow on the project's conservation lands, if the animal is found in terrestrial areas; if the animal is found in aquatic habitat, the relocation site will be a suitable pool on the project's conservation lands (for California tiger salamanders), or for California red-legged frogs, either a suitable pool on the project's conservation lands or a pool in Moller Creek outside the impact area, whichever is closest*.]
    - A Service/CDFW-approved biologist will be present for initial ground disturbing activities.
    - If the work site is within the typical dispersal distance (contact Service/CDFW for latest research on this distance for species of interest) of potential breeding habitat, barrier fencing will be constructed around the worksite to prevent amphibians from entering the work area. Barrier fencing will be removed within 72 hours of completion of work. [*The*

project impact site is known to be within dispersal distance of potential breeding habitat, and therefore barrier fencing consisting of silt fence and orange construction zone fencing will be installed around the entire worksite. Per the PBO, the barrier fencing will be at least 3 ft high and the lower 6 inches of the fence will be buried in the ground to prevent animals from crawling under. The remaining 2.5 ft will be left above ground to serve as a barrier for animals moving on the ground surface.]

- No monofilament plastic will be used for erosion control.
- Construction personnel will inspect open trenches in the morning and evening for trapped amphibians.
- A qualified biologist possessing a valid FESA Section 10(a)(1)(A) permit or Service-approved under an active biological opinion, will be contracted to trap and to move amphibians to nearby suitable habitat if amphibians are found inside a fenced area. [*No trapping, such as the use of upland traplines for California tiger salamanders, is proposed for this project. However, a biologist approved by the Service and by the CDFW under the project's ITP will survey for and relocate any individuals found within the impact area.*]
- Work will be avoided within suitable habitat from 15 October (or the first measurable fall rain of 1 inch or greater) to 1 May.

EACCS Measures for Mammals

1. MAMM-1.
    - If potential dens are present, their disturbance and destruction will be avoided. [*Potential dens are defined in the PBO {see PBO San Joaquin Kit Fox Measure 1below}.*]
    - If potential dens are located within the proposed work area and cannot be avoided during construction, a qualified biologist will determine if the dens are occupied or were recently occupied using methodology coordinated with the Service and CDFW. If unoccupied, the qualified biologist will collapse these dens by hand in accordance with Service procedures (Service 1999).
    - Exclusion zones will be implemented following Service procedures (Service 1999) or the latest Service procedures available at the time. The radius of these zones will follow current standards or will be as follows: Potential Den—50 ft; Known Den—100 ft; Natal or Pupping Den—to be determined on a case-by-case basis in coordination with Service and CDFW.
    - Pipes will be capped and trenches will contain exit ramps to avoid direct mortality while construction areas are active.

This Project will also employ all of the avoidance and minimization measures from the Programmatic Biological Opinion (hereafter, PBO; Revised draft language submitted by H. T. Harvey & Associates to USFWS, April 9 2014). As above, text has been added in italics and square brackets where necessary to elucidate how the Project will implement the measure.

PBO General Minimization Measures

1. At least 15 days prior to any ground disturbing activities, the applicant will submit to the Service for review and approval the qualifications of the proposed biological monitor(s). A qualified biological monitor means any person who has completed at least four years of university training in wildlife biology or a related science and/or has demonstrated field experience in the identification and life history of the listed species.

2. A Service-approved biological monitor will remain on-site during all construction activities in or adjacent to habitat for listed species. The Service-approved biological monitor(s) will be given the authority to stop any work that may result in the take of listed species. If the Service-approved biological monitor(s) exercises this authority, the Service will be notified by telephone and electronic mail within one working day. The Service-approved biological monitor will be the contact for any employee or contractor who might inadvertently kill or injure a listed species or anyone who finds a dead, injured, or entrapped individual. The Service-approved biological monitor will possess a working wireless/mobile phone whose number will be provided to the Service.

3. Prior to construction, a construction employee education program will be conducted in reference to potential listed species on site. At minimum, the program will consist of a brief presentation by persons knowledgeable in endangered species biology and legislative protection (Service-approved biologist) to explain concerns to contractors, their employees, and agency personnel involved in the project. The program will include: a description of the species and their habitat needs; any reports of occurrences in the project area; an explanation of the status of each listed species and their protection under the Act; and a list of measures being taken to reduce effects on the species during construction and implementation. Fact sheets conveying this information and an educational brochure containing color photographs of all listed species in the work area(s) will be prepared for distribution to the above-mentioned people and anyone else who may enter the project area. A list of employees who attend the training sessions will be maintained by the applicant to be made available for review by the Service upon request. Contractor training will be incorporated into construction contracts and will be a component of weekly project meetings.

4. Pre-construction surveys for listed species will be performed immediately prior to groundbreaking activities. Surveys will be conducted by Service-approved biologists. If at any point, construction activities cease for more than five consecutive days, additional pre-construction surveys will be conducted prior to the resumption of these actions.

5. To prevent the accidental entrapment of listed species during construction, all excavated holes or trenches deeper than 6 inches will be covered at the end of each work day with plywood or similar materials. Foundation trenches or larger excavations that cannot easily be covered will be ramped at

the end of the work day to allow trapped animals an escape method. Prior to the filling of such holes, these areas will be thoroughly inspected for listed species by Service-approved biologists. In the event of a trapped animal is observed, construction will cease until the individual has been relocated to an appropriate location.

6. Translocation will be approved on a project specific basis. The applicant will prepare a listed species translocation plan for the project to be reviewed and approved by the Service prior to project implementation. The plan will include trapping and translocation methods, translocation site, and post translocation monitoring. [*This project does not propose any trapping regimes. However, any individuals of listed species found during pre-construction surveys or at any time during project activities will be relocated by an agency-approved biologist to suitable locations outside of the work area. For the California tiger salamander and California red-legged frog, the relocation site will be a suitable burrow on the project's conservation land, if the animal is found in terrestrial areas; if the animal is found in aquatic habitat, the relocation site will be a suitable pool on the project's conservation land (for California tiger salamanders), or for California red-legged frogs, either a suitable pool on the project's conservation land or a pool in Moller Creek outside the impact area, whichever is closest. The applicant will prepare a relocation plan for the project to be reviewed and approved by the Service prior to the onset of construction.*]

7. Only Service-approved biologists will conduct surveys and move listed species.

8. All trash and debris within the work area will be placed in containers with secure lids before the end of each work day in order to reduce the likelihood of predators being attracted to the site by discarded food wrappers and other rubbish that may be left on-site. Containers will be emptied as necessary to prevent trash overflow onto the site and all rubbish will be disposed of at an appropriate off-site location.

9. All vegetation which obscures the observation of wildlife movement within the affected areas containing or immediately adjacent to aquatic habitats will be completely removed by hand just prior to the initiation of grading to remove cover that might be used by listed species. The Service-approved biologist will survey these areas immediately prior to vegetation removal to find, capture, and relocate any observed listed species, as approved by the Service.

10. All construction activities must cease one half hour before sunset and should not begin prior to one half hour after sunrise. There will be no nighttime construction.

11. Grading and construction will be limited to the dry season, typically May-October, or if dry weather persists outside of this period, upon approval by the Service.

12. BMPs will be used to minimize erosion and effects on water quality and effects on aquatic habitat. If necessary, a SWPPP will be prepared.

13. The applicant will ensure a readily available copy of this BO is maintained by the construction foreman/manager on the project site whenever earthmoving and/or construction is taking place. The name and telephone number of the construction foreman/manager will be provided to the Service prior to groundbreaking.

14. The construction area shall be delineated with high visibility temporary fencing at least 4 ft in height, flagging, or other barrier to prevent encroachment of construction personnel and equipment outside of the construction area. Such fencing shall be inspected and maintained daily until completion of the project. The fencing will be removed only when all construction equipment is removed from the site.

15. Silt fencing or wildlife exclusion fencing will be used to prevent listed species from entering the project area. Exclusion fencing will be at least 3 ft high and the lower 6 inches of the fence will be buried in the ground to prevent animals from crawling under. The remaining 2.5 ft will be left above ground to serve as a barrier for animals moving on the ground surface. The fence will be pulled taut at each support to prevent folds or snags. Fencing shall be installed and maintained in good condition during all construction activities. Such fencing shall be inspected and maintained daily until completion of the project. The fencing will be removed only when all construction equipment is removed from the site.

16. A Service-approved biologist shall ensure that the spread or introduction of invasive exotic plant species shall be avoided to the maximum extent possible. When practicable, invasive exotic plants in the project areas shall be removed.

17. Project sites shall be revegetated with an appropriate assemblage of native riparian wetland and upland vegetation suitable for the area. A species list and restoration and monitoring plan shall be included with the project proposal for review and approval by the Service and the USACE. Such a plan must include, but not be limited to, location of the restoration, species to be used, restoration techniques, time of year the work will be done, identifiable success criteria for completion, and remedial actions if the success criteria are not achieved.

18. If a work site is to be temporarily dewatered by pumping, intakes shall be completely screened with wire mesh not larger than 5 millimeters. Water shall be released or pumped downstream at an appropriate rate to maintain downstream flows during construction. Upon completion of construction activities, any barriers to flow shall be removed in a manner that would allow flow to resume with the least disturbance to the substrate.

19. A Service-approved biologist shall permanently remove, from within the project area, any individuals of exotic species, such as bullfrogs [*Lithobates catesbeianus*], crayfish [*Pacifastacus leniusculus*

and *Procambarus clarkii*], and centrarchid fishes, to the maximum extent possible. The applicant shall have the responsibility to ensure that their activities are in compliance with the California Fish and Game Code.

PBO California Red-legged Frog Minimization Measures

1. A Service-approved biologist shall survey the work site immediately prior to construction activities. If California red-legged frogs, tadpoles, or eggs are found, the approved biologist shall contact the Service to determine if moving any of these life-stages is appropriate. In making this determination, the Service shall consider if an appropriate relocation site exists as provided in the relocation plan. If the Service approves moving animals, the approved biologist shall be allowed sufficient time to move California red-legged frogs from the work site before work activities begin. Only Service-approved biologists shall participate in activities associated with the capture, handling, and monitoring of California red-legged frogs. [*For California red-legged frogs, the relocation site will be a suitable burrow on the project's conservation land, if the animal is found in terrestrial areas, or if the animal is found in aquatic habitat, a suitable pool on the project's conservation land or in Moller Creek outside the impact area, whichever is closest.*]

2. Bare hands shall be used to capture California red-legged frogs. Service-approved biologists will not use soaps, oils, creams, lotions, repellents, or solvents of any sort on their hands within two hours before and during periods when they are capturing and relocating individuals. To avoid transferring disease or pathogens of handling of the amphibians, Service-approved biologists will follow the Declining Amphibian Populations Task Force's "Code of Practice."

PBO California Tiger Salamander Minimization Measures

1. A Service-approved biologist shall survey the work site immediately prior to construction activities. If Central California tiger salamanders, larvae, or eggs are found, the approved biologist shall contact the Service to determine if moving any of these life-stages is appropriate. In making this determination, the Service shall consider if an appropriate relocation site exists as provided in the relocation plan. If the Service approves moving animals, the approved biologist shall be allowed sufficient time to move Central California tiger salamanders from the work site before work activities begin. Only Service-approved biologists shall participate in activities associated with the capture, handling, and monitoring of Central California tiger salamanders. [*For California tiger salamanders, the relocation site will be a suitable burrow on the project's conservation lands, if the animal is found in terrestrial areas, or if the animal is found in aquatic habitat, a suitable pool on the project's conservation lands.*]

2. Bare hands shall be used to capture Central California tiger salamanders. Service approved biologists will not use soaps, oils, creams, lotions, repellents, or solvents of any sort on their hands within two hours before and during periods when they are capturing and relocating individuals. To avoid

transferring disease or pathogens of handling of the amphibians, Service-approved biologists will follow the Declining Amphibian Populations Task Force's "Code of Practice."

PBO San Joaquin Kit Fox Minimization Measures

1. A qualified Service-approved biologist will conduct a pre-construction survey no more than 30 days before the beginning of ground disturbance or any activity likely to affect San Joaquin kit fox. This measure will be implemented in all off-road construction areas. The biologist will survey the proposed construction area and a 200-ft buffer area around the construction area to identify suitable dens. The biologist will conduct den searches by systematically walking transects spaced 30-100 ft apart through the survey area. Transect distance should be determined on the basis of the height of vegetation such that 100 percent visual coverage of the project area is achieved. If dens are found during the survey, the biologist will map the location of each den as well as record the size and shape of the den entrance; the presence of tracks, scat, and prey remains; and if the den was recently excavated. The biologist will also record information on prey availability (e.g., ground squirrel colonies). The status of the den as defined by the Service should also be determined and recorded. Dens will be classified in one of the following four den status categories:

    a. **Potential den:** Any subterranean hole within the species' range that has entrances of appropriate dimensions for which available evidence is sufficient to conclude that it is being used or has been used by a San Joaquin kit fox. Potential dens comprise: (1) any suitable subterranean hole or (2) any den or burrow of another species (e.g., coyote [*Canis latrans*], badger [*Taxidea taxus*], red fox [*Vulpes vulpes*], or ground squirrel) that otherwise has appropriate characteristics for San Joaquin kit fox use.
    b. **Known den:** Any existing natural den or artificial structure that is used or has been used at any time in the past by a San Joaquin kit fox. Evidence of use may include historical records; past or current radio telemetry or spotlighting data; San Joaquin kit fox signs such as tracks, scat, and/or prey remains; or other reasonable proof that a given den is being or has been used by a San Joaquin kit fox.
    c. **Natal or pupping den:** Any den used by San Joaquin kit fox to whelp and/or rear their pups. Natal/pupping dens may be larger with more numerous entrances than dens occupied exclusively by adults. These dens typically have more San Joaquin kit fox tracks, scat, and prey remains in the vicinity of the den, and may have a broader apron of matted dirt and/or vegetation at one or more entrances. A natal den, defined as a den in which San Joaquin kit fox pups are actually whelped but not necessarily reared, is a more restrictive version of the pupping den. In practice, however, it is difficult to distinguish between the two; therefore, for purposes of this definition either term applies.
    d. **Atypical den:** Any artificial structure that has been or is being occupied by a San Joaquin kit fox. Atypical dens may include pipes, culverts, and diggings beneath concrete slabs and buildings.

Written results of the surveys will be submitted to the Service within one week of the completion of surveys and prior to the beginning of ground disturbance and/or construction activities likely to affect the San Joaquin kit fox.

2. After pre-construction den searches and before the commencement of construction activities, a qualified Service-approved biologist will establish and maintain the following exclusion zones measured in a radius outward from the entrance or cluster of entrances of each den.

    a. **Potential and atypical dens:** A total of 4-5 flagged stakes will be placed 50 ft from the den entrance to identify the den location.
    b. **Known den:** Orange construction barrier fencing will be installed between the construction work area and the known den site at a minimum distance of 100 ft from the den. The fencing will be maintained until all construction-related disturbances have been terminated. At that time, all fencing will be removed to avoid attracting subsequent attention to the den.
    c. **Natal/pupping den:** The Service will be contacted immediately if a natal or pupping den is discovered at or within 200 ft from the boundary of the construction area.
    d. Construction and other project activities will be prohibited or greatly restricted within these exclusion zones. Only essential vehicular operation on existing roads and foot traffic should be permitted and articulated to the Service. All other construction activities, vehicle operation, material and equipment storage, and other surface-disturbing activities will be prohibited in the exclusion zones.
    e. In cases where avoidance is not a reasonable alternative, limited destruction of potential San Joaquin kit fox dens will be allowed. Potential dens can be removed by careful hand excavation by a Service-approved biologist or under the supervision of a Service-approved biologist, after the dens have been monitored for three days with tracking medium or a remote sensor camera and determined to be vacant of San Joaquin kit foxes. If, during excavation or monitoring, a potential den is determined to be currently or previously used (e.g., San Joaquin kit fox sign found inside) by San Joaquin kit fox, then destruction of the den or construction in that area will cease and the Service will be notified immediately. [*For the Moller Ranch Project, any potential den found within the impact footprint will be subject to the three-day monitoring approach and hand excavation described in this measure.*]

3. Vehicle traffic will be restricted to established roads, construction areas, and other designated areas.

4. Grading activities shall be designed to minimize or eliminate effects on rodent burrows. Areas with high concentrations of burrows and large burrows suitable for San Joaquin kit fox dens shall be avoided by grading activities to the maximum extent possible. In addition, when concentrations of burrows or large burrows are observed within the site these areas shall be staked and flagged to ensure construction personnel are aware of their location and to facilitate avoidance of these areas.

5. Compensate for the loss of San Joaquin kit foxes and suitable habitat by protecting occupied habitat and/or restoring suitable habitat to establish and maintain San Joaquin kit fox presence.

Finally, this Project will employ the following avoidance and minimization measures from the 2012 SEIR (Haag 2012), the 2006 SEIR (Haag 2006), and the 1993 EIR (Wallace Roberts & Todd 1993):

General

The City shall require development applicants to conduct a pre-construction survey within 60 days prior to habitat modification (clearing construction and road site, etc.) to verify the presence of sensitive species, especially the San Joaquin kit fox, nesting raptors, the red-legged frog, the Pacific pond turtle, the California tiger salamander, the tri-colored blackbird and other species of special concern.

American badger (*Taxidea taxus*)

- Undertake preconstruction surveys on the Project site by a U.S. Fish and Wildlife Service (USFWS)/California Department of Fish and Wildlife (CDFW) approved biologist prior to grading or ground disturbance.
- Avoid disturbance and destruction of potential badger dens to the extent practicable.
- If disturbance of dens is unavoidable, a qualified biologist shall determine if the dens are occupied using methodology developed in coordination with the USFWS and/or CDFW. If the dens are determined to be unoccupied, they shall be collapsed by hand in accordance with USFWS procedures.
- Exclusion zones around occupied dens will be established by a qualified biologist following USFWS procedures following current standards (potential den- 50 ft; known den - 100 ft; natal den - determined on a case-by-case basis in consultation with the USFWS and CDFW).
- Pipes will be capped and trenches equipped with exit ramps to prevent animals from becoming trapped.
- If an active badger den is discovered on the Project site and cannot be avoided using the measures described above, mitigation for loss of the burrow(s) will be provided at a 3:1 ratio, and mitigation lands will be protected in perpetuity.
- Maintain a minimum buffer (at least 300 feet) around known or those identified by the aforementioned pre-construction surveys nesting sites of the burrowing owl and breeding sites of the American badger during the breeding season.

Tri-colored Blackbird (*Agelaius tricolor*)

If the proposed project were to remove trees during the nesting bird season (February 1- August 31) then pre-construction breeding bird surveys should be conducted within 10-14 days of ground disturbance to avoid disturbance to active nests, eggs, and/or young of ground-nesting birds.

Golden eagle (Aquila chrysaetos)

The following steps shall be undertaken if a Golden eagle nets is discovered on the site:

- If an active nest is identified near (i.e., within 1000 ft. or as determined by a qualified biologist in consultation with the CDFW) a proposed work area, work shall be conducted outside of the nesting season (February 1 to September 1).
- If an active nest is identified near a proposed work area and work cannot be conducted outside of the nesting season, a no-activity zone shall be established by a qualified biologist. The no-activity zone shall be large enough to avoid nest abandonment and will at a minimum be 250-feet radius from the nest.
- If an effective no-activity zone cannot be established in either case, an experienced golden eagle biologist shall develop a site-specific plan (i.e., a plan that considers the type and extent of the proposed activity, the duration and timing of the activity, the sensitivity and habituation of the eagles, and the dissimilarity of the proposed activity with background activities) to minimize the potential to affect the reproductive success of the eagles.

Loggerhead shrike (*Lanius ludovicianus*) and White-tailed Kite (*Elanus leucurus*)

- A qualified biologist shall conduct white-tailed kite and loggerhead shrike nest surveys prior to tree pruning, tree removal, ground disturbing activities, or construction activities to locate any active nests on or immediately adjacent to the site. Preconstruction surveys shall be conducted at least 30 days prior to construction or ground disturbing activities and at 30-day intervals until construction activities have been initiated in an area. Preconstruction surveys shall be conducted between February 1 and August 31. Locations of active nests shall be described and protective measures implemented. Protective measures shall include establishment of clearly delineated (i.e., orange construction fencing) avoidance areas around each nest site that is a minimum of 300 feet from the dripline of the nest tree or nest for raptors and 100 feet for shrikes. The active nest sites within an exclusion zone shall be monitored on a weekly basis throughout the nesting season to identify any signs of disturbance. These protection measures shall remain in effect until the young have left the nest and are foraging independently or the nest is no longer active. A report shall be prepared at the end of each construction season detailing the results of the preconstruction surveys. The report shall be submitted to CDFW by November 30 of each year.
- If the proposed project were to remove trees during the nesting bird season (February 1- August 31) then pre-construction breeding bird surveys should be conducted within 10-14 days of ground disturbance to avoid disturbance to active nests, eggs, and/or young of ground-nesting birds.
- Any trees and shrubs in or adjacent to the project area that are proposed for removal and that could be used as nesting sites by loggerhead shrike and white-tailed kite may only be removed during the non-breeding season (September through February).

Pacific Pond Turtle (*Actinemys marmorata*)

Maintain a minimum buffer (at least 100 feet) around breeding sited of the red-legged frog, California tiger salamander, and the Pacific pond turtle identified by the aforementioned pre-construction surveys.

Raptors

A qualified biologist shall conduct raptor and loggerhead shrike nest surveys prior to tree pruning, tree removal, ground disturbing activities, or construction activities to locate any active nests on or immediately adjacent to the site. Preconstruction surveys shall be conducted at least 30 days prior to construction or ground disturbing activities and at 30-day intervals until construction activities have been initiated in an area. Preconstruction surveys shall be conducted between February 1 and August 31. Locations of active nests shall be described and protective measures implemented. Protective measures shall include establishment of clearly delineated (i.e., orange construction fencing) avoidance areas around each nest site that is a minimum of 300 feet from the dripline of the nest tree or nest for raptors and 100 feet for shrikes. The active nest sites within an exclusion zone shall be monitored on a weekly basis throughout the nesting season to identify any signs of disturbance. These protection measures shall remain in effect until the young have left the nest and are foraging independently or the nest is no longer active. A report shall be prepared at the end of each construction season detailing the results of the preconstruction surveys. The report shall be submitted to CDFW by November 30 of each year.

Burrowing owl (Athene cunicularia)

- Preconstruction surveys shall be conducted for burrowing owls prior to ground disturbing activities, including clearing and grubbing. These surveys shall conform to the survey protocol established by the California Burrowing Owl Consortium (1993). Preconstruction surveys shall be conducted no more than 30 days prior to the initiation of construction activities and at 30-day intervals if construction activities have not been initiated in an area.
- If an active nest is identified within 250 foot distance of a burrowing owl nest or a distance determined by a qualified biologists in coordination with CDFW, a proposed work area work shall be conducted outside of the nesting season (15 March to 1 September) if feasible.
- If an active nest is identified near a proposed work area and work cannot be conducted outside of the nesting season, a no-activity zone will be established by a qualified biologist. The no-activity zone shall be large enough to avoid nest abandonment and will at a minimum be a 250-feet radius from the nest.
- If burrowing owls are present at the site during the non-breeding period, a qualified biologist shall establish a no-activity zone of at least 150 feet, if feasible.
- If an effective no activity zone cannot be established around an occupied burrow, an experienced burrowing owl biologist shall develop a site-specific plan (i.e., a plan that considers the type and extent of the proposed activity, the duration and timing of the activity, the sensitivity and habituation of the owls

and the dissimilarity of the proposed activity with background activities) to minimize the potential to affect the reproductive success of the owls.

- A Burrowing Owl Exclusion Plan shall be prepared if occupied burrows cannot be avoided during the breeding season.

Nesting birds

- If the proposed project were to remove trees during the nesting bird season (February 1- August 31) then pre-construction breeding bird surveys should be conducted within 10-14 days of ground disturbance to avoid disturbance to active nests, eggs, and/or young of ground-nesting birds.
- Any trees and shrubs in or adjacent to the project area that are proposed for removal and that could be used as nesting sites by loggerhead shrike and white-tailed kite may only be removed during the non-breeding season (September through February).
- Prior to removal of any on-site trees, a qualified bat biologist shall perform a survey to identify any roosting bats present. If a maternity roost is found, tree removal shall be postponed until the young become independent and the mothers vacate the roost.

Bats, including Townsend's western big-eared bat (*Corynorhinus townsendii townsendii*), Yuma myotis (*Myotis yumanensis*), and Pallid bat (*Antrozous pallidus*):

- Prior to removal of any on-site trees, a qualified bat biologist shall perform a survey to identify any roosting bats present. If a maternity roost is found, tree removal shall be postponed until the young become independent and the mothers vacate the roost.

Impacts to special-status plants (BIOL-5-12).

Approximately, 305 San Joaquin spearscale plants were found in the 2003 rare plant surveys in sparsely vegetated alkali wetlands. Updated floristic surveys are required to comply with the EACCS and impacts will be assessed based on those surveys. Because spearscale plants are CNPS List 1B species that occupy a relatively narrow habitat niche, the loss individuals of these plants on the project site (depending on survey results) represents a large enough proportion of its regional population such that the loss is a potentially significant impact.

Special-status plant species on the project site shall be avoided to the extent possible and impacts be mitigated based on an assessment of how the project will affect the focal plant population, with the assessment methodology requiring agency approval. [*For the Project, floristic surveys of the potential riparian mitigation areas will be conducted in June- July of the year in which riparian mitigation plantings will be installed. If special-status plants are identified in any of the potential riparian mitigation planting areas, the location of the planting area will be adjusted such that the plant(s) is (are) not impacted by habitat mitigation, if possible.*]

REFERENCES

Haag, J. 2012. Moller Ranch/Moller Creek Culvert Replacement Project. City of Dublin File #PLPA 2011-0003. Draft Supplemental Environmental Impact Report. Prepared by Jerry Haag, Urban Planner. September 2012.

H. T. Harvey & Associates. 2014. Revised Draft Biological Opinion on the Moller Ranch Residential Development /Tassajara Road Culvert Replacement Project. 9 April 2014.

ICF International. 2010. East Alameda County Conservation Strategy (Final Draft). Prepared for the East Alameda County Conservation Strategy Steering Committee. October 2010.

[USFWS] U.S. Fish and Wildlife Service. 1999. U. S. Fish and Wildlife Service Standardized Recommendations for Protection of the San Joaquin Kit Fox Prior to or During Ground Disturbance. Prepared by the Sacramento Fish and Wildlife Office.

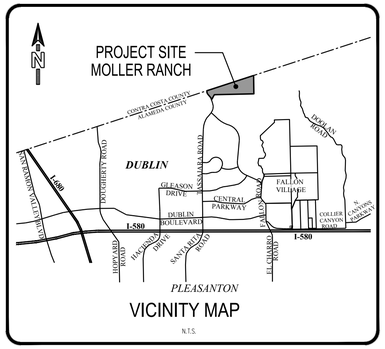


EXHIBIT I

TASSAJARA HILLS DEVELOPMENT
Mitigation Grading Plan

MITIGATION GRADING PLAN
TASSAJARA HILLS
(FORMERLY MOLLER RANCH)

AUGUST 2016



VICINITY MAP

N.T.S.

ENGINEER'S NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR HAVING A SET OF CURRENT PLANS AVAILABLE DURING ALL PHASES OF CONSTRUCTION. ANY TIME THE CONTRACTOR DOUBTS THE REASONABLENESS OR CORRECTNESS OF AN ELEMENT IN THE PLANS OR FIELD CONTROL STAKING, IT SHALL CONTACT THE OWNERS ENGINEER FOR CLARIFICATION.
2. ALL WORK WITHIN THIS PROJECT SHALL COMPLY WITH THE STD. DETAILS & STD. SPECIFICATIONS OF THE CITY OF DUBLIN.

MITIGATION NOTES:

1. CONSTRUCTION TRAFFIC ROUTING PROGRAM: CONSTRUCTION TRAFFIC SHALL ACCESS THE SITE VIA I-580 AND TASSAJARA ROAD. IF ALTERNATE ROUTES ARE DESIRED, THE CONTRACTOR SHALL OBTAIN WRITTEN PERMISSION FROM THE CITY ENGINEER, CITY OF DUBLIN.
2. CONSTRUCTION IMPACT REDUCTION PROGRAM: CONSTRUCTION AND GRADING OPERATIONS, INCLUDING THE MAINTENANCE AND WARMING OF EQUIPMENT, SHALL BE LIMITED TO WEEKDAYS, MONDAY THROUGH FRIDAY, AND NON-CITY HOLIDAYS, BETWEEN THE HOURS OF 7:30 AM AND 5:30 PM. THE DIRECTOR OF PUBLIC WORKS MAY APPROVE DAYS AND HOURS BEYOND THE ABOVE MENTIONED DAYS AND HOURS. THE DEVELOPER IS RESPONSIBLE FOR THE ADDITIONAL COST OF THE PUBLIC WORKS INSPECTORS' OVERTIME.

   THE GRADING CONTRACTOR SHALL MINIMIZE THE IMPACTS TO AREAS OUTSIDE THE GRADING LIMITS.

DEVELOPER / CIVIL ENGINEER / SOILS ENGINEER

DEVELOPER: BRADDOCK AND LOGAN SERVICES INC.
4155 BLACKHAWK PLAZA CIR., SUITE 201
DANVILLE, CA 94596
(925) 736-4000
CONTACT: JEFFREY LAWRENCE/ ANDY BYDE

CIVIL ENGINEER: MACKAY & SOMPS,INC.
5142 FRANKLIN DRIVE, SUITE B
PLEASANTON, CA 94588
(925) 225-0690 FAX: (925) 225-0698
CONTACT: MARK McCLELLAN / JEFF MATSON

SOILS ENGINEER: ENGEO INC.
2010 CROW CANYON PLACE, SUITE 250
SAN RAMON, CA 94583
(925) 866-9000
CONTACT: RAY SKINNER

MITIGATION GRADING NOTES:

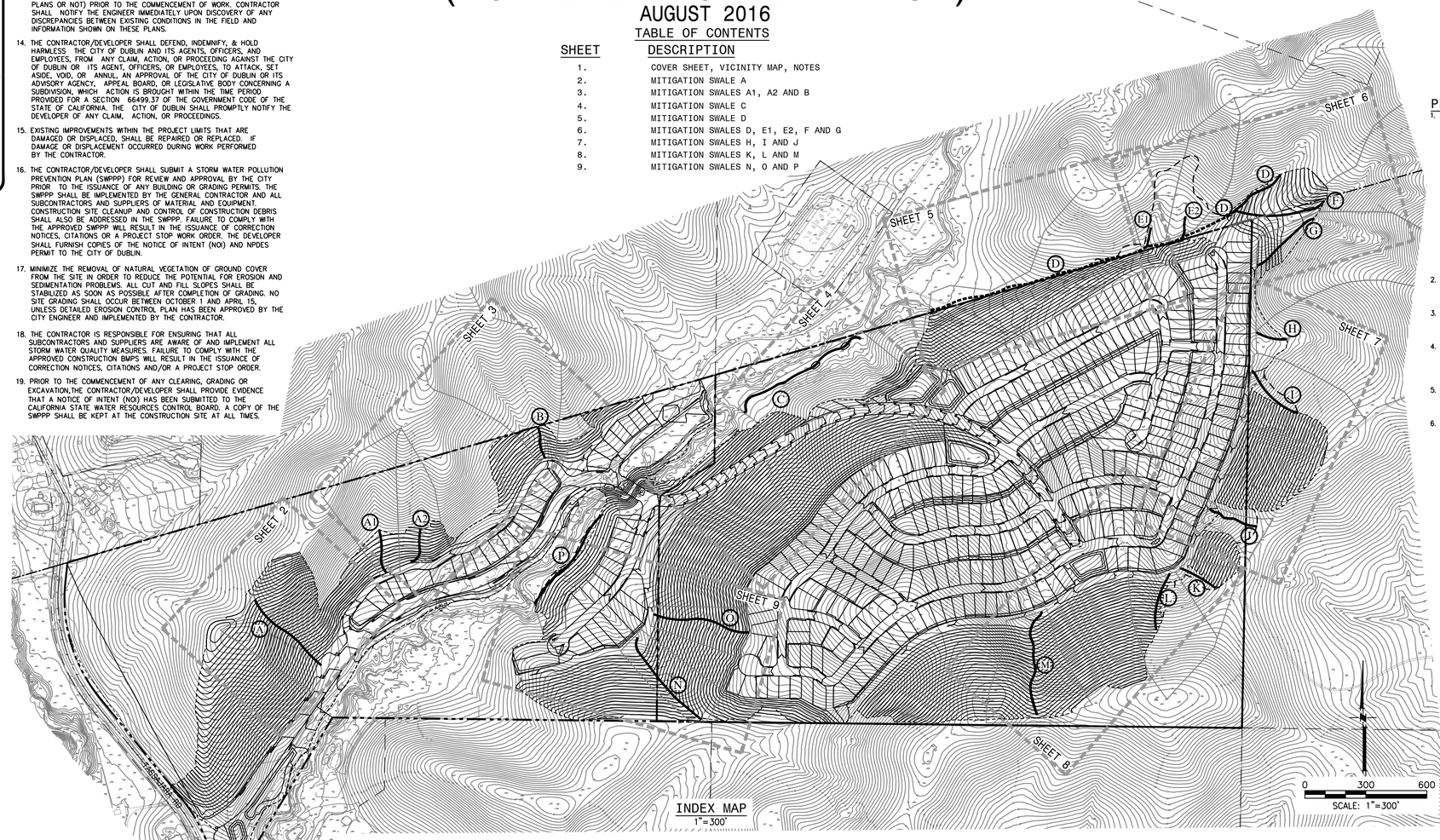
1. THIS GRADING OPERATION IS TO BE USED IN CONJUNCTION WITH THE FOLLOWING:
   A. GRADING RECOMMENDATIONS AND SPECIFICATIONS CONTAINED IN THE GEOTECHNICAL EXPLORATION REPORTS BY ENGEO INCORPORATED, LISTED BELOW:

   ENGEO REPORTS
   ENGEO PROJECT No. 5661.000.001
   - GEOTECHNICAL REPORT, "GEOTECHNICAL EXPLORATION, MOLLER PROPERTIES", DATED NOVEMBER 29, 2012

   B. CORRECTIVE GRADING PLANS FOR BULK GRADING, PREPARED BY ENGEO INC., DATED MAY, 2013
   C. BULK GRADING PLANS, PREPARED BY MACKAY & SOMPS, DATED JULY 2013
2. ALL GRADING SHALL BE OBSERVED AND TESTED BY A QUALIFIED SOILS ENGINEER OR UNDER THEIR OBSERVATION. THE SOILS ENGINEER SHALL OBSERVE AND TEST THE EXCAVATION, PLACEMENT OF FILLS AND BACKFILLS AND COMPACTION OF TRENCHES. THE SOILS ENGINEER SHALL SUBMIT SOILS REPORTS AS REQUIRED AND WILL DETERMINE THE SUITABILITY OF ANY FILL MATERIAL. UPON COMPLETION OF GRADING OPERATIONS THE SOILS ENGINEER SHALL STATE IN A REPORT TO THE OWNER THAT OBSERVATIONS AND TESTS ARE MADE BY HIM/HER OR UNDER HIS/HER SUPERVISION AND THAT IN HIS/HER OPINION ALL EMBANKMENTS AND EXCAVATIONS WERE CONSTRUCTED IN ACCORDANCE WITH THE APPROVED GRADING PLANS & SPECIFICATIONS AND THE RECOMMENDATIONS CONTAINED IN THE GEOTECHNICAL INVESTIGATION REPORTS AND APPROVED REVISIONS THERETO AND ALL EMBANKMENTS AND EXCAVATIONS ARE ACCEPTABLE FOR THEIR INTENDED USE.
3. EXISTING VEGETATION CONSISTING OF WEEDS AND OTHER ORGANIC MATERIAL TO BE STRIPPED AND HANDLED IN ACCORDANCE WITH RECOMMENDATION OF GEOTECHNICAL ENGINEER.
4. GRADING TO BE SUBJECT TO ADDITIONAL CONDITIONS, IF ANY, IMPOSED BY THE CITY OF DUBLIN PURSUANT TO ISSUANCE OF A GRADING PERMIT. CITY CONSTRUCTION INSPECTOR TO BE NOTIFIED 2 WORK DAYS PRIOR TO WORK COMMENCING ON SITE.
5. ALL EXISTING FENCES THAT INTERFERE WITH THE GRADING OPERATION SHALL BE REMOVED.
6. PRIOR TO GRADING A COPY OF ALL AGENCY REQUIRED PERMITS INCLUDING ZONE 7, FISH AND GAME, ARMY CORPS OF ENGINEERS, REGIONAL WATER QUALITY CONTROL BOARD, CALTRANS, AND ANY OTHER AGENCY HAVING JURISDICTION SHALL BE PROVIDED TO THE CITY.
7. ALL PRECONSTRUCTION SURVEYS REQUIRED OF RESOURCE AGENCIES SHALL BE COMPLETED PRIOR TO CONSTRUCTION.
8. PRIOR TO THE START OF CONSTRUCTION, THE DEVELOPER AND/OR CONTRACTOR SHALL CONTACT THE CITY'S PUBLIC WORKS DEPARTMENT AT (925) 833-6630 AND REQUEST A PRE-CONSTRUCTION CONFERENCE.
9. NOTIFY UNDERGROUND SERVICE ALERT (800) 227-2600 AT LEAST THREE (3) WORKING DAYS PRIOR TO ANY EXCAVATION. THE USA AUTHORIZATION NUMBER SHALL BE KEPT AT THE JOBSITE.
10. SHOULD IT APPEAR THAT THE WORK TO BE DONE, OR ANY MATTER RELATIVE THERETO, IS NOT SUFFICIENTLY DETAILED OR EXPLAINED ON THESE PLANS, THE CONTRACTOR SHALL CONTACT MACKAY & SOMPS AT (925)225-0690 FOR SUCH FURTHER EXPLANATION AS MAY BE NECESSARY.
11. EROSION CONTROL FACILITIES SHALL BE INSTALLED PRIOR TO OCTOBER 1 AND SHALL BE MAINTAINED DAILY UNTIL APRIL 15. THESE FACILITIES SHALL CONTROL AND CONTAIN EROSION-CAUSED SILT DEPOSITS AND PROVIDE FOR THE SAFE DISCHARGE OF SILT-FREE STORM WATERS INTO EXISTING STORM DRAIN FACILITIES. DESIGN OF THESE FACILITIES MUST BE APPROVED/UPDATED EACH YEAR PRIOR TO SEPTEMBER 30 AND SHALL BE SIGNED BY THE CITY ENGINEER.
12. IF, DURING CONSTRUCTION, ARCHAEOLOGICAL REMAINS ARE ENCOUNTERED, CONSTRUCTION WITHIN 30 FEET OF THOSE MATERIALS SHALL BE HALTED, AN ARCHAEOLOGIST CONSULTED, AND THE CITY PLANNING DEPARTMENT NOTIFIED. IF, IN THE OPINION OF THE ARCHAEOLOGIST, THE REMAINS ARE SIGNIFICANT, MEASURES AS MAY BE REQUIRED BY THE PLANNING DIRECTOR SHALL BE TAKEN TO PROTECT THEM.
13. INFORMATION REGARDING THE EXISTING SUBSURFACE IMPROVEMENTS AND UTILITIES SHOWN ON THESE PLANS WAS TAKEN FROM RECORD DATA KNOWN TO THE ENGINEER AND IS NOT MEANT TO BE A FULL CATALOG OF EXISTING CONDITIONS. CONTRACTOR SHALL CONDUCT FIELD INVESTIGATIONS AS REQUIRED TO VERIFY THE LOCATION AND ELEVATION OF ALL EXISTING SUBSURFACE IMPROVEMENTS AND UTILITIES (WHETHER SHOWN ON THESE PLANS OR NOT) PRIOR TO THE COMMENCEMENT OF WORK. CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY UPON DISCOVERY OF ANY DISCREPANCIES BETWEEN EXISTING CONDITIONS IN THE FIELD AND INFORMATION SHOWN ON THESE PLANS.
14. THE CONTRACTOR/DEVELOPER SHALL DEFEND, INDEMNIFY, & HOLD HARMLESS THE CITY OF DUBLIN AND ITS AGENTS, OFFICERS, AND EMPLOYEES, FROM ANY CLAIM, ACTION, OR PROCEEDING AGAINST THE CITY OF DUBLIN OR ITS AGENT, OFFICERS, OR EMPLOYEES, TO ATTACK, SET ASIDE, VOID, OR ANNUL, AN APPROVAL OF THE CITY OF DUBLIN OR ITS ADVISORY AGENCY, APPEAL BOARD, OR LEGISLATIVE BODY CONCERNING A SUBDIVISION, WHICH ACTION IS BROUGHT WITHIN THE TIME PERIOD PROVIDED FOR A SECTION 66499.37 OF THE GOVERNMENT CODE OF THE STATE OF CALIFORNIA. THE CITY OF DUBLIN SHALL PROMPTLY NOTIFY THE DEVELOPER OF ANY CLAIM, ACTION, OR PROCEEDINGS.
15. EXISTING IMPROVEMENTS WITHIN THE PROJECT LIMITS THAT ARE DAMAGED OR DISPLACED, SHALL BE REPAIRED OR REPLACED. IF DAMAGE OR DISPLACEMENT OCCURRED DURING WORK PERFORMED BY THE CONTRACTOR.
16. THE CONTRACTOR/DEVELOPER SHALL SUBMIT A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) FOR REVIEW AND APPROVAL BY THE CITY PRIOR TO THE ISSUANCE OF ANY BUILDING OR GRADING PERMITS. THE SWPPP SHALL BE IMPLEMENTED BY THE GENERAL CONTRACTOR AND ALL SUBCONTRACTORS AND SUPPLIERS OF MATERIAL AND EQUIPMENT. CONSTRUCTION SITE CLEANUP AND CONTROL OF CONSTRUCTION DEBRIS SHALL ALSO BE ADDRESSED IN THE SWPPP. FAILURE TO COMPLY WITH THE APPROVED SWPPP WILL RESULT IN THE ISSUANCE OF CORRECTION NOTICES, CITATIONS OR A PROJECT STOP WORK ORDER. THE DEVELOPER SHALL FURNISH COPIES OF THE NOTICE OF INTENT (NOI) AND NPDES PERMIT TO THE CITY OF DUBLIN.
17. MINIMIZE THE REMOVAL OF NATURAL VEGETATION OF GROUND COVER FROM THE SITE IN ORDER TO REDUCE THE POTENTIAL FOR EROSION AND SEDIMENTATION PROBLEMS. ALL CUT AND FILL SLOPES SHALL BE STABILIZED AS SOON AS POSSIBLE AFTER COMPLETION OF GRADING. NO SITE GRADING SHALL OCCUR BETWEEN OCTOBER 1 AND APRIL 15, UNLESS DETAILED EROSION CONTROL PLAN HAS BEEN APPROVED BY THE CITY ENGINEER AND IMPLEMENTED BY THE CONTRACTOR.
18. THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT ALL SUBCONTRACTORS AND SUPPLIERS ARE AWARE OF AND IMPLEMENT ALL STORM WATER QUALITY MEASURES. FAILURE TO COMPLY WITH THE APPROVED CONSTRUCTION BMPS WILL RESULT IN THE ISSUANCE OF CORRECTION NOTICES, CITATIONS AND/OR A PROJECT STOP ORDER.
19. PRIOR TO THE COMMENCEMENT OF ANY CLEARING, GRADING OR EXCAVATION,THE CONTRACTOR/DEVELOPER SHALL PROVIDE EVIDENCE THAT A NOTICE OF INTENT (NOI) HAS BEEN SUBMITTED TO THE CALIFORNIA STATE WATER RESOURCES CONTROL BOARD. A COPY OF THE SWPPP SHALL BE KEPT AT THE CONSTRUCTION SITE AT ALL TIMES.
20. THE SWPPP FOR MOLLER RANCH MITIGATION GRADING WILL BE PREPARED BY A SEPERATE FIRM AND SHALL BE BASED ON THESE BULK GRADING PLANS.
21. ALL CONSTRUCTION ACTIVITY SHALL INCLUDE PROVISIONS TO CONTROL DUST AND MUD AS NOT TO CREATE A NUISANCE FOR ADJACENT RESIDENTS AND PROPERTIES. ALL UNPAVED CONSTRUCTION SITES SHALL BE SPRINKLED WITH WATER AT LEAST TWICE PER DAY. TRUCKS HAULING MATERIALS SHALL BE COVERED WITH TARPAULINS. STREETS SURROUNDING THE SITE SHALL BE SWEPT AT LEAST ONCE PER DAY.
22. THE CONTRACTOR SHALL POST EMERGENCY TELEPHONE NUMBERS FOR POLICE, FIRE, AMBULANCE, AND THOSE AGENCIES RESPONSIBLE FOR MAINTENANCE OF UTILITIES IN THE VICINITY OF THE JOB SITE.
23. UPPER 1 FOOT OF SOIL, WITHIN 15 HORIZONTAL FEET ON BOTH SIDES OF SWALE CENTERLINE (30 FEET WIDE SWATH) MUST MEET SOIL HORTICULTURAL CRITERIA IN MITIGATION MONITORING PLAN.
24. CONTRACTOR SHALL COORDINATE TESTING OF SURFACE SOIL FOR HORTICULTURAL PROPERTIES WITH OWNER'S REPRESENTATIVE (WHO WILL COORDINATE WITH H.T. HARVEY & ASSOCIATES) AFTER SWALE ROUGH GRADING. SOIL IN UPPER 1 FOOT OF SOME SWALES MAY REQUIRE AMENDMENT OR REPLACEMENT TO MEET HORTICULTURAL CRITERIA IN MITIGATION MONITORING PLAN, PENDING RESULTS OF H.T. HARVEY & ASSOCIATES' TOPSOIL SAMPLING.
25. CONTRACTOR SHALL COORDINATE WITH OWNER'S REPRESENTATIVE (WHO WILL COORDINATE WITH H.T. HARVEY & ASSOCIATES) TO IDENTIFY, SALVAGE, AND STOCKPILE HORTICULTURALLY SUITABLE TOPSOIL, IN THE EVENT SUCH TOPSOIL IS NEEDED TO MEET HORTICULTURAL CRITERIA IN CERTAIN SWALES.

TABLE OF CONTENTS

SHEET	DESCRIPTION
1.	COVER SHEET, VICINITY MAP, NOTES
2.	MITIGATION SWALE A
3.	MITIGATION SWALES A1, A2 AND B
4.	MITIGATION SWALE C
5.	MITIGATION SWALE D
6.	MITIGATION SWALES D, E1, E2, F AND G
7.	MITIGATION SWALES H, I AND J
8.	MITIGATION SWALES K, L AND M
9.	MITIGATION SWALES N, O AND P



INDEX MAP
1"=300'

PLANTING AND SEEDING NOTES:

1. ALL GRADED SWALES SHALL BE HYDROSEEDED WITH THE SEED MIX AND APPLICATION RATES PROVIDED IN TABLE 7. SEED SHOULD ORIGINATE FROM SAN FRANCISCO BAY AREA ECOTYPES. HYDROSEED WILL BE APPLIED IN A ONE-STEP PROCESS PRIOR TO INSTALLATION OF EROSION CONTROL FABRIC. THE ONE-STEP HYDROSEED APPLICATION WILL CONSIST OF WOOD FIBER (700 LBS/ACRE), NON-ASPHALTIC TACKIFIER (120 LBS/ACRE), AND SEED. SEE HYDROSEED MIX BELOW:

TABLE 7. CREATED MITIGATION SWALE/CHANNEL HYDROSEED MIX[1]

COMMON NAME	SCIENTIFIC NAME	SEEDING RATE
THREE-WEEK FESCUE	FESTUCA MICROSTACHYS	10 LBS/AC PURE LIVE SEED
MEADOW BARLEY VAR-SALT	HORDEUM BRACHYANTHERUM	20 LBS/AC PURE LIVE SEED
CALIFORNIA BROME	BROMUS CALIFORNICUS	20 LBS/AC PURE LIVE SEED
BLUE WILD RYE	ELYMUS GLAUCUS	20 LBS/AC PURE LIVE SEED
ARROYO LUPINE	LUPINUS SUCCULENTUS	10 LBS/AC PURE LIVE SEED
CALIFORNIA POPPY	ESCHSCHOLZIA CALIFORNICA	6 LBS/AC PURE LIVE SEED
		2 LBS/AC PURE LIVE SEED

[1] NOTE- THIS HYDROSEED MIX SUPERSEDES THAT SHOWN IN APPENDIX C (TABLE 3).

2. HYDROSEED SHOULD BE APPLIED TO MINIMUM 30-FT WIDE SWATH (15-FT WIDE ON BOTH SIDES OF SWALE CENTERLINES) AFTER FINISHED GRADING.
3. TEMPORARY EROSION CONTROL BLANKETS SHALL BE INSTALLED IN ALL GRADED SWALES PRIOR TO THE RAINY SEASON. TEMPORARY EROSION CONTROL BLANKETS SHALL BE CURLEX, OR EQUAL.
4. HIGH GRADIENT SWALES (A, A1, A2, B, UPPER D, E1, E2, F, G, H, I, J, K, L, M, N AND O) SHALL BE PLANTED WITH ONE COYOTE BRUSH (BACCHARIS PILULARIS) SPECIES EVERY 20-FT ON CENTER STAGGERED ON EITHER SIDE OF THE SWALE FLOWLINE.
5. LOW GRADIENT SWALES (C AND P) SHALL BE PLANTED WITH ONE COYOTE BRUSH (BACCHARIS PILULARIS) SPECIES EVERY 8-FT ON CENTER STAGGERED ON EITHER SIDE OF THE SWALE FLOWLINE.
6. LOWER PORTION OF SWALE D SHALL BE PLANTED PER NOTE 5 WITH ONE COAST LIVE OAK (QUERCUS AGRIFOLIA) ON NORTH SLOPE AT 50-FT ON CENTER.

CREATION SWALE SUMMARY:

TABLE	LENGTH (L.F.)	TRIBUTARY AREA S.F.
A	463	203151
A1	222	160889
A2	187	106585
B	162	346329
D	1881	969800
E1	97	99374
E2	112	134800
F	458	723848
G	367	391623
H	154	412302
I	317	172176
J	256	39852
K	202	62522
L	293	167373
M	540	189521
N	530	100862
O	487	83827
P	559	168122
TOTAL	7287	

ENHANCEMENT SWALE SUMMARY:

TABLE	LENGTH (L.F.)	TRIBUTARY AREA S.F.
C	711	201563
TOTAL	711	

PRIOR TO ISSUANCE OF GRADING PERMIT:

1. DEVELOPER SHALL SUBMIT COPIES OF PERMITS FROM ALL APPLICABLE JURISDICTIONAL AGENCIES AND RESOURCE AGENCIES IN CONFORMANCE WITH COA #50 AND #61. THE PROPOSED SCOPE OF WORK MAY NEED TO BE MODIFIED IF THE RESOURCE AGENCY PERMITS OR OTHER MATTERS DELAY THE START OF CONSTRUCTION.
2. DEVELOPER SHALL SUBMIT COPIES OF ALL PRECONSTRUCTION SURVEYS COMPLETED AS REQUIRED PRIOR TO CONSTRUCTION/GRADING.
3. DEVELOPER SHALL SUBMIT DOCUMENTATION DEMONSTRATING HOW ALL MITIGATION MEASURES REQUIRED PRIOR TO CONSTRUCTION/GRADING HAVE BEEN MET.
4. A DEVELOPMENT AGREEMENT SHALL BE EXECUTED FOR THIS PROJECT PER COA #25.
5. DEVELOPER SHALL SUBMIT A TRAFFIC CONTROL PLAN PROVIDING TRAFFIC CONTROL MEASURES IN CONFORMANCE WITH COA#37.
6. DEVELOPER SHALL SUBMIT A CONSTRUCTION NOISE MANAGEMENT PLAN PER COA #33.
7. A CONSTRUCTION BOND OR FORM OF SECURITY WILL BE REQUIRED FOR GRADING/EROSION CONTROL.
8. PRIOR TO ANY CLEARING OR GRADING, A COPY OF THE NOI AND SWPPP SHALL BE SUBMITTED TO THE CITY IN CONFORMANCE WITH COA #98 AND 99. SWPPP INFORMATION SHALL BE NOTED ON THE PLANS WHEN AVAILABLE.

LEGEND

- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE (EARTH CHANNEL)
- APPROXIMATE LOCATION OF IMPROVED TRIBUTARY CREEK CHANNEL (EARTH AND ROCK CHANNEL)
- APPROXIMATE LIMITS OF SUBWATERSHED BOUNDARY
- (A) MITIGATION CREEK SUBWATERSHED
- APPROXIMATE LOCATION OF GRADE CONTROL STRUCTURE CREEK 'D'
- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE WITH POOL-RIFFLE ENHANCEMENT
- ---------- LIMIT OF ROUGH GRADING
- – – – – LIMIT OF CORRECTIVE GRADING

GEOTECHNICAL ENGINEER APPROVAL

THESE PLANS HAVE BEEN REVIEWED BY ENGEO INC. AND APPEAR TO BE IN GENERAL CONFORMITY WITH THE RECOMMENDATIONS IN OUR REPORT NO. 5661.000.001 DATED NOV. 29, 2012
WE MAKE NO REPRESENTATION AS TO ACCURACY OF DIMENSIONS, MEASUREMENTS, CALCULATIONS, OR ANY PORTION OF THE DESIGN.

BY: _____ DATE: _____

WARNING • CAUTION

EXISTING UNDERGROUND UTILITIES
CONTACT: UNDERGROUND SERVICE ALERT
PHONE: (800) 227-2600
FOR MARKING PRIOR TO DIGGING

CONSTRUCTION RECORD	BY	NO.	REFERENCE/REVISIONS	DATE	APPROVED
CONTRACTOR					
INSPECTOR					
DATE COMPLETED					

REGISTERED PROFESSIONAL ENGINEER
JAMES F. TEMPLETON JR.
No.43061
CIVIL
STATE OF CALIFORNIA

DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE
Jim Templeton	Amanda Karchefski	Kim Reed	08-09-2016	HOR: AS NOTED VERT: NONE

PLANS PREPARED UNDER THE DIRECTION OF:

BY: _____
JAMES F. TEMPLETON JR. RCE No. 43061

MacKAY & SOMPS
ENGINEERS PLANNERS SURVEYORS
PLEASANTON, CA (925) 225-0690

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REVIEWED BY: _____ DATE: _____
CITY ENGINEER

CITY OF DUBLIN
PUBLIC WORKS DEPARTMENT

PLANS FOR THE IMPROVEMENTS OF
TASSAJARA HILLS
ROUGH GRADING PLANS FOR

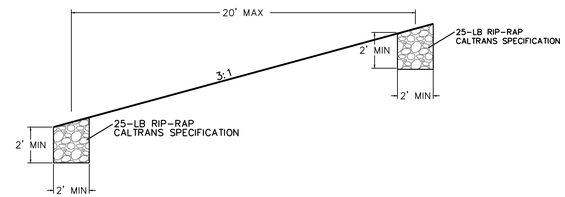
DUBLIN CALIFORNIA

JOB NO. 19569.00
DRAWING NO.
SHEET 1 OF 9

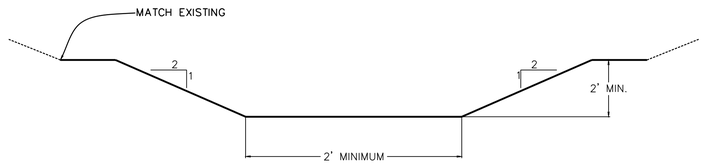


LEGEND

- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE (EARTH CHANNEL)
- APPROXIMATE LOCATION OF IMPROVED TRIBUTARY CREEK CHANNEL (EARTH AND ROCK CHANNEL)
- APPROXIMATE LIMITS OF SUBWATERSHED BOUNDARY
- (A) MITIGATION CREEK SUBWATERSHED
- APPROXIMATE LOCATION OF GRADE CONTROL STRUCTURE CREEK 'D'
- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE WITH POOL-RIFFLE ENHANCEMENT
- PROPOSED CONTOUR GRADING FOR MITIGATION SWALES



HIGH GRADIENT ROCK CHECK DAM (TYP)
NTS



(1) TYPICAL MITIGATION SWALE DIMENSIONS
NTS

0 20 40 80
SCALE: 1"=40'

CONSTRUCTION RECORD	BY	NO.	REFERENCE/REVISIONS	DATE	APPROVED
CONTRACTOR					
INSPECTOR					
DATE COMPLETED					

REGISTERED PROFESSIONAL ENGINEER
JAMES F. TEMPLETON JR.
No.43061
CIVIL
STATE OF CALIFORNIA

DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE
Jim Templeton	Amanda Karchefski	Kim Reed	08-09-2016	HOR: 1"=40' VERT: NONE

PLANS PREPARED UNDER THE DIRECTION OF:

BY: _____
JAMES F. TEMPLETON JR. RCE No. 43061

MacKAY & SOMPS
ENGINEERS PLANNERS SURVEYORS
PLEASANTON, CA (925) 225-0690

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REVIEWED BY: _____ DATE: _____
CITY ENGINEER

CITY OF DUBLIN
PUBLIC WORKS DEPARTMENT

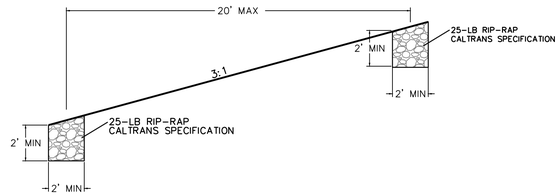
PLANS FOR THE IMPROVEMENTS OF
TASSAJARA HILLS
ROUGH GRADING PLANS FOR SWALE A

DUBLIN CALIFORNIA

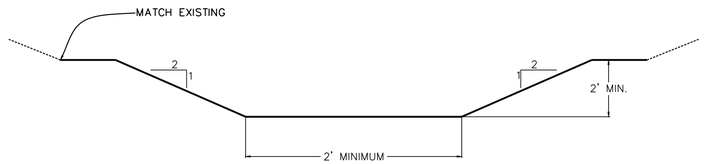
JOB NO. 19569.00
DRAWING NO.
SHEET 2 OF 9

LEGEND

- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE (EARTH CHANNEL)
- APPROXIMATE LOCATION OF IMPROVED TRIBUTARY CREEK CHANNEL (EARTH AND ROCK CHANNEL)
- APPROXIMATE LIMITS OF SUBWATERSHED BOUNDARY
- (A) MITIGATION CREEK SUBWATERSHED
- APPROXIMATE LOCATION OF GRADE CONTROL STRUCTURE CREEK 'D'
- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE WITH POOL-RIFFLE ENHANCEMENT
- PROPOSED CONTOUR GRADING FOR MITIGATION SWALES



HIGH GRADIENT ROCK CHECK DAM (TYP)
NTS



(1) TYPICAL MITIGATION SWALE DIMENSIONS
NTS

CONSTRUCTION RECORD	BY	NO.	REFERENCE/REVISIONS	DATE	APPROVED
CONTRACTOR					
INSPECTOR					
DATE COMPLETED					

REGISTERED PROFESSIONAL ENGINEER
JAMES F. TEMPLETON JR.
No.43061
CIVIL
STATE OF CALIFORNIA

DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE
Jim Templeton	Amanda Karchefski	Kim Reed	08-09-2016	HOR: 1"=40' VERT: NONE

PLANS PREPARED UNDER THE DIRECTION OF:

BY: _____
JAMES F. TEMPLETON JR. RCE No. 43061

MACKAY & SOMPS
ENGINEERS PLANNERS SURVEYORS
PLEASANTON, CA (925) 225-0690

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REVIEWED BY: _____ DATE: _____
CITY ENGINEER

CITY OF DUBLIN
PUBLIC WORKS DEPARTMENT

PLANS FOR THE IMPROVEMENTS OF
TASSAJARA HILLS
ROUGH GRADING PLANS FOR SWALES A1, A2 AND B

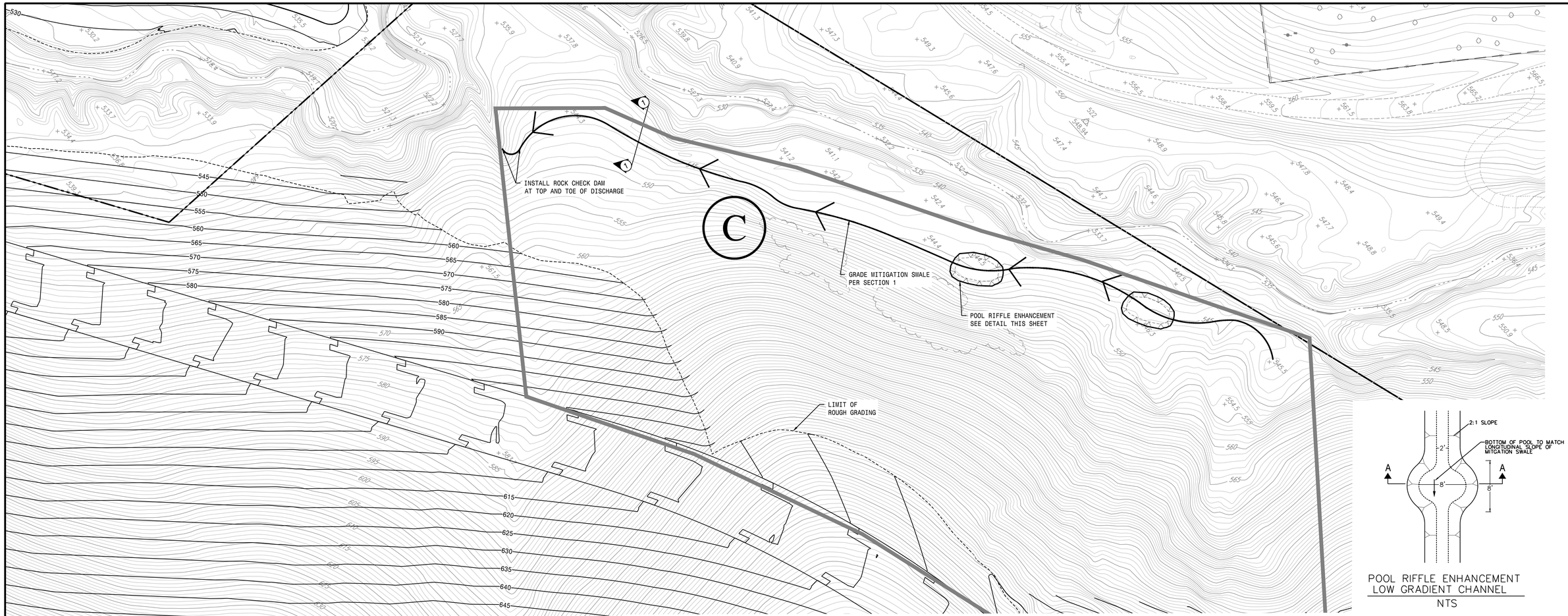
DUBLIN CALIFORNIA

JOB NO. 19569.00

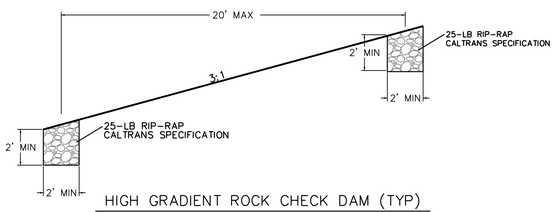
DRAWING NO.

SHEET 3 OF 9

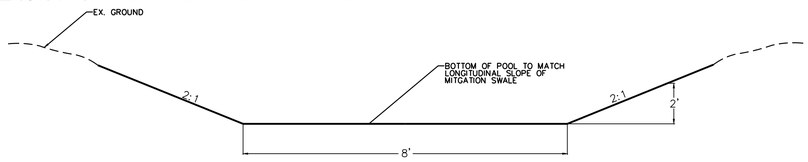
08-10-2016 11:17am Tyler Matson P:\19569\IP-GP\MITIGATION GP\SHEET 2-8- 40 SCALE.DWG



POOL RIFFLE ENHANCEMENT
LOW GRADIENT CHANNEL
NTS



HIGH GRADIENT ROCK CHECK DAM (TYP)
NTS



SECTION A–A
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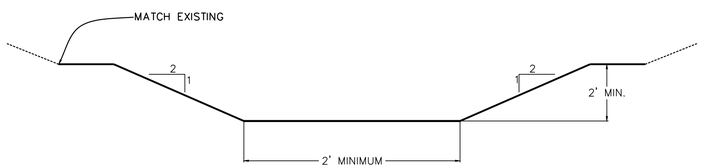

1 TYPICAL MITIGATION SWALE DIMENSIONS
NTS

LEGEND

- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE (EARTH CHANNEL)
- APPROXIMATE LOCATION OF IMPROVED TRIBUTARY CREEK CHANNEL (EARTH AND ROCK CHANNEL)
- APPROXIMATE LIMITS OF SUBWATERSHED BOUNDARY
- (A) MITIGATION CREEK SUBWATERSHED
- APPROXIMATE LOCATION OF GRADE CONTROL STRUCTURE CREEK 'D'
- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE WITH POOL-RIFFLE ENHANCEMENT
- PROPOSED CONTOUR GRADING FOR MITIGATION SWALES

0 20 40 80
SCALE: 1"=40'

CONSTRUCTION RECORD	BY	NO.	REFERENCE/REVISIONS	DATE	APPROVED
CONTRACTOR					
INSPECTOR					
DATE COMPLETED					

REGISTERED PROFESSIONAL ENGINEER
JAMES F. TEMPLETON JR.
No.43061
CIVIL
STATE OF CALIFORNIA

DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE
Jim Templeton	Amanda Karchefski	Kim Reed	08-09-2016	HOR: 1"=40' VERT: NONE

PLANS PREPARED UNDER THE DIRECTION OF:

BY: _____
JAMES F. TEMPLETON JR. RCE No. 43061

MacKAY & SOMPS
ENGINEERS PLANNERS SURVEYORS
PLEASANTON, CA (925) 225-0690

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REVIEWED BY: _____ DATE: _____
CITY ENGINEER

CITY OF DUBLIN
PUBLIC WORKS DEPARTMENT

PLANS FOR THE IMPROVEMENTS OF
TASSAJARA HILLS
ROUGH GRADING PLANS FOR
SWALE C

DUBLIN CALIFORNIA

JOB NO. 19569.00
DRAWING NO.
SHEET 4 OF 9

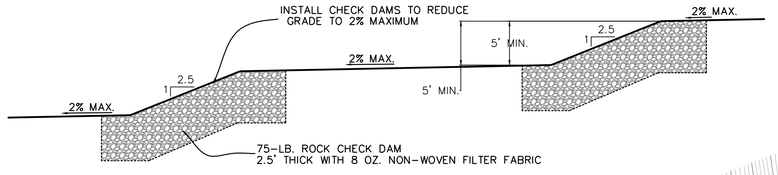
08-10-2016 11:18am Tyler Matson P:\19569\IP-GP\MITIGATION GP\SHEET 2-8- 40 SCALE.DWG

LEGEND

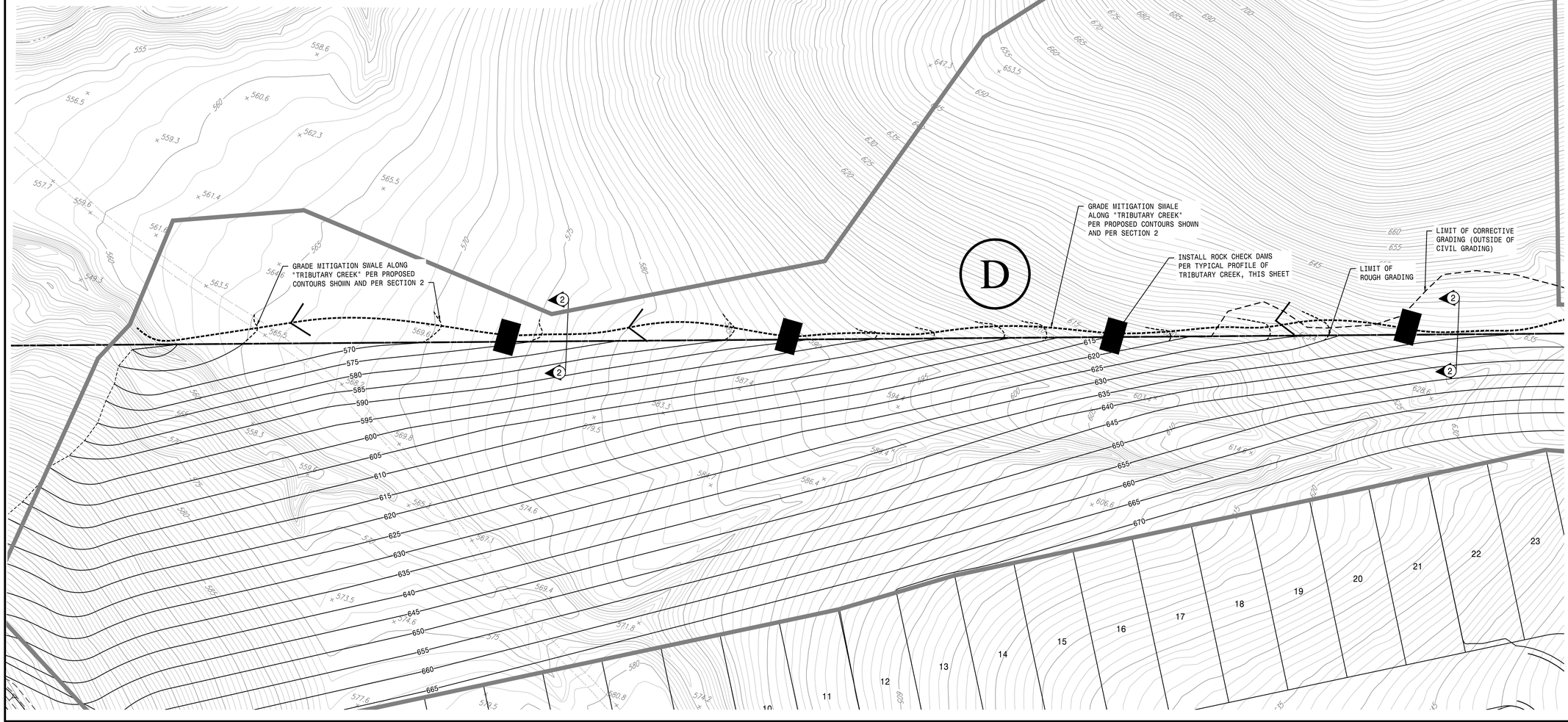
- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE (EARTH CHANNEL)
- APPROXIMATE LOCATION OF IMPROVED TRIBUTARY CREEK CHANNEL (EARTH AND ROCK CHANNEL)
- APPROXIMATE LIMITS OF SUBWATERSHED BOUNDARY
- (A) MITIGATION CREEK SUBWATERSHED
- APPROXIMATE LOCATION OF GRADE CONTROL STRUCTURE CREEK 'D'
- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE WITH POOL-RIFFLE ENHANCEMENT
- PROPOSED CONTOUR GRADING FOR MITIGATION SWALES



2 MINIMUM CHANNEL DIMENSIONS TRIBUTARY CREEK 'D'
NTS



TYPICAL PROFILE TRIBUTARY CREEK 'D'
NTS



0 20 40 80
SCALE: 1"=40'

CONSTRUCTION RECORD	BY	NO.	REFERENCE/REVISIONS	DATE	APPROVED
CONTRACTOR					
INSPECTOR					
DATE COMPLETED					

REGISTERED PROFESSIONAL ENGINEER
JAMES F. TEMPLETON JR.
No.43061
CIVIL
STATE OF CALIFORNIA

PLANS PREPARED UNDER THE DIRECTION OF:

BY: JAMES F. TEMPLETON JR. RCE No. 43061

DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE
Jim Templeton	Amanda Karchefski	Kim Reed	08-09-2016	HOR: 1"=40' VERT: NONE

MACKAY & SOMPS
ENGINEERS PLANNERS SURVEYORS
PLEASANTON, CA (925) 225-0690

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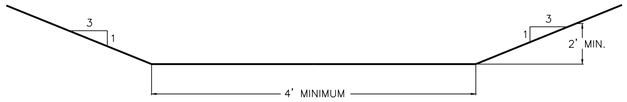
REVIEWED BY: _____ DATE: _____
CITY ENGINEER

CITY OF DUBLIN
PUBLIC WORKS DEPARTMENT

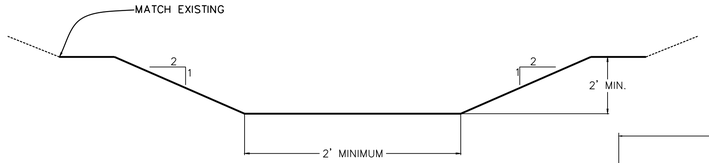
PLANS FOR THE IMPROVEMENTS OF
TASSAJARA HILLS
ROUGH GRADING PLANS FOR SWALE D

DUBLIN CALIFORNIA

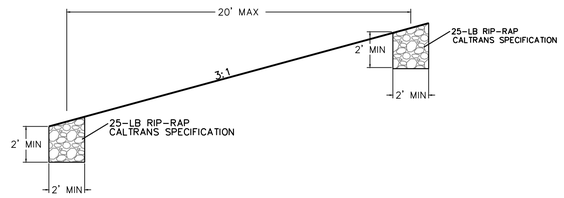
JOB NO. 19569.00
DRAWING NO.
SHEET 5 OF 9



2 MINIMUM CHANNEL DIMENSIONS TRIBUTARY CREEK 'D'
NTS



1 TYPICAL MITIGATION SWALE DIMENSIONS
NTS



HIGH GRADIENT ROCK CHECK DAM (TYP)
NTS

LEGEND

- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE (EARTH CHANNEL)
- APPROXIMATE LOCATION OF IMPROVED TRIBUTARY CREEK CHANNEL (EARTH AND ROCK CHANNEL)
- APPROXIMATE LIMITS OF SUBWATERSHED BOUNDARY
- (A) MITIGATION CREEK SUBWATERSHED
- APPROXIMATE LOCATION OF GRADE CONTROL STRUCTURE CREEK 'D'
- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE WITH POOL-RIFFLE ENHANCEMENT
- PROPOSED CONTOUR GRADING FOR MITIGATION SWALES

TYPICAL PROFILE TRIBUTARY CREEK 'D1'
NTS

0 20 40 80
SCALE: 1"=40'

CONSTRUCTION RECORD	BY	NO.	REFERENCE/REVISIONS	DATE	APPROVED
CONTRACTOR					
INSPECTOR					
DATE COMPLETED					

REGISTERED PROFESSIONAL ENGINEER
JAMES F. TEMPLETON JR.
No.43061
CIVIL
STATE OF CALIFORNIA

DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE
Jim Templeton	Amanda Karchefski	Kim Reed	08-09-2016	HOR: 1"=40' VERT: NONE

PLANS PREPARED UNDER THE DIRECTION OF:

BY: JAMES F. TEMPLETON JR. RCE No. 43061

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REVIEWED BY: _____ DATE: _____
CITY ENGINEER

CITY OF DUBLIN
PUBLIC WORKS DEPARTMENT

PLANS FOR THE IMPROVEMENTS OF
TASSAJARA HILLS
ROUGH GRADING PLANS FOR
SWALES D, E1, E2, F AND G

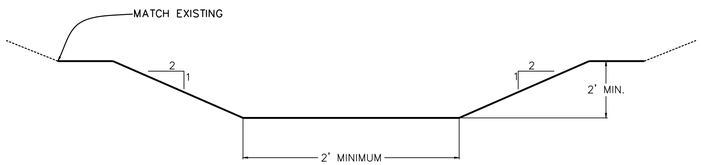
DUBLIN CALIFORNIA

JOB NO. 19569.00
DRAWING NO.
SHEET 6 OF 9

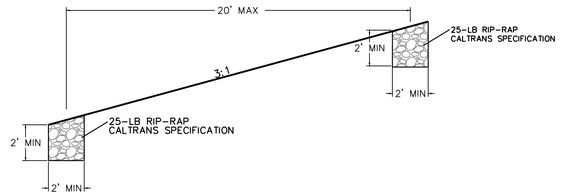
08-10-2016 11:21am Tyler Matson P:\19569\IP-GP\MITIGATION GP\SHEET 2-8- 40 SCALE.DWG

LEGEND

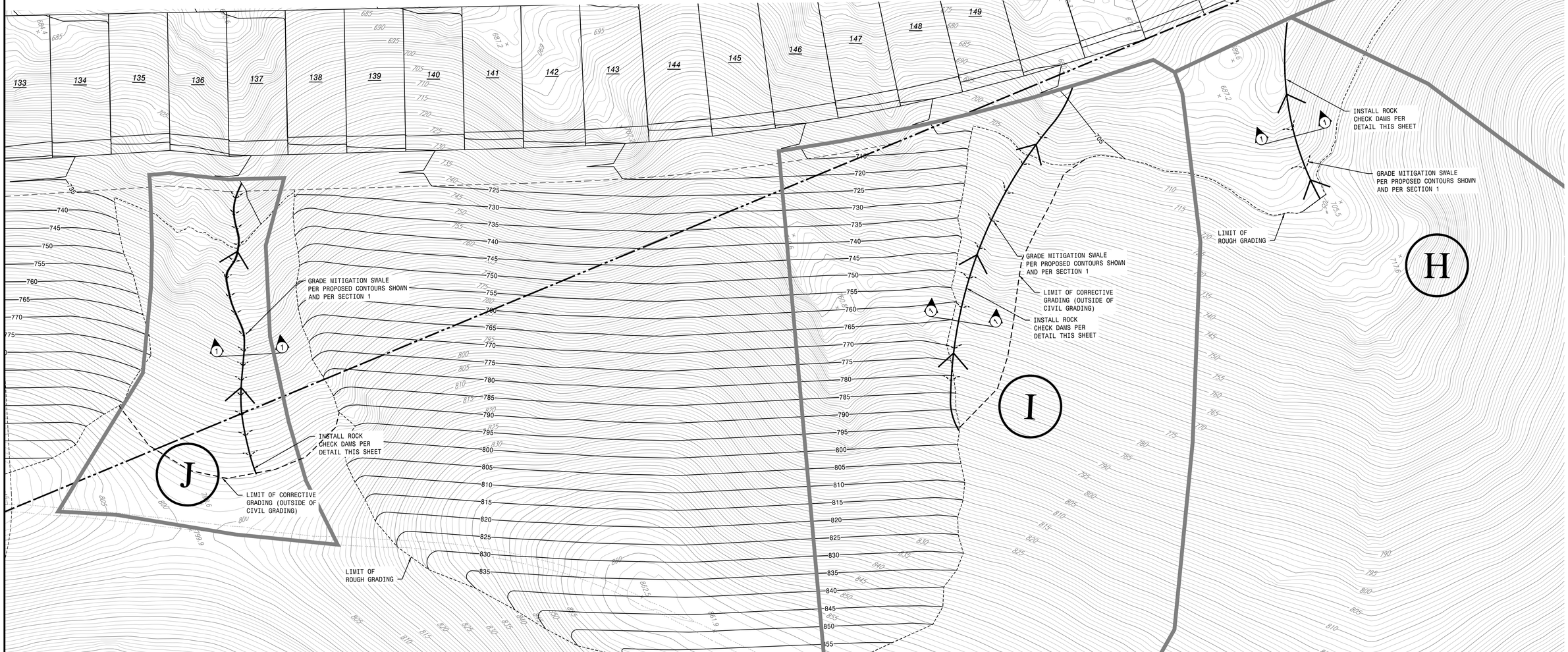
- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE (EARTH CHANNEL)
- APPROXIMATE LOCATION OF IMPROVED TRIBUTARY CREEK CHANNEL (EARTH AND ROCK CHANNEL)
- APPROXIMATE LIMITS OF SUBWATERSHED BOUNDARY
- (A) MITIGATION CREEK SUBWATERSHED
- APPROXIMATE LOCATION OF GRADE CONTROL STRUCTURE CREEK 'D'
- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE WITH POOL-RIFFLE ENHANCEMENT
- PROPOSED CONTOUR GRADING FOR MITIGATION SWALES



1 TYPICAL MITIGATION SWALE DIMENSIONS
NTS



HIGH GRADIENT ROCK CHECK DAM (TYP)
NTS



0 20 40 80
SCALE: 1"=40'

CONSTRUCTION RECORD	BY	NO.	REFERENCE/REVISIONS	DATE	APPROVED
CONTRACTOR					
INSPECTOR					
DATE COMPLETED					

REGISTERED PROFESSIONAL ENGINEER
JAMES F. TEMPLETON JR.
No.43061
CIVIL
STATE OF CALIFORNIA

DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE
Jim Templeton	Amanda Karchefski	Kim Reed	08-09-2016	HOR: 1"=40' VERT: NONE

PLANS PREPARED UNDER THE DIRECTION OF:

BY: _____
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REVIEWED BY: _____ DATE: _____
CITY ENGINEER

CITY OF DUBLIN
PUBLIC WORKS DEPARTMENT

PLANS FOR THE IMPROVEMENTS OF
TASSAJARA HILLS
ROUGH GRADING PLANS FOR
SWALES H, I AND J

DUBLIN CALIFORNIA

JOB NO. 19569.00

DRAWING NO.

SHEET 7 OF 9

LEGEND

- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE (EARTH CHANNEL)
- APPROXIMATE LOCATION OF IMPROVED TRIBUTARY CREEK CHANNEL (EARTH AND ROCK CHANNEL)
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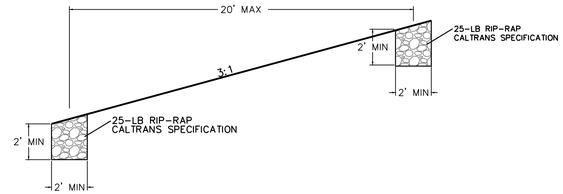
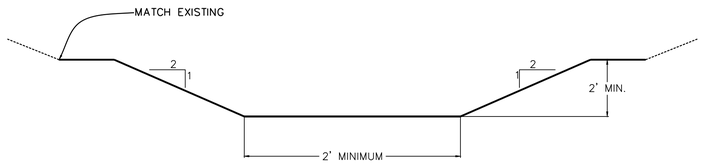
- PROPOSED CONTOUR GRADING FOR MITIGATION SWALES



HIGH GRADIENT ROCK CHECK DAM (TYP)
NTS



(1) TYPICAL MITIGATION SWALE DIMENSIONS
NTS

CONSTRUCTION RECORD	BY	NO.	REFERENCE/REVISIONS	DATE	APPROVED
CONTRACTOR					
INSPECTOR					
DATE COMPLETED					

REGISTERED PROFESSIONAL ENGINEER
JAMES F. TEMPLETON JR.
No.43061
CIVIL
STATE OF CALIFORNIA

DESIGNED BY	DRAWN BY	CHECKED BY
Jim Templeton	Amanda Karchefski	Kim Reed

PLANS PREPARED UNDER THE DIRECTION OF:

BY: _____
JAMES F. TEMPLETON JR. RCE No. 43061

DATE	SCALE
08-09-2016	HOR: 1"=40' VERT: NONE

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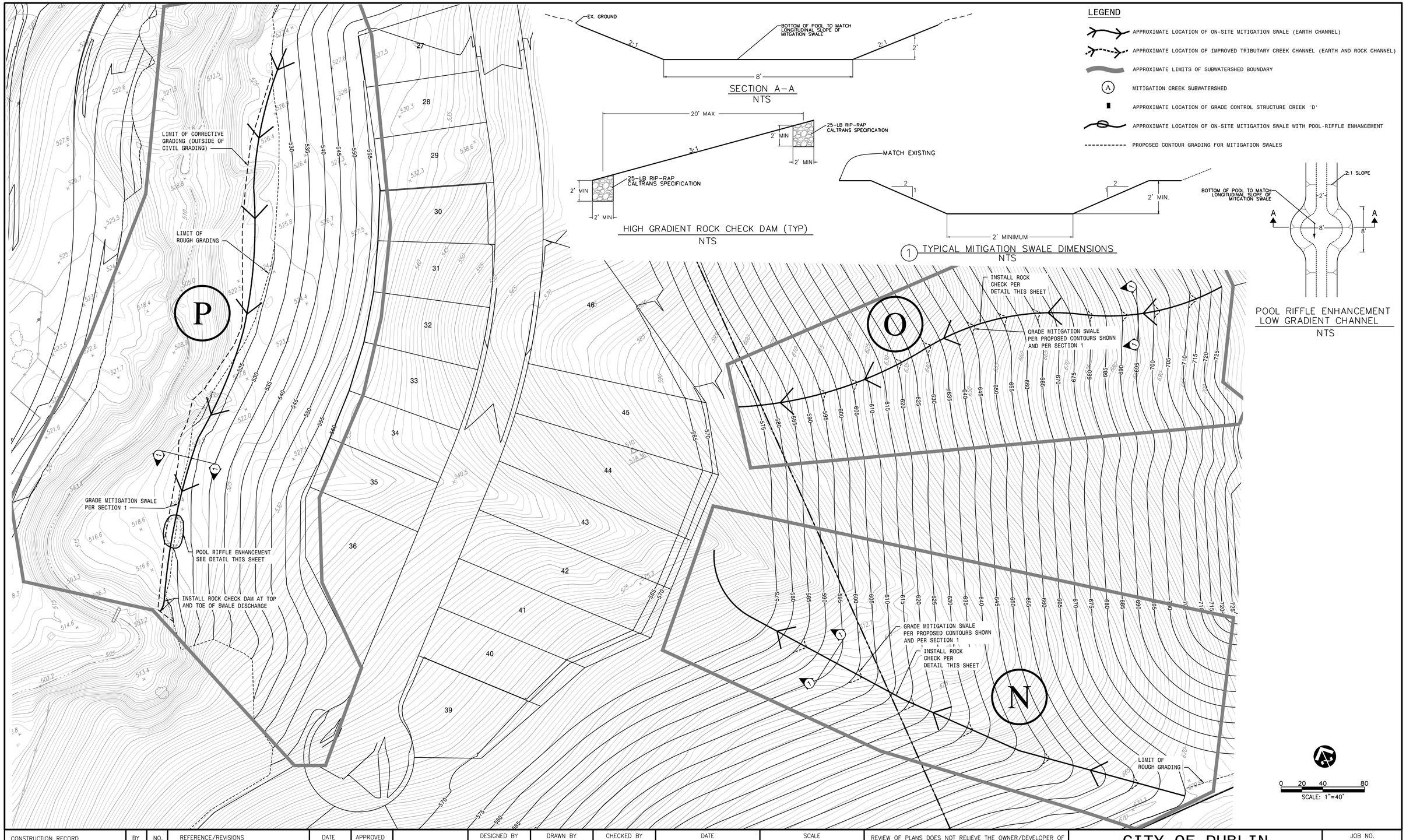
REVIEWED BY: _____ DATE: _____
CITY ENGINEER

CITY OF DUBLIN
PUBLIC WORKS DEPARTMENT

PLANS FOR THE IMPROVEMENTS OF
TASSAJARA HILLS
ROUGH GRADING PLANS FOR
SWALE K, L AND M

DUBLIN CALIFORNIA

JOB NO. 19569.00
DRAWING NO.
SHEET 8 OF 9



EX. GROUND
BOTTOM OF POOL TO MATCH LONGITUDINAL SLOPE OF MITGATION SWALE
2:1
2:1
2'
8'

SECTION A–A
NTS

20' MAX
2' MIN
25–LB RIP–RAP CALTRANS SPECIFICATION
3:1
2' MIN
2' MIN
25–LB RIP–RAP CALTRANS SPECIFICATION
2' MIN

HIGH GRADIENT ROCK CHECK DAM (TYP)
NTS

MATCH EXISTING
2
1
2
1
2' MIN.
2' MINIMUM

1 TYPICAL MITIGATION SWALE DIMENSIONS
NTS

LEGEND

- APPROXIMATE LOCATION OF ON-SITE MITIGATION SWALE (EARTH CHANNEL)
- APPROXIMATE LOCATION OF IMPROVED TRIBUTARY CREEK CHANNEL (EARTH AND ROCK CHANNEL)
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- PROPOSED CONTOUR GRADING FOR MITIGATION SWALES

BOTTOM OF POOL TO MATCH LONGITUDINAL SLOPE OF MITGATION SWALE
2:1 SLOPE
2'
A
A
8'
8'

POOL RIFFLE ENHANCEMENT LOW GRADIENT CHANNEL
NTS

0 20 40 80
SCALE: 1"=40'

CONSTRUCTION RECORD	BY	NO.	REFERENCE/REVISIONS	DATE	APPROVED
CONTRACTOR					
INSPECTOR					
DATE COMPLETED					

REGISTERED PROFESSIONAL ENGINEER JAMES F. TEMPLETON JR. No.43061 CIVIL STATE OF CALIFORNIA

DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE
Jim Templeton	Amanda Karchefski	Kim Reed	08-09-2016	HOR: 1"=40' VERT: NONE

PLANS PREPARED UNDER THE DIRECTION OF:

BY: _____
JAMES F. TEMPLETON JR. RCE No. 43061

MacKay & Somps
ENGINEERS PLANNERS SURVEYORS
PLEASANTON, CA (925) 225-0690

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PUBLIC WORKS DEPARTMENT

PLANS FOR THE IMPROVEMENTS OF
TASSAJARA HILLS
ROUGH GRADING PLANS FOR SWALES N, O AND P

DUBLIN CALIFORNIA

JOB NO. 19569.00
DRAWING NO.
SHEET 9 OF 9