28 March 2024

Technical Memorandum No. 3

To: Kevin O'Connell, P.E., City of Morgan Hill

From: Donald Barraza, P.E., Kennedy/Jenks Consultants

By: Katie McCoy, P.E., Kennedy/Jenks Consultants

Subject: Design Alternative Evaluation No. 3 – Site Drainage Alternatives
E. Dunne Hillside Water Reservoir Project
Department of Public Works
City of Morgan Hill, CA
K/J 1672001*00, Phase 3, Task 3.1.3

Introduction

The City of Morgan Hill, CA intends to undertake the construction of the new E. Dunne Hillside Water Reservoir facilities. Key objectives for the project are: 1) completion of construction documents that have been reviewed and approved by all permitting agencies to allow the City to bid the project in May 2016 in order to have the new reservoir constructed and operational by 30 June 2017; 2) delivery of a project within the current FY 15/16 year Capital Improvement Program budget of $2,200,000; 3) construction and operation of the new reservoir, future pump station, and pipelines with the least adverse impact to adjacent homeowners; 4) design and construction of facilities that satisfy the requirements of the Department of Water Resources, Division of Drinking Water to provide a reliable potable water supply to City users; and 5) preparation of an Initial Study and related CEQA documentation to assess and minimize construction-related and long-term adverse environmental impacts associated with the project.

This Technical Memorandum (TM) No. 3 summarizes the design evaluation for site drainage alternatives for the E. Dunne Hillside Water Reservoir Project in the City of Morgan Hill, CA. Within TM No. 3 are presented goals and objectives, background information, site conditions and field observations, regulatory issues and review, description of the conceptual design, description(s) of design alternatives, advantages and disadvantages, engineer's opinion of probable construction cost, issues to be resolved during final design, and conclusions and recommendations.

Goals and Objectives

The goals and objectives of this design alternative evaluation are:

1. Evaluate alternatives for conveying surface water from improved areas of the reservoir pad and access road to offsite natural drainage features and storm drains.

2. Evaluate calculation of peak reservoir site runoff to determine impacts to offsite storm drainage facilities.

3. Evaluate site drainage improvements that do not enlarge unnamed topographic swales on the site and convey surface runoff from the site to Upper Llagas Creek without increasing the size of scarp areas or contributing to dormant or active landslides.

4. Evaluate ways to disperse versus concentrate runoff from the improved areas of the tank pad site and from the improved paved access roadway.t

5. Evaluate the need for storm drain detention basin. Identify size, location, construction requirements. Evaluate if storm drain detention can be constructed below grade beneath the tank pad.

6. Identify approach for site storm drainage improvements including additional swales, inlets, drains, and retention basins.

7. Evaluate requirements for reservoir overflow containment, retention, energy dissipation and discharge.

Background Information

The site is located in the Pajaro River Watershed which drains to Monterey Bay. Drainage from the site makes its way south and southwest to Upper Llagas Creek located approximately ¼ mile south of the site. Water in Upper Llagas Creek drains into Little Llagas Creek which later drains into Llagas Creek and then the Chesbro Reservoir. The Chesbro Reservoir is located approximately 6 miles east of the site and discharges to the Pajaro River. Precipitation in the Morgan Hill area is approximately 21.7 inches per year.

The key elements of the project are summarized below:

1. **Reservoir:** A drinking water reservoir of 850,000 gallon capacity with 80'-0" nominal diameter and 25'-0" maximum water depth. The tank will be constructed of welded steel at ground level. Included would be all reservoir appurtenances, interior piping, inlet/outlet piping, foundations/anchoring, and corrosion protection elements including protective coatings and cathodic protection systems.

2. **Pipelines:** Approximately 700 lineal feet of inlet 16"-diameter and outlet 12"–diameter connecting pipelines to and from interconnections in the water distribution system on E. Dunne Avenue north of Flaming Oaks Court.

3. **Access Road:** Approximately 600 lineal feet of asphalt concrete paved access road from E. Dunne Avenue to the reservoir tank pad site including roadway retaining structures and drainage elements.

4. **Retaining Structures:** Two-tier earth retaining structures with combined total heights of 26'-0" for the reservoir tank pad site, and single tier heights up to 14'-0" for the access roadway.

5. **Pump Station:** Planning and layout of the reservoir site to accommodate a future approximately 20'-0" x 30'-0" (600 sq.ft.) pump station.

6. **Site Drainage:** Grading and drainage improvements for the reservoir pad, access roadway, and proposed retention/infiltration basin(s).

7. **Landscaping:** Landscaping and irrigation for screening the reservoir and permanently cut slopes, and reconstruction of construction-related disturbed areas.

Site Conditions and Field Observations

The majority of the site is an open, grass-covered hillslope with sparse oak trees. The approximate slope of the site is 17%. A 440-foot-long concrete v-ditch runs along the southwestern side of the site, parallel to E. Dunne Ave. It connects to the roadway at the bottom, travels northeast, and turns to the north before ending at approximately 45 feet east of the roadway. According to a *Preliminary Engineering Geologic Feasibility Evaluation* conducted for the project site, there are no landslides but there are earthflow-style landslide deposits in the general vicinity (along southeast edge of existing v-ditch). There are also no active seismic faults passing through project site (CE&G, 2015).

Field observations made during the geologic feasibility evaluation indicate that the majority of the site is cobbly sandstone to sandy claystone with a few areas toward the top of the hill having basalt and basalt flow breccia soil types. The geologic feasibility evaluation also indicated that Santa Clara Foundation bedrock underlies the site.

Regulatory Issues and Review

The following regulatory entities were referenced for guidance in determining the applicable regulatory issues associated with drainage and stormwater for the project. An evaluation of each entity's requirements follows.

A. *City of Gilroy, City of Morgan Hill and County of Santa Clara:* Stormwater Management Guidance Manual for Low Impact Development & Post-Construction Requirements, June (Morgan Hill, 2015 or Guidance Manual)

B. *Santa Clara County:* Drainage Manual, 14 August (SCCDM, 2007 or Drainage Manual)

C. *Santa Clara Valley Water District:* applicable construction permitting requirements

D. *State of California:* Phase II Small MS4 General Permit; Regional Water Quality Control Board Region 3's Post-Construction Requirements (Order No. 2013-0001-DWQ, 1 July 2913)

E. *State of California:* Construction General Permits (CGP) requirements [Order 2012-0006-DWQ (amends 2009-0009-DWQ as amended by 2010-0014-DWQ), 1 July 2012]

Stormwater Management Guidance Manual

The project is estimated to be less than 5 acres and to create between 15,000 square feet (sf) and 22,499 sf of impervious surface. Per the Guidance Manual, Tier 3 Performance Requirements (PR-3) will be required to manage surface water flows from the pervious and impervious surfaces of the project. Regulated projects subject to PR-3 must also meet the requirements of the first two tiers and include the submitted certifications (Morgan Hill, 2015). The requirements of the three tiers include:

- PR-1 - Site Design and Runoff Reduction
  - Limit disturbance of natural drainage features
  - Limit clearing, grading and soil compaction
  - Minimize impervious surfaces
  - Minimize runoff by dispersing runoff to landscape or using permeable pavements
- PR-2 - Water Quality Treatment
  - Treat runoff with an approved and appropriately sized low impact development (LID) treatment system prior to discharge from the site
- PR-3 - Runoff Retention
  - Required to retain stormwater runoff on the site.
  - Prevent offsite discharge from events up to the 95th percentile rainfall event using Source Control Measures (SCMs) (site's requirement is 85th percentile; refer to the Description of Conceptual Design section below)

Specific information must be included in the Stormwater Control Plan (SWCP) for PR-1, PR-2 and PR-3 projects. Copies of the checklists for these three tiers and the SWCP are found in Attachment A to this memo. The City of Morgan Hill Public Works Department also has a

specific construction Best Management Practices (BMP) sheet that must be considered and included in the project documents.

Santa Clara County Drainage Manual

According to the Drainage Manual, the project is located in a "Very Small Drainage Area" because it is less than 50 acres. Projects in Santa Clara County are to be designed using a 10-year, 24-hour design storm. For flooding considerations, a 100-year, 24-hour design storm is used.

Santa Clara Valley Water District

Drainage area is less than 320 acres, therefore no permit coverage required (SCCDM, 2007).

Phase II Small MS4 General Permit

Gilroy, Morgan Hill and the portion of Santa Clara County that drains to the Pajaro River watershed (this portion referred to as "South Santa Clara County") are traditional Permittees under the State's Phase II Small MS4 General Permit (Phase II Permit) (SWRCB, 2013). Since Gilroy, Morgan Hill and South Santa Clara County are located in Regional Water Quality Control Board Region 3 (Central Coast Region), they are subject to the Central Coast Post-Construction Requirements.

The types of post-construction controls include LID site design, pollutant source control, stormwater treatment, and hydromodification management measures. The LID approach reduces stormwater runoff impacts by minimizing disturbed areas and impervious surfaces, maximizing opportunities for infiltration and evapotranspiration, and using stormwater as a resource (e.g. rainwater harvesting for non-potable uses). Compliance with the Guidance Manual (Morgan Hill, 2015) and associated performance requirements described under Guidance Manual above addresses these Phase II Small MS4 requirements.

Statewide Construction General Permit

As long as the area of disturbance (including contractor staging area and earthen material storage) is not equal to or greater than an acre of land, permit coverage under the CGP is not required (CGP, 2012). This will need to be verified during final design.

Upon review of the above-mentioned regulatory entities, the project will need to adhere to the PR-3 requirements in the Guidance Manual for low flow and water quality considerations. For high flow and storm water runoff management considerations, guidance provided in the

Drainage Manual shall be used. Additionally, storm water management requirements from the post-construction requirements of the Phase II permit shall also be considered.

Design Storm Estimates

Design information provided in the Guidance Manual and the Drainage Manual was used to evaluate the runoff management requirements for surface water flow from the project site. Additionally, the Post-Construction Water Balance Calculator from Appendix 2 of the CGP (WBC) was used to estimate flow quantities and runoff management options.

Per the Guidance Manual, the site is located in the Santa Clara County Watershed Zone 5 (WZ-5). The PR-3 Runoff Retention requirements section in Appendix B of the Guidance Manual provides WZ-specific information for the Design Rainfall Events & Treatment Requirements. For WZ-5, runoff retention is to be made via optimized infiltration to prevent offsite discharge from events up to the 85th percentile, 24-hour storm event. After infiltration is optimized, storage, rainwater harvesting, and/or evapotranspiration may be used. For this project, the 85th percentile average 24-hour storm event was determined using the Post-Construction Water Balance Calculator in Appendix 2 of the CGP.

The Drainage Manual identified the 10-year, 24-hour duration for general designs and the 100-year, 24-hour duration for safe conveyance of flooding incidents. For this project, the intensity/duration/frequency data were gathered from the Point Precipitation Frequency Estimates table on the NOAA website for Morgan Hill, CA (NOAA, 2016). The table is found in Attachment B to this TM.

The amounts of rain from these three precipitation events relevant to design are:

- 85th percentile, 24-hour storm event: **0.84** inches (WBC)
- 10-year, 24-hour storm event: **4.27** inches (Attachment B)
- 100-year, 24-hour storm event: **7.01** inches (Attachment B)

Description of Conceptual Design

The construction activities associated with the project site will add impervious surfaces that will increase the amount of stormwater runoff generated during a storm event. The Conceptual Design for stormwater runoff management for the project site was considered with a Water Quality Design approach and a Water Quantity and Flooding Safety Design approach. The Water Quality Design approach used the 85th percentile average 24-hour storm event and the runoff credit criteria from the Water Balance Calculator. The 10-yr and 100-yr design storm information was used in consideration of the increase in the quantity of water and the potential

for flooding incidents. Although the Water Balance Calculator indicated that runoff credits could be used to manage the excess water for each of the three design storm scenarios, the project site's slope characteristics need to be taken into account for the larger two storm events. Water flowing down a hillside with a slope of 16-17% will take the path of least resistance and have the potential to grow in quantity and speed and cause erosion and/or other soil instability occurrences. Although an assumed infiltration rate was used in the concept design, a more accurate account of the soil's infiltrative capacity is necessary to better determine where/how the water will travel down the hillside from the project site. In some areas, additional facilities may be needed to redistribute flow to enable better sheet flow and increase the potential for infiltration. Retention/infiltration facilities may even be needed.

When considering how to manage the increase in runoff from the project site, two approaches were evaluated: 1) break up the discharge areas by disconnecting the impervious drainage surfaces to enable the existing pervious surfaces to infiltrate the runoff, or 2) prevent offsite discharge of the stormwater by providing retention.

The tank and booster station impervious area is approximately 12,500 sf. The two proposed road alignments (Options #1 and #2) are approximately 8,300 sf and 9,100 sf, respectively. They will produce differing effects on surface water flow from the project site. Thus, differing considerations were made for the quantity and management of surface water generated from these impervious areas.

For the purpose of this Conceptual Design, we have presumed a permeability value of 0.13 inches/hour. Pre-construction and post-construction runoff estimates in cubic feet (cf) from the impervious surface areas for the three design storm scenarios, as calculated by the Water Balance Calculator, are summarized in Table 1. The various design factors and related notes from which the design flows were calculated are displayed in the calculation sheet found in Attachment C to this TM.

Table 1: Pre-Project and Post-Project Related Runoff Estimates

	Pre-Construction Runoff, cf			Post- Construction Runoff, cf		
	85th Percentile	10-yr, 24-hr	100-yr, 24-hr	85th Percentile	10-yr, 24-hr	100-yr, 24-hr
Tank & booster station area	35	1,000	2,850	640	3,250	4,280
Roadway Option #1	20	660	1,870	420	2,130	2,800
Roadway Option #2	25	730	2,070	460	2,350	3,100

Runoff credits from the "impervious disconnect" option from non-rooftop surfaces provided in the Water Balance Calculator will be sufficient to mitigate the runoff generated from the 85th percentile average 24-hour storm event coming from the impervious surfaces of the tank and booster station pads, and from the roadway (whichever option is chosen). This credit option will be sufficient as long as the following criteria can be met:

1. Each discharge point drains a maximum of 5,000 sf
2. Continuous runs (i.e. roadway) must be less than 75 feet.

Additional credits such as tree planting and porous pavement were considered but deemed unnecessary. Further explanation is provided below to demonstrate how these criteria can be met for the two proposed road alignments.

Description of Design Alternative No. 1A

Design Alternative No. 1A pertains to Road Alignment Option No. 1 (RA #1). RA #1, approximately 555 feet long, begins at E Dunne Ave., approximately 40 feet south of where the concrete v-ditch meets the roadway and extends up the hill, ending in the lower southeast area of the proposed booster station pad. Surface water drainage in this Design Alternative is separated into three drainage management areas (DMAs) which are shown on the figure found in Attachment D to this TM.

- **DMA 1:** RA #1 is expected to act as a drainage break for water draining south from the northeast area of the project site. As water flows south and reaches RA #1, it is redirected east and south to continue infiltrating along the hillside.

  This area is anticipated to drain the impervious surface of the tank (~5,000 sf).

- **DMA 2:** Surface water flowing from the west side of the project site flows in the south-southwest direction toward the concrete v-ditch.

  This area is anticipated to drain the impervious surfaces of the driveway around the tank (~4,500 sf).

- **DMA 3:** From the south side of RA #1 where it ends at the booster station pad, water is anticipated to flow south and southeast along the path of least resistance with the contour lines.

This area is anticipated to drain the impervious surface of the booster station pad (~3,000 sf).

Drainage from the impervious surface of RA#1 can be mitigated with curb cuts every 75 feet along the alignment to allow water to infiltrate as it flows down the hillside. An alignment of 555 feet will require a minimum of six (6) curb cuts. Additional flow distribution, retention, infiltration and/or armoring may be required to minimize erosion associated with larger storm events as runoff flows down the steep hillside. As summarized in Table 1, approximate runoff volumes to the three DMAs from the tank and booster area would range from 780 cf to 1,300 cf for the 10-yr design storm and from 1,030 cf to 1,700 cf for the 100-yr design storm. Approximate runoff volumes to each of the curb cut areas from the roadway would be 355 cf for the 10-yr design storm and 470 cf for the 100-yr design storm.

Approximate locations of the curb cuts and the drainage arrows from the DMAs for the tank and booster station pads are provided on the figure in Attachment D.

Description of Design Alternative No. 1B

Design Alternative No. 1B pertains to Road Alignment Option No. 2 (RA #2). RA #2, approximately 608 feet long, begins at E Dunne Ave. where the concrete v-ditch meets the roadway, and extends up the hill resembling an S-curve shape, ending on the east side of the proposed tank and booster station pad at the junction where the booster station and tank pads meet.

Surface water drainage in this Design Alternative is separated into two DMAs:

- **DMA 1:** RA #2 is expected to act as a drainage break for water draining south from the northeast area of the project site. As water flows south and reaches RA #2, it is redirected east and south to continue infiltrating along the hillside.

  This area is anticipated to drain the impervious surface of the tank (~5,000 sf).

- **DMA 2:** Surface water flowing from the west side of the project site flows in the south-southwest direction toward the concrete v-ditch. Additionally, from the south side of RA #2 where it ends at the tank and booster station pads, water is expected to flow south and southeast along the path of least resistance with the contour lines.

  This area is anticipated to drain the impervious surfaces of the area surrounding the tank (~4,500 sf) to the southwest toward the v-ditch and the impervious surface of the booster station pad (~3,000 sf) to the south along the hillside. A culvert may be needed to convey water under the RA #2 near the 3+50 mark to allow the water to continue down t

he hillside. Otherwise, there potentially could be excess runoff that will make its way to the v-ditch and join the potential excess runoff in the v-ditch from the area surrounding the tank.

Drainage from the impervious surface of RA#2 can be mitigated with curb cuts every 75 feet along the alignment to allow water to infiltrate as it flows down the hillside. An alignment of 608 feet will require a minimum of seven (7) curb cuts. Additional flow distribution retention, infiltration and/or armoring may be required to minimize erosion associated with larger storm events as runoff flows down the steep hillside. As summarized in Table 1, approximate runoff volumes to the two DMAs from the tank and booster area would range from 780 cf to 1,300 cf for the 10-yr design storm and from 1,030 cf to 1,700 cf for the 100-yr design storm. Approximate runoff volumes to each of the curb cut areas from the roadway would be 300 cf for the 10-yr design storm and 440 cf for the 100-yr design storm.

Approximate locations of the curb cuts and the drainage arrows from the tank and booster station pads are shown on the figure in Attachment D.

Assessment of Design Alternatives

Alternative No. 1A has an additional DMA for the excess runoff to be mitigated, allowing runoff to be distributed over a larger area, as opposed to Alternative No. 1B which only has two DMAs. In Alternative No. 1B, the water draining from the booster station pad could require the installation of a culvert with appropriate armoring/flow distribution at the discharge near the 3+50 mark to allow the water to continue draining down the hillside.

Flow volume from Alternative No. 1A is slightly less than Alternative No. 1B because the road alignment is shorter.

As mentioned above in the Site Conditions and Field Observations section, there are earthflow-style landslide deposits in the general vicinity (along southeast edge of existing v-ditch) suggesting the potential for excess water to increase the potential for soil instability in the area near the existing tree line at the south end of the project site. Although the potential is expected to be minimal, the road alignment for Alternative No. 1A brings the excess water closer to this earthflow deposit area than the Alternative No. 1B alignment.

Engineer's Opinion of Probable Construction Cost

It is anticipated that any additional cost for the needed stormwater drainage features will be minimal although potential retention/infiltration facilities may increase costs and will require careful design consideration given the steepness of the slope. The required features needed to provide the "impervious disconnect" criteria mentioned above to mitigate the post-construction

runoff related to the project are expected to be handled with standard drainage design construction measures (i.e. piping, storm drains in the tank and booster station pad areas, sloped pavement, outfalls to pervious surfaces, cuts in curbing along roadside, gravel strips alongside the roadway for additional infiltrating - as a conservative measure).

Issues to be Resolved during Final Design

A comprehensive geotechnical investigation is underway and field investigations are scheduled for the week of 11 April 2016. As part of this investigation, a sample will be collected for permeability information. Two to three infiltration tests per the Central Coast Region Post Construction infiltration testing methods using the shallow method should also be performed. For the purpose of this Conceptual Design, we have presumed a permeability value of 0.13 inches/hour. Should this value and/or any other information gathered from the investigation be considered more appropriate or otherwise useful, the mitigation options for the runoff from impervious surfaces shall be reassessed.

The area of disturbance (including contractor staging area and earthen material storage) will need to be verified during final design. Provided the total does not equal or add up to greater than an acre of land, permit coverage under the CGP will continue to not be required (CGP, 2012).

Regulated projects located in the Cities of Gilroy or Morgan Hill or in Santa Clara County need to comply with certain requirements in the Guidance Manual. The SWCP and PR-1, PR-2, PR-3 checklists need to be completed and submitted for approval. Additionally, the City of Morgan Hill Public Works Department also has a specific construction BMP sheet that must be considered and included in the project documents.

Conclusions and Recommendations

Currently, there are no impervious surfaces at the top of the hill where the project site is located. The construction of a new tank, booster station pad, and roadway at the top of the hill will create additional runoff that will need to be managed to avoid erosion as it flows down the hill and to minimize the potential for impact to the existing stormwater drainage system. Where the water will flow down the hill from the project site will depend on many factors. Some of these factors include: maximum slope of the current hillside; proposed slope of the new roadway; infiltrative capacity of the soil, and existing drainage patterns.

Based on the information provided in the Water Balance Calculator, runoff credits from the "impervious disconnect" option from non-rooftop surfaces will be sufficient to meet the water quality requirements (i.e. 85th percentile) from the impervious surfaces of the tank and booster station pads and the roadway, whichever option is chosen. Additional credits such as tree

planting and porous pavement were considered but deemed unnecessary. This credit option will be sufficient as long as drainage areas are less than 5,000 sf and continuous drainage runs are less than 75 feet.

Considering the project-related water quality impacts, runoff can be mitigated with the "impervious disconnect" credit. No offsite discharge is anticipated and thus the PR-3 criteria will be met. No retention and minimal impact to existing storm drainage or conveyance features are expected. Other post-construction requirements identified in the Phase II MS4 permit and the Guidance Manual shall be included in the construction documents.

Considering the water quantity and proper conveyance of potential flooding incidents, additional evaluation and design are needed. Based on the results of the geotechnical investigation and infiltration testing, further analysis will be conducted to evaluate the management of the runoff generated from 10-year and 100-year precipitation events for compliance with the requirements of the Drainage Manual.

References

(CE&G, 2015) *Preliminary Engineering Geologic Feasibility Evaluation*
(Morgan Hill, 2015) *Stormwater Management Guidance Manual for Low Impact Development & Post-Construction Requirements.* City of Gilroy, City of Morgan Hill and County of Santa Clara. July 27.

(CGP, 2012) *Statewide Construction General Permit*. Order 2012-0006-DWQ (amends 2009-0009-DWQ as amended by 2010-0014-DWQ). State of California. July 1.

(Morgan Hill, 2015) *Stormwater Management Guidance Manual for Low Impact Development & Post-Construction Requirements.* City of Gilroy, City of Morgan Hill and County of Santa Clara. June.

(NOAA, 2016) NOAA website: http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html [37.1375, -121.595; Station: Morgan Hill 2 E (04-5844)]. March 14.

(SCCDM, 2007) *Santa Clara County, California, Drainage Manual.* Schaaf &Wheeler Consulting Civil Engineers, Santa Clara, CA. August 14.

(SWRCB, 2013) *State Phase II Small MS4 General Permit, Post-Construction Requirements, Order No. 2013-0001-DWQ. Regional* Water Quality Control Board Region 3. July 1.

Attachment(s) (4)

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A. PR-1 checklist
   PR-2 checklist
   PR-3 checklist
   SWCP checklist
B. Point Precipitation Frequency Estimates Table
C. Water Balance Calculator Calculations Sheet
D. Figure

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