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INTRODUCTION

During May of 2020, a Preliminary Geotechnical and Infiltration Feasibility Investigation was performed by LOR Geotechnical Group, Inc., for the construction of proposed Enchanted Hills Park in the City of Perris, Riverside County, California. The purpose of this investigation was to evaluate the subsurface conditions within the areas of proposed improvements and to provide geotechnical design recommendations. The scope of our services included: 1) a subsurface field investigation; 2) infiltration testing; 3) laboratory testing of selected soil samples obtained during the field investigation; 4) development of geotechnical recommendations for foundation design and construction; and 5) preparation of this report.

A Site Plan was available at the time of our site investigation and this image was utilized to orient our investigation at the site. The general location of the site is shown on the attached Index Map, Enclosure A-1, within Appendix A.

PROJECT DESCRIPTION

Information provided by you indicates that the new park improvements will include a multi-use field, two restroom buildings, paved access roads and parking areas, two basketball courts, various play areas, trails, and landscaping. The Site Plan also identifies two proposed basins for infiltration/subsurface storage for WQMP purposes.

EXISTING SITE CONDITIONS

The subject site consists of approximately 22.5 acres of vacant land within the northwest portion of the City of Perris, California. The rectangular shaped property is largely in a natural condition with some dirt road and trails traversing the west and northeast portions. Outcrops of granitic rock dot much of the surface and drainage is mainly as sheet flow into small swales and canyons that drain toward the southeast corner of the site. In general, the site area is in a fairly natural condition. Modifications to the natural environment in the project area consist of relatively thin and/or isolated accumulations of undocumented fill soils with the bulk of this in the southwestern portion in the form of bmx jumps and ramps. A fair amount of trash and debris has been illegally placed within the site with this material mainly in the northwest and southwest parts of the site. Vegetation across the site consists of a moderate growth of annual grasses, weeds, and brush with small trees present located along the drainage areas in the southeast portion of the property.

FIELD INVESTIGATION

Our field exploration program was conducted on May 1, 2020 and consisted of excavating eight exploratory trenches using a New Holland LB -75B backhoe equipped with a 24-inch bucket. The trenches were excavated to depths ranging from approximately 6 to 14 feet below the existing ground surface. In-place density tests were taken in accordance with ASTM D 1556, the Sand Cone Method. Bulk samples of the encountered materials were obtained and returned to the laboratory in sealed containers for further testing and evaluation. The approximate locations of our exploratory trenches are presented on the attached Plat, Enclosure A-2, within Appendix A.

Logs of the subsurface conditions encountered in the exploratory trenches were maintained by an engineering geologist from this firm. Relatively undisturbed and bulk samples were obtained and returned to the laboratory in sealed containers for further testing and evaluation. A detailed description of the field exploration program and the trench logs are presented in Appendix B.

INFILTRATION TESTING AND TEST RESULTS

Four falling head infiltration tests were conducted within the areas proposed for infiltration, two at each of two proposed basin locations. Testing consisted of test holes which were excavated using backhoe equipment to depths of between 2.5 and 3 feet below the ground surface and then hand digging test holes to depths of 15 inches in the bottom of the backhoe excavated trenches.

The holes were 6-inches in diameter. Test holes were filled with approximately 24-inches of water. The depth of the water was measured at approximately 30-minute intervals for a total of 6 hours. Test holes were refilled with water after each reading. The infiltration rate was established utilizing the Porchet Method on the final reading.

Infiltration test results are summarized in the following table:

Test No.	Depth (ft.)*	Clear Water Infiltration Rate (in/hr)
FH-1	2.83	2.77
FH-2	2.5	0.7
FH-3	3.0	0.06
FH-4	3.0	1.63
* depth measured below existing ground surface to top of test hole.		

The results of our infiltration testing are attached as Enclosures D-1 through D-4.

LABORATORY TESTING PROGRAM

Selected soil samples obtained from the field soil investigation trenches were subjected to laboratory testing to evaluate their physical and engineering properties. Laboratory testing included in-place moisture content and density, laboratory compaction characteristics, direct shear, sieve analysis, sand equivalent, R-Value, and soluble sulfate content. A detailed description of the laboratory testing program and the test results are presented in Appendix C.

GEOLOGIC CONDITIONS

Regional Geologic Setting

The proposed park site is located within the northwest portion of the City of Perris, which lies along the western side of Perris Valley. This area is located on the Perris block, within the northern Peninsular Ranges geologic province of southern California. While the Perris block is considered to be a relatively stable structural block, it is bounded by active faults. The Perris block is underlain predominately by a very large mass of crystalline igneous rocks of Cretaceous age and older metasedimentary and metavolcanic rocks.

The Perris block has a series of erosional surfaces, marked by low topographic relief and capped with unconsolidated alluvial sediments stripped from the surrounding highlands, such as the Box Spring Mountains, the Perris Erosion Surface upon which the site rests, and the hills around Lake Perris, located east of the site. These sediments have been mapped by the California Division of Mines and Geology as being composed of deposits of relatively unconsolidated, but weakly to moderately indurated younger to older alluvium

(Morton, 2001). The site area is a source zone for the nearby, lower-lying older alluvial sediments and represents an elevated erosion surface that generates the adjacent areas of accumulated sediments. Being an area of erosion, the surface exposes bedrock and the sediments are thin and relatively young.

The nearest known active fault zone is the Elsinore fault zone located approximately 15.3 kilometers (9.5 miles) to the southwest. Other major faults within the region include the San Jacinto fault, located approximately 16.1 kilometers (10 miles) to the northeast, and the San Andreas fault zone, located approximately 34.6 kilometers (21.5 miles) to the northeast.

Review of aerial photographs of the site and vicinity indicates the presence of several bedrock faults with a fairly strong northwest orientation. The faults are believed to have formed during implacement of the local intrusive rock bodies and none have been identified as active or potentially active.

The regional geologic setting of the site and surrounding area been mapped by the U.S.G.S. (Morton, 2001), as shown on Enclosure A-3, within Appendix A.

Site Geologic Conditions

Granitic bedrock underlies the entire site, either as outcrops or below surficial soils at fairly shallow depth. The earth materials encountered during our site investigation are described briefly below and in detail on the Trench Logs within Appendix B.

Alluvium

Within the low lying portions of the site, generally limited to a poorly defined area that extends across the central portion of the site from north to south and within the drainage area with heavier vegetation in the southeastern portion of the property, alluvial materials were noted. The alluvial soils extended from the ground surface to depths of up to 12.5 feet. These soils were composed of brown silty sands in a moist and loose to medium dense state.

Colluvium

Colluvium was encountered within most of our exploratory trenches placed within the relatively elevated portions of the site, particularly in the southwest and western portions.

These materials were found at the ground surface of the site to depths ranging from 2 to 6 feet. These soils were noted to consist of silty sands which were brown in color, damp, loose to medium dense, and contained some pinhole porosity.

Granitic Bedrock

Bedrock was found across the site beneath the colluvial and alluvial materials at highly variable depths. The bedrock materials mainly consisted of tonalite and diorite, which is moderately weathered and slightly decomposed within the upper 1 to 2 feet. As encountered within our exploratory trenches, the upper, weathered and decomposed bedrock is typically recovered as fine to coarse grained sand that is yellowish-brown in color, damp, and relatively easy to excavate. Below depths of 1 to 2 feet from encountering rock, the bedrock materials become grayish brown, fresher, and less decomposed as well as harder to excavate. It should be noted that the hardness of the rock caused difficulty and early refusal during the excavation of most of our trenches. Therefore, knobs or corestones of more resistant granitic bedrock should be anticipated to be encountered during the grading of the site.

Groundwater Hydrology

Groundwater was not encountered in our exploratory trenches. However, moist soils were present just above the bedrock contact and it is likely that seasonal, perched water accumulates upon the bedrock within localized areas during or following periods of heavy precipitation. There is no readily available groundwater data for wells in the area and groundwater is not anticipated to be a factor in site development.

Surface Runoff

Current surface runoff of precipitation waters across the site is generally from the north to the south and ultimately toward the natural drainage course in the southeast corner of the property.

Mass Movement

The majority of the site lies on a relatively flat surface. The occurrence of mass movement failures such as landslides, rockfalls or debris flows within such areas is generally not considered common and no evidence of mass movement was observed on the site or during our review of aerial photographs of the site and vicinity. There may be a slight

potential for rockfall or topple to occur locally. This potential should be further evaluated once grading and development plans have been prepared.

Faulting

There are no known active faults at the site. In addition, according to the Official Maps of Alquist-Priolo Earthquake Fault Zones of California (Hart and Bryant, 1997) the subject site does not lie within a current State of California Earthquake Fault Zone.

As previously mentioned, the closest known active fault is the Elsinore fault, located approximately 15.3 kilometers (9.5 miles) to the southwest. In addition, other relatively close active faults include the San Bernardino segment of the San Andreas fault zone, located approximately 34.6 kilometers (21.5 miles) to the northeast, and the San Jacinto fault, located approximately 16.1 kilometers (10 miles) to the northeast.

The Elsinore fault zone is one of the largest in southern California. At its northern end, it splays into two segments and at its southern end it is cut by the Yuba Wells fault. The primary sense of slip along the Elsinore fault is right lateral strike-slip. It is believed that the Elsinore fault zone is capable of producing an earthquake magnitude on the order of 6.5 to 7.5.

The San Jacinto fault zone is a sub-parallel branch of the San Andreas fault zone, extending from the northwestern San Bernardino area, southward into the El Centro region. This fault has been active in recent times with several large magnitude events. It is believed that the San Jacinto fault is capable of producing an earthquake magnitude on the order of 6.5 or greater.

The San Andreas fault is considered to be the major tectonic feature of California, separating the Pacific Plate and the North American Plate. While estimates vary, the San Andreas fault is generally thought to have an average slip rate on the order of 24mm/yr and capable of generating large magnitude events on the order of 7.5 or greater.

Current standards of practice often include a discussion of all potential earthquake sources within a 100 kilometer (62 mile) radius. However, while there are other large earthquake faults within a 100 kilometer (62 mile) radius of the site, none of these are considered as relevant to the site as the faults described above, due to their greater distance and/or smaller anticipated magnitudes.

Historical Seismicity

In order to obtain a general perspective of the historical seismicity of the site and surrounding region, a search was conducted for seismic events at and around the area within various radii. This search was conducted utilizing the historical seismic search website of the USGS. This website conducts a search of a user selected cataloged seismic events database, within a specified radius and selected magnitudes, and then plots the events onto a map. At the time of our search, the data base contained data from May 8, 1932 through May 8, 2020.

In our first search, the general seismicity of the region was analyzed by selecting an epicenter map listing all events of magnitude 4.0 and greater, recorded since 1932, within a 100 kilometer (62 mile) radius of the site, in accordance with guidelines of the California Division of Mines and Geology. This map illustrates the regional seismic history of moderate to large events. As depicted on Enclosure A-4, within Appendix A, the site lies within a relatively active region associated with the Elsinore, San Jacinto and San Andreas fault zones trending southeast to northwest.

In the second search, the micro seismicity of the area lying within a 10 kilometer (6.2 mile) radius of the site was examined by selecting an epicenter map listing events on the order of 1.0 and greater since 1978. The result of this search is a map that presents the seismic history around the area of the site with much greater detail, not permitted on the larger map. The reason for limiting the events to the last 40 ± years on the detail map is to enhance the accuracy of the map. Events recorded prior to the mid 1970s are generally considered to be less accurate due to advancements in technology. As depicted on this map, Enclosure A-5, the Elsinore and San Jacinto fault zones appear to be the source of numerous events.

In summary, the historical seismicity of the site entails numerous small to medium magnitude earthquake events occurring around the subject site, predominately associated with the presence of the San Jacinto and San Andreas faults. Any future developments at the subject site should anticipate that moderate to large seismic events could occur very near the site.

Secondary Seismic Hazards

Other secondary seismic hazards generally associated with severe ground shaking during an earthquake include liquefaction, seismic-induced settlement, seiches and tsunamis, earthquake induced flooding, landsliding, and rockfalls.

Liquefaction: The potential for liquefaction generally occurs during strong ground shaking within loose, granular sediments where the groundwater is usually less than 50 feet. Based on our field investigation, the site is underlain at depth by relatively dense older alluvial materials and the depth to groundwater levels is greater than 50 feet. Therefore, the possibility of liquefaction at the site is considered nil.

Seiches/Tsunamis: The potential for the site to be affected by a seiche or tsunami (earthquake generated wave) is considered nil due to absence of any large bodies of water near the site.

Flooding (Water Storage Facility Failure): There is a normally dry earthen basin located to the east of the site, a couple hundred feet east of Emerald Avenue, that could possibly rupture during an earthquake. If full at the time, the flood waters would likely flow into the drainage area located to the south of the proposed residence. However, the flooding potential at the site related to this possibility should be further evaluated by the project design civil engineer, as necessary.

Seismically-Induced Landsliding: Due to the low relief of the site and adjacent surrounding region, the potential for landslides to occur at the site is considered nil. No evidence for landsliding was observed to be present within slopes in areas near the proposed residence.

Rockfalls. No large, exposed, loose or unrooted boulders are present above the site that could affect the integrity of the site. However, a few isolated rocks may be subject to falling or toppling. This should be further evaluated as grading and development plans are prepared.

SOILS AND SEISMIC DESIGN CRITERIA (California Building Code 2019)

Design requirements for structures can be found within Chapter 16 of the 2019 California Building Code (CBC) based on building type, use and/or occupancy. The classification of use and occupancy of all proposed structures at the site, and thus the design requirements, shall be the responsibility of the structural engineer and the building official. For structures at the site to be designed in accordance with the provisions of Chapter 16, the subject site specific criteria is provided below:

Site Classification

Chapter 20 of ASCE7-16 defines six possible site classes for earth materials that underlie any given site. Bedrock is assigned one of three of these six site classes and these are: A B, or C. Per ASCE 7-16, Site Class A and Site Class B shall be measured on-site or estimated by a geotechnical engineer, engineering geologist or seismologist for competent rock with moderate fracturing and weathering. Site Class A and Site Class B shall not be used if more than 10 feet of soil is between the rock surface and bottom of the spread footing or mat foundation. Site Class C can be used for very dense soil and soft rock with $\bar{N}$ values greater than 50 blows per foot. Site Class D can be used for stiff soil with $\bar{N}$ values ranging from 15 to 50 blows per foot. Site Class E is for soft clay soils with $\bar{N}$ values less than 15 blows per foot. Because the site is underlain by igneous bedrock, site class C should be used for design of structures at the site.

CBC Earthquake Design Summary

The following earthquake design criteria have been formulated for the site utilizing the source referenced above. However, these values should be reviewed and the final design should be performed by a qualified structural engineer familiar with the region.

CBC 2019 SEISMIC DESIGN SUMMARY* Site Location (WGS 84) 33.7920, -117.2566, Occupancy Category II	
Site Class Definition Chapter 20 ASCE 7-16	C
S_s Mapped Spectral Response Acceleration at 0.2s Period	1.464
S_1 Mapped Spectral Response Acceleration at 1s Period	0.539
F_a Short Period Site Coefficient at 0.2s Period	1.2
F_v Long Period Site Coefficient at 1s Period	1.461
S_{MS} Adjusted Spectral Response Acceleration at 0.2s Period	1.756
S_{M1} Adjusted Spectral Response Acceleration at 1s Period	0.787
S_{DS} Design Spectral Response Acceleration at 0.2s Period	1.171
S_{D1} Design Spectral Response Acceleration at 1s Period	0.525
Seismic Design Category - Short Period	D
Seismic Design Category - Long Period	D
*Values obtained from OSHPD online Seismic Design Maps tool	

CONCLUSIONS

The subsurface conditions encountered in our exploratory trenches are indicative of the locations explored. It should not be assumed that these conditions are the same throughout the project area. If conditions are encountered during the construction of the project which differ significantly from those presented in this report, this firm should be notified immediately in order that we may assess the impact to the recommendations provided.

On the basis of our field investigation and testing program, it is the opinion of LOR Geotechnical Group, Inc., that the proposed park improvements are feasible from a soil engineering standpoint, provided the recommendations presented in this report are incorporated into design and implemented during grading and construction.

Based upon the field investigation and test data, it is our opinion that the near surface soils will not, in their present condition, provide uniform and/or adequate support for the proposed improvements. Our observations and field in-place density data indicated variable in-situ conditions of the upper soils, ranging from loose to medium dense states. Left as is, these conditions may cause unacceptable differential and/or overall settlements upon application of the anticipated loads.

Foundation Support

To provide adequate support for proposed structural improvements, we recommend that a compacted fill mat be constructed beneath footings and slabs. This compacted fill mat will provide a dense, high-strength soil layer to uniformly distribute the anticipated foundation loads over the underlying soils.

Conventional foundation systems using either individual spread footings and/or continuous wall footings will provide adequate support for the anticipated downward and lateral loads when utilized in conjunction with the recommended fill mat.

Infiltration Testing

The results of our infiltration tests indicate highly variable infiltration rates for the soils tested. The sandier alluvial soils showed fair to good rates, however, the colluvial soils - particularly the finer grained colluvial soils, showed slow infiltration rates. Similarly, the upper, weathered granitic bedrock materials showed fair to good infiltration characteristics but the bedrock becomes fresher and less conducive to infiltration at shallow depth below

the weathered zone. Geologic conditions appear to be somewhat restrictive to vertical infiltration and to favor lateral movement of water. Due to the highly variable rates and site geologic conditions, the use of on-site infiltration systems to manage storm water does not appear to be feasible.

Geologic Mitigations

No special mitigation methods are deemed necessary at this time, other than the geotechnical recommendations provided in the following sections.

Seismicity

Seismic ground rupture is generally considered most likely to occur along pre-existing active faults. Since no known active faults are known to exist at, or project into the site, the probability of ground surface rupture occurring at the site is considered nil.

Due to the site's close proximity to the faults described above, it is reasonable to expect a relatively strong ground motion seismic event to occur during the lifetime of the proposed development on the site. Large earthquakes could occur on other faults in the general area, but because of their lesser anticipated magnitude and/or greater distance, they are considered less significant than the faults described above from a ground motion standpoint.

The effects of ground shaking anticipated at the subject site should be mitigated by the seismic design requirements and procedures outlined in Chapter 16 of the California Building Code. Appendix E of this report presents the data generated through site specific, deterministic and probabilistic seismic analysis for use by the structural engineer during project design development. However, it should be noted that the current building code requires the minimum design to allow a structure to remain standing after a seismic event, in order to allow for safe evacuation. A structure built to code may still sustain damage which might ultimately result in the demolishing of the structure (Larson and Slosson, 1992).

RECOMMENDATIONS

Geologic Recommendations

No special geologic recommendations are deemed necessary at this time, other than the geotechnical recommendations provided in the following sections.

General Site Grading

It is imperative that no clearing and/or grading operations be performed without the presence of a qualified geotechnical engineer. An on-site, pre-job meeting with the owner, the contractor, and soil engineer should occur prior to all grading related operations. Operations undertaken at the site without the geotechnical engineer present may result in exclusions of affected areas from the final compaction report for the project.

Grading of the subject site should be performed in accordance with the following recommendations as well as applicable portions of Chapter 18 and Appendix J of the California Building Code, and/or applicable local ordinances.

All areas to be graded should be stripped of significant vegetation and other deleterious materials.

It is our recommendation that any undocumented fills under proposed flatwork and paved areas be removed and replaced with engineered compacted fill. If this is not done, premature structural distress (settlement) of the flatwork and pavement may occur. Any undocumented fills encountered during grading should be completely removed and cleaned of significant deleterious materials. These may then be reused as engineered compacted fill.

Cavities created by removal of subsurface obstructions should be thoroughly cleaned of loose soil, organic matter and other deleterious materials, shaped to provide access for construction equipment, and backfilled as recommended in the following Engineered Compacted Fill section of this report.

Initial Site Preparation

All existing loose colluvium, alluvium, and highly weathered bedrock materials should be removed from structural areas and areas to receive engineered compacted fill. The data developed during this investigation indicates that removals typically on the order of 1 to 3 feet from the existing ground surface will be required within areas of proposed structural improvements at the site. However, some local areas may require deeper removals. The given removal depths are preliminary. The actual depths of removals should be determined during the grading operation by observation. In general, removals should expose medium dense to dense natural soils or competent bedrock materials to be approved by the geotechnical engineer.

Preparation of Fill Areas

After the removals recommended above and prior to placing fill, the surfaces of areas to receive fill should be scarified to a depth of 6 inches as conditions allow. The scarified soil should be brought to near optimum moisture content and recompacted to a relative compaction of at least 90 percent (ASTM D 1557). Where removals extend to competent bedrock, scarification and processing will not be required.

Preparation of Foundation Areas

All footings should rest entirely upon at least 24 inches of properly compacted fill material placed over competent natural soils or relatively unweathered bedrock. In areas where the required fill thickness is not accomplished by the recommended removals or by site rough grading, the footing areas should be further subexcavated to a depth of at least 24 inches below the proposed footing base grade, with the subexcavation extending at least 5 feet beyond the footing lines. The bottom of this excavation should then be scarified to a depth of at least 6 inches, brought to near optimum moisture content, and recompacted to at least 90 percent relative compaction (ASTM D 1557) prior to refilling the excavation to grade as properly compacted fill.

Engineered Compacted Fill

The on-site soils should provide adequate quality fill material, provided they are free from organic matter and other deleterious materials. Unless approved by the geotechnical engineer, rock or similar irreducible material with a maximum dimension greater than 6 inches should not be buried or placed in fills. Oversized materials (rocks greater than 6 inches) should be placed within planned landscaped areas or disposed of offsite.

Import fill should be inorganic, non-expansive granular soils free from rocks or lumps greater than 6 inches in maximum dimension. Sources for import fill should be approved by the geotechnical engineer prior to their use.

Fill should be spread in maximum 8-inch uniform, loose lifts, each lift brought to near optimum moisture content, and compacted to a relative compaction of at least 90 percent in accordance with ASTM D 1557.

Based upon the relative compaction of the near surface soils determined during this investigation and the relative compaction anticipated for compacted fill soil, we estimate a compaction shrinkage of approximately 10 to 15 percent. In addition, we would anticipate

subsidence will be nil. Granitic bedrock materials are anticipated to bulk approximately 5 percent. These values are for estimating purposes only, and are exclusive of losses due to stripping or the removal of subsurface obstructions. These values may vary due to differing conditions within the project boundaries and the limitations of this investigation.

Short-Term Excavations

Following the California Occupational and Safety Health Act (CAL-OSHA) requirements, excavations deeper than 5 feet should be sloped or shored. All excavations and shoring should conform to CAL-OSHA requirements.

Short-term excavation greater than 5 feet deep shall conform to Title 8 of the California Code of Regulations, Construction Safety Orders, Section 1504 and 1539 through 1547. Based on our exploratory trenches, it appears that the upper 2 to 6 feet of the site soils can be classified as Type C soils and the materials below these depths can be classified as Stable Rock. These are the predominant types of soils on the project and all short-term excavations should be based on these types of soils. Deviation from the standard short-term slopes are permitted using option 4, Design by a Registered Professional Engineer (Section 1541.1).

Slope Construction

Preliminary data indicates that cut and fill slopes should be constructed no steeper than 2:1 (horizontal to vertical). Fill slopes should be overfilled during construction and then cut back to expose fully compacted soil. A suitable alternative would be to compact the slopes during construction, then roll the final slopes to provide dense, erosion-resistant surfaces.

Slope Protection

Since the native materials are susceptible to erosion by running water, measures should be provided to prevent surface water from flowing over slope faces. Slopes at the project should be planted with a deep rooted ground cover as soon as possible after completion. The use of succulent ground covers such as iceplant or sedum is not recommended. If watering is necessary to sustain plant growth on slopes, then the watering operation should be monitored to assure proper operation of the irrigation system and to prevent over watering.

Soil Expansiveness

The upper materials encountered during this investigation were observed to be granular and are considered to have a very low expansion potential. Therefore, specialized construction procedures to specifically resist expansive soil activity are not anticipated at this time. In order to verify this, additional evaluation of on-site and imported soils for their expansion potential should be conducted, as necessary, during the grading operation.

Foundation Design

If the site is prepared as recommended, the proposed structural improvements may be safely founded on conventional shallow foundation systems, either individual spread footings and/or continuous wall footings, bearing entirely on a minimum of 24 inches of engineered compacted fill placed over competent natural soils or relatively unweathered bedrock. Conventional foundations should have a minimum width of 12 inches and should be established a minimum of 12 inches below lowest adjacent grade.

For the minimum width and depth, footings may be designed using a maximum soil bearing pressure of 2,000 pounds per square foot (psf) for dead plus live loads. Footings at least 15 inches wide, placed at least 18 inches below the lowest adjacent final grade, may be designed for a maximum soil bearing pressure of 2,500 psf for dead plus live loads.

The above values are net pressures; therefore, the weight of the foundations and the backfill over the foundations may be neglected when computing dead loads. The values apply to the maximum edge pressure for foundations subjected to eccentric loads or overturning. The recommended pressures apply for the total of dead plus frequently applied live loads, and incorporate a factor of safety of at least 3.0. The allowable bearing pressures may be increased by one-third for temporary wind or seismic loading. The resultant of the combined vertical and lateral seismic loads should act within the middle one-third of the footing width. The maximum calculated edge pressure under the toe of foundations subjected to eccentric loads or overturning should not exceed the increased allowable pressure. Footings should be setback from slopes as recommended by the California Building Code.

Resistance to lateral loads will be provided by passive earth pressure and base friction. For footings bearing against compacted fill, passive earth pressure may be considered to be developed at a rate of 300 pounds per square foot per foot of depth.

Base friction may be computed at 0.30 times the normal load. Base friction and passive earth pressure may be combined without reduction. These values are for dead load plus live load and may be increased by 1/3 for wind or seismic loading.

Settlement

Total settlement of individual foundations will vary depending on the width of the foundation and the actual load supported. Maximum settlement of shallow foundations designed and constructed in accordance with the preceding recommendations are estimated to be on the order of 0.5 inch. Differential settlements between adjacent footings should be about one-half of the total settlement. Settlement of all foundations is expected to occur rapidly, primarily as a result of elastic compression of supporting soils as the loads are applied, and should be essentially completed shortly after initial application of the loads.

Slabs-On-Grade

To provide adequate support, concrete slabs-on-grade should bear on a minimum of 12 inches of compacted soil. The final pad surfaces should be rolled to provide smooth, dense surfaces upon which to place the concrete.

Slabs to receive moisture-sensitive coverings should be provided with a moisture vapor barrier. This barrier may consist of an impermeable membrane. Two inches of sand over the membrane will reduce punctures and aid in obtaining a satisfactory concrete cure. The sand should be moistened just prior to placing of concrete.

The slabs should be protected from rapid and excessive moisture loss which could result in slab curling. Careful attention should be given to slab curing procedures, as the site area is subject to large temperature extremes, humidity, and strong winds.

Wall Pressures

The design of footings for retaining wall structures should be performed in accordance with the recommendations described earlier under Preparation of Foundation Areas and Foundation Design. For design of retaining wall footings, the resultant of the applied loads should act in the middle one-third of the footing, and the maximum edge pressure should not exceed the basic allowable value without increase.

For design of retaining walls unrestrained against movement at the top, we recommend an active pressure of 46 pounds per square foot (psf) per foot of depth be used. This assumes level backfill consisting of recompacted, non-expansive native soils placed against the structures and within the back cut slope extending upward from the base of the stem at 35 degrees from the vertical or flatter.

Retaining structures subject to uniform surcharge loads within a horizontal distance behind the structures equal to the structural height should be designed to resist additional lateral loads equal to 0.30 times the surcharge load. Any isolated or line loads from adjacent foundations or vehicular loading will impose additional wall loads and should be considered individually.

To avoid over stressing or excessive tilting during placement of backfill behind walls, heavy compaction equipment should not be allowed within the zone delineated by a 45 degree line extending from the base of the wall to the fill surface. The backfill directly behind the walls should be compacted using light equipment such as hand operated vibrating plates and rollers. No material larger than 3 inches in diameter should be placed in direct contact with the wall.

Wall pressures should be verified prior to construction, when the actual backfill materials and conditions have been determined. Recommended pressures are applicable only to level, non-expansive, properly drained backfill with no additional surcharge loadings. If inclined backfills are proposed, this firm should be contacted to develop appropriate active earth pressure parameters. Toe bearing pressure for non-structural walls on soils, not prepared as described earlier under Preparation of Foundation Areas, should not exceed California Building Code values, (CBC Table 18-1-A).

Preliminary Pavement Design

Testing and design for preliminary on-site pavement was conducted in accordance with the California Highway Design Manual. Based upon our preliminary sampling and testing, and upon Traffic Indices generally associated with this type of project, it appears that the structural section tabulated below should provide satisfactory pavements for the subject improvements:

TYPE OF TRAFFIC	TRAFFIC INDEX (T.I.)	DESIGN R-VALUE	PRELIMINARY SECTION
Light Vehicle and Incidental Truck Traffic	5.0	25	0.25' AC/0.50' AB
AC - Asphalt Concrete AB - Class 2 Aggregate Base			

The above structural section is predicated upon 90 percent relative compaction (ASTM 1557) of all utility trench backfills and 95 percent relative compaction (ASTM 1557) of the upper 12 inches of street subgrade soils and of any aggregate base utilized. In addition, the aggregate base should meet Caltrans specifications for Class 2 Aggregate Base.

In areas of the pavement which will receive high abrasion loads due to start-ups and stops, or where trucks will move on a tight turning radius, consideration should be given to installing concrete pads. Such pads should be a minimum of 0.5 foot thick concrete, with a 0.35 foot thick aggregate base.

The above pavement designs were based upon the results of preliminary sampling and testing, and should be verified by additional sampling and testing when the actual subgrade soils are exposed.

Infiltration

Based upon our field investigation and infiltration test data, the variable rates encountered indicate that onsite infiltration of runoff waters at the site is not a viable option.

Sulfate Protection

The results of the soluble sulfate tests conducted on selected subgrade soils expected to be encountered at foundation levels are presented on Enclosure C.

Based on the test results, it appears that there is a negligible sulfate exposure to concrete elements in contact with the on site soils per the California Building Code. Therefore, no specific recommendations are given for concrete elements to be in contact with the on site soils.

Construction Monitoring

Post investigative services are an important and necessary continuation of this investigation. Project plans and specifications should be reviewed prior to construction to confirm that the intent of the recommendations presented herein have been incorporated into the design and to provide supplemental geotechnical recommendations, as necessary.

During construction, sufficient and timely geotechnical observation and testing should be provided to correlate the findings of this investigation with the actual subsurface conditions exposed during construction. Items requiring observation and testing include, but are not necessarily limited to, the following:

1. Site preparation-stripping and removals.

2. Excavations, including approval of the bottom of excavation prior to backfilling.

3. Scarifying and recompacting prior to fill placement.

4. Subgrade preparation for pavements and slabs-on-grade.

5. Placement of engineered compacted fill and backfill, including approval of fill materials and the performance of sufficient density tests to evaluate the degree of compaction being achieved.

6. Foundation/footing excavations.

LIMITATIONS

This report contains geotechnical conclusions and recommendations developed solely for use by Community Works Design Group and their design consultants, for the purposes described earlier. It may not contain sufficient information for other uses or the purposes of other parties. The contents should not be extrapolated to other areas or used for other facilities without consulting LOR Geotechnical Group, Inc.

The recommendations are based on interpretations of the subsurface conditions concluded from information gained from subsurface explorations, and a surficial site reconnaissance.

The interpretations may differ from actual subsurface conditions, which can vary horizontally and vertically across the site. Due to possible subsurface variations, all aspects of field construction addressed in this report should be observed and tested by the project geotechnical consultant.

If parties other than LOR Geotechnical Group, Inc., provide construction monitoring services, they must be notified that they will be required to assume responsibility for the geotechnical phase of the project being completed by concurring with the recommendations provided in this report or by providing alternative recommendations.

This report was prepared using generally accepted geotechnical engineering practices under the direction of a state licensed geotechnical engineer. No warranty, expressed or implied, is made as to conclusions and professional advice included in this report. Any persons using this report for bidding or construction purposes should perform such independent investigations as deemed necessary to satisfy themselves as to the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project.

TIME LIMITATIONS

The findings of this report are valid as of this date. Changes in the condition of a property can, however, occur with the passage of time, whether they be due to natural processes or the work of man on this or adjacent properties. In addition, changes in the Standards-of-Practice and/or Governmental Codes may occur. Due to such changes, the findings of this report may be invalidated wholly or in part by changes beyond our control. Therefore, this report should not be relied upon after a significant amount of time without a review by LOR Geotechnical Group, Inc., verifying the suitability of the conclusions and recommendations.

CLOSURE

It has been a pleasure to assist you with this project. We look forward to being of further assistance to you as construction begins. Should conditions be encountered during construction that appear to be different than indicated by this report, please contact this office immediately in order that we might evaluate their effect.

Should you have any questions regarding this report, please fee free to contact us at your convenience.

Respectfully submitted,
LOR Geotechnical Group, Inc.

John P. Leuer, GE 2030
President

RMM:CP:JPL/ss

Distribution: Addressee (4) and pdf: scott@comworksdg.com

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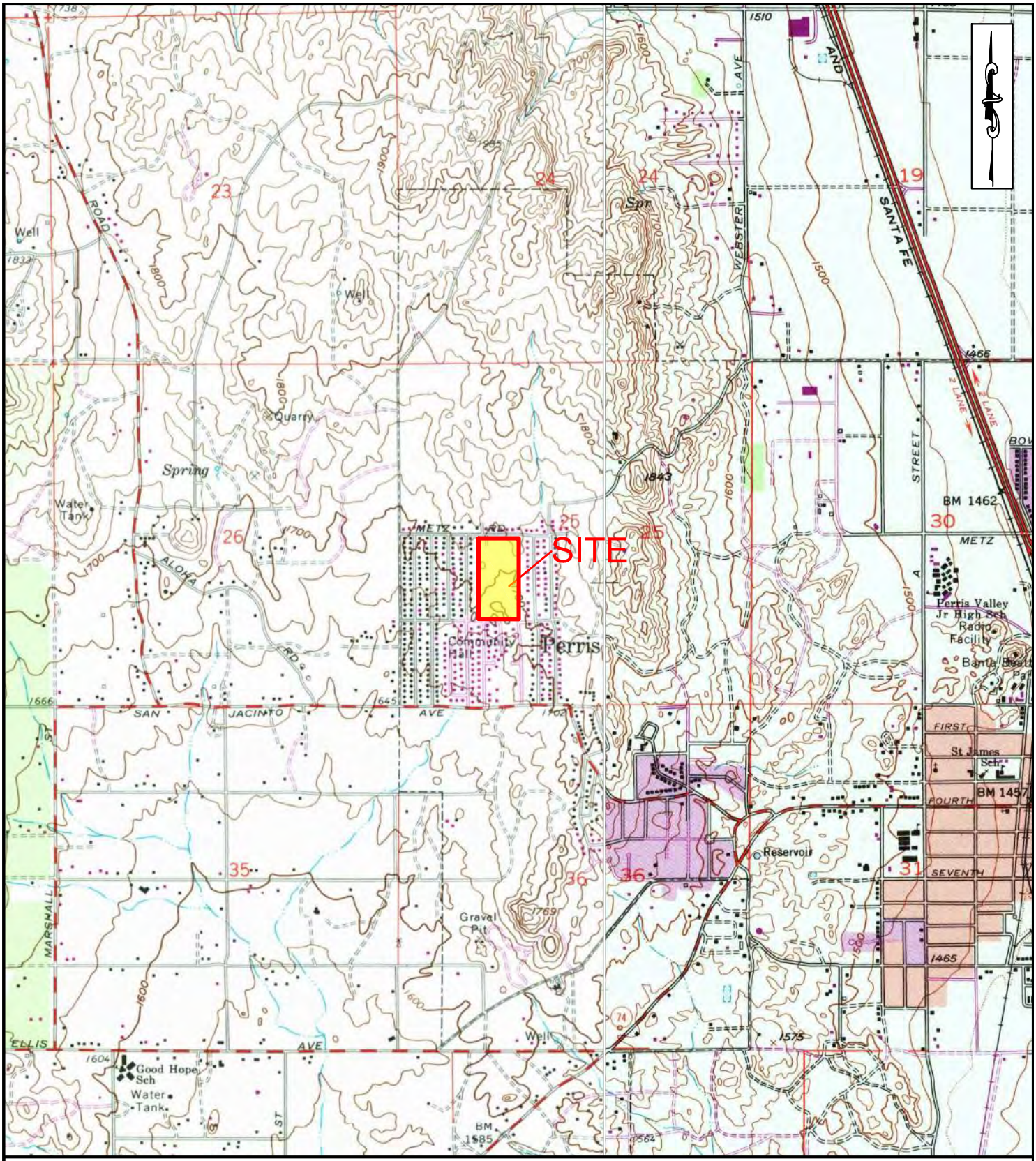
APPENDIX A

Index Map, Exploratory Trench Location Map, Regional Geologic Map and Historical Seismicity Maps



INDEX MAP

PROJECT:	PROPOSED ENCHANTED HILLS PARK, CITY OF PERRIS, CALIFORNIA	**PROJECT NO:**	63639.1
CLIENT:	COMMUNITY WORKS DESIGN GROUP	**ENCLOSURE:**	A-1
LOR Geotechnical Group, Inc.		**DATE:**	MAY 2020
		SCALE:	1" ≈ 2000'

Legend

(Locations Approximate)

Map Symbols

T-8 - Exploratory Trench Location

FH-4 - Infiltration Test Location

1. MULTI-USE FIELD
2. CHILD PLAY AREA
3. TOT PLAY AREA
4. LARGE RESTROOM BUILDING
5. SMALL RESTROOM BUILDING
6. PICNIC SHELTERS
7. HARDSCAPE
8. PARKING LOTS
9. BRIDGES
10. TRAILS
11. FULL-COURT BASKETBALL (2)
12. BMX COURSE IMPROVEMENTS
13. ART ROCKS
14. PROTECT EXISTING OWL ROCK
15. SPLASH PLAY
16. SKATE SPOT
17. ADVENTURE PLAY
18. ZIP LINE
19. RIPARIAN/RIVERINE AREAS
20. BASIN
21. PLAZA
22. NEW TREES: 200 TOTAL

ENCHANTED HILLS PARK

CITY OF PERRIS

NORTH

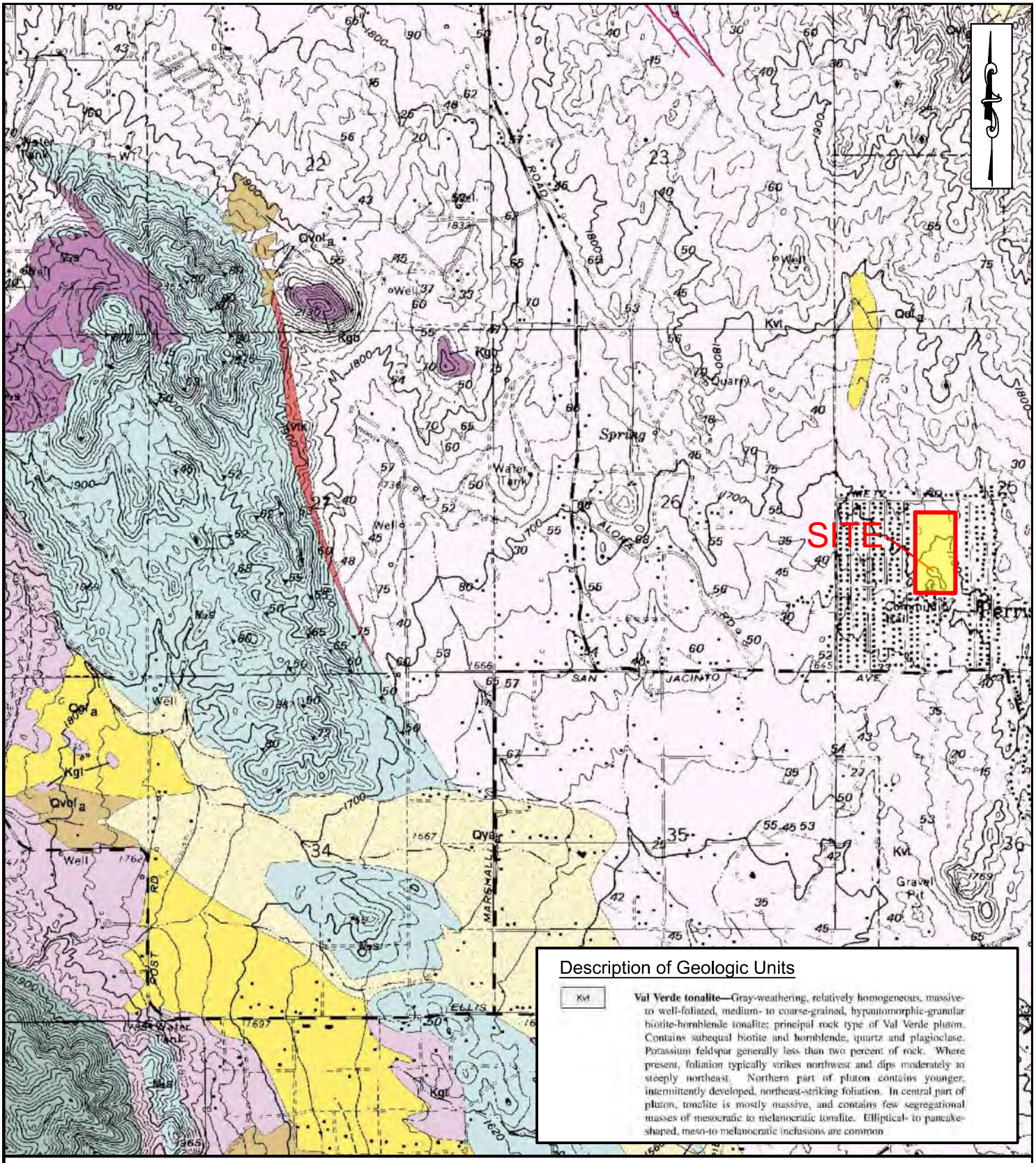
0' 50' 100' 200'

DATE: MARCH 9, 2020

EXPLORATORY TRENCH AND INFILTRATION TEST LOCATION MAP

PROJECT:	ENCHANTED HILLS PARK, PERRIS, CALIFORNIA
CLIENT:	COMMUNITY WORKS DESIGN GROUP
PROJECT NO:	63639.1
ENCLOSURE:	A-2
DATE:	MAY 2020
SCALE:	1" ≈ 140'

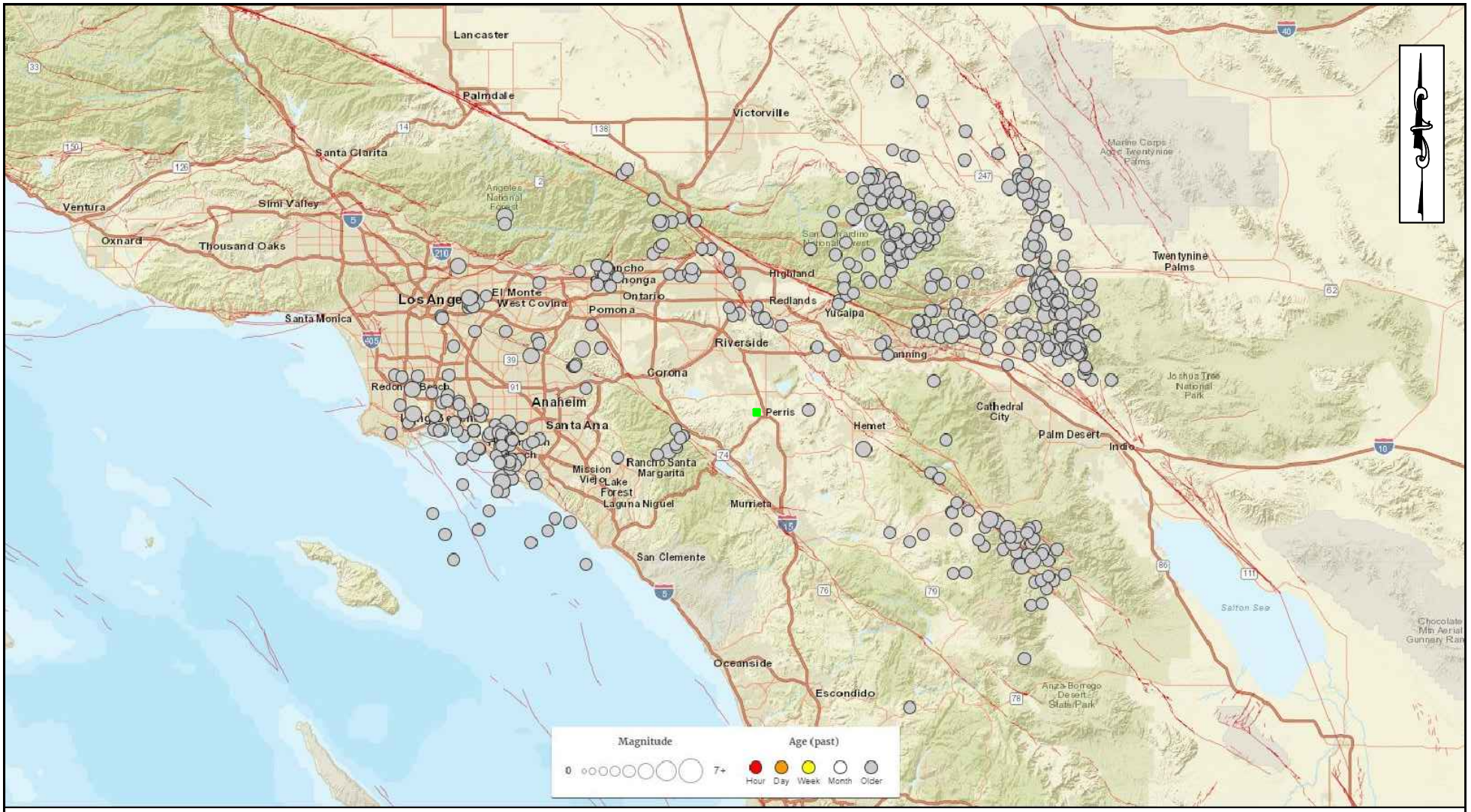
LOR Geotechnical Group, Inc.



REGIONAL GEOLOGIC MAP

(Morton, 2001)

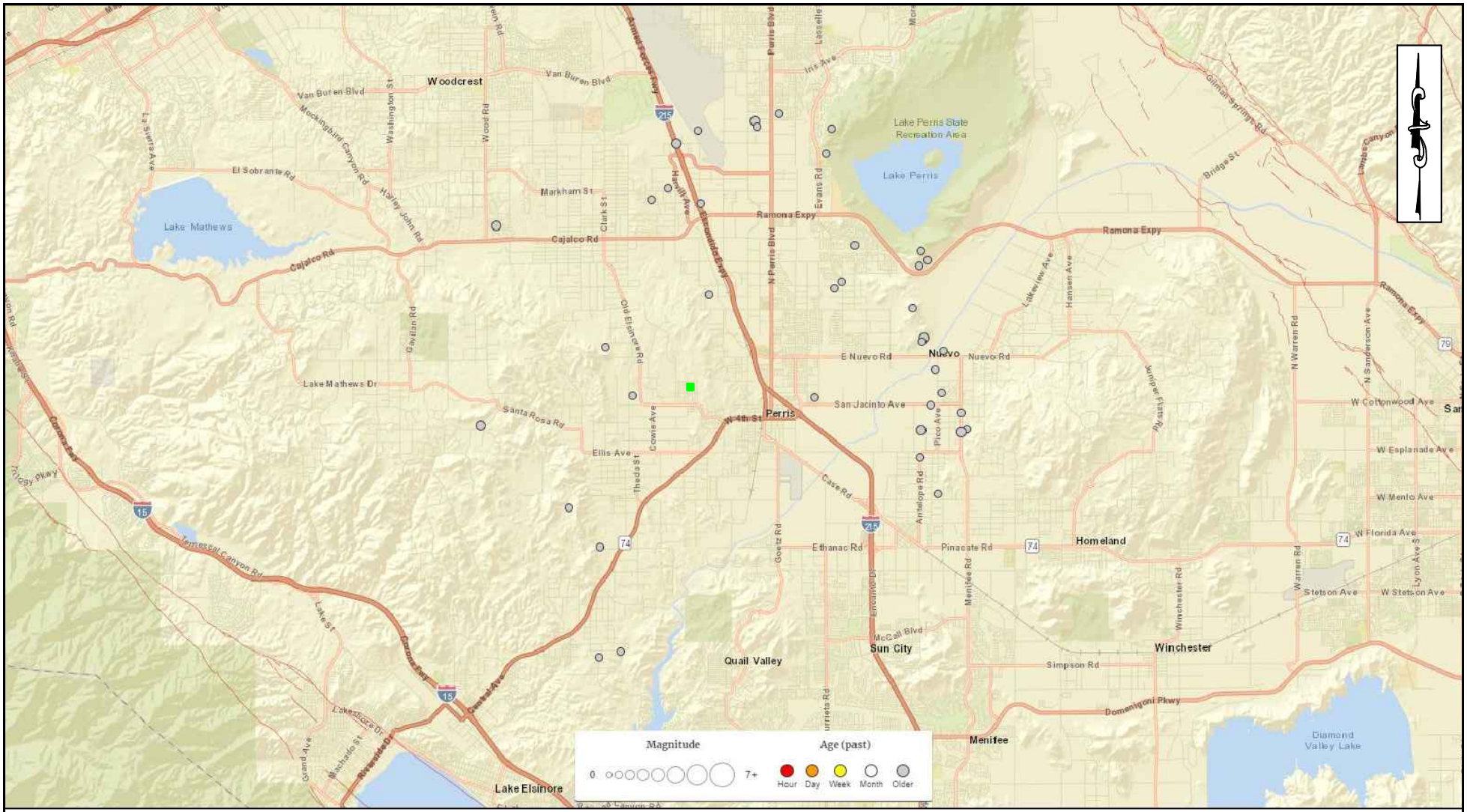
PROJECT:	PROPOSED ENCHANTED HILLS PARK, CITY OF PERRIS, CALIFORNIA	**PROJECT NO:**	63639.1
CLIENT:	COMMUNITY WORKS DESIGN GROUP	**ENCLOSURE:**	A-3
LOR Geotechnical Group, Inc.		**DATE:**	MAY 2020
		SCALE:	1" ≈ 2000'



U.S. Geologic Survey (2020) real-time earthquake epicenter map. Plotted are 510 epicenters of instrument-recored events from 1932 to present (05/10/20) of local magnitude greater than M4.0 within a radius of ~62 miles (100 kilometers) of the site. Location accuracy varies. The site is indicated by the green square. The selected magnitude corresponds to a threshold intensity value where very light damage potential begins. These evens are also generally widely felt by persons. Red lines mark the surface traces of known Quaternary-age faults.

HISTORICAL SEISMICITY MAP - 100km Radius

PROJECT:	PROPOSED ENCHANTED HILLS PARK, CITY OF PERRIS, CALIFORNIA	**PROJECT NO:**	63639.1
CLIENT:	COMMUNITY WORKS DESIGN GROUP	**ENCLOSURE:**	A-4
LOR Geotechnical Group, Inc.		**DATE:**	MAY 2020
		SCALE:	1" ≈ 40km



U.S. Geologic Survey (2020) real-time earthquake epicenter map. Plotted are 39 epicenters of instrument-recored events from 1978 to present (05/10/20) of local magnitude greater than M2.0 within a radius of ~6.2 miles (10 kilometers) of the site. Location accuracy varies. The site is indicated by the green square. Red lines mark the surface traces of known Quaternary-age faults.

HISTORICAL SEISMICITY MAP - 10km Radius

PROJECT:	PROPOSED ENCHANTED HILLS PARK, CITY OF PERRIS, CALIFORNIA	**PROJECT NO:**	63639.1
CLIENT:	COMMUNITY WORKS DESIGN GROUP	**ENCLOSURE:**	A-5
LOR Geotechnical Group, Inc.		**DATE:**	MAY 2020
		SCALE:	1" ≈ 4km

APPENDIX B

Field Investigation Program and Trench Logs

APPENDIX B
FIELD INVESTIGATION

Subsurface Exploration

The site was investigated on May 1, 2020 and consisted of excavating eight exploratory trenches to depths between 6 and 14 feet below the existing ground surface. The approximate locations of the trenches are shown on Enclosure A-2, within Appendix A.

The exploration was conducted using a New Holland LB 75B backhoe with a 24-inch bucket. The soils were continuously logged by an engineering geologist from this firm who visually inspected the site, maintained detailed logs of the trenches, obtained disturbed soil samples for evaluation and testing, and classified the soils by visual examination in accordance with the Unified Soil Classification System.

In-place density determinations were conducted at selected levels within the trenches utilizing the Sand Cone Method, in accordance to the standard ASTM D 1556. Bulk soil samples were obtained at soil changes and other selected levels within the trenches. The samples were placed in sealed containers for transport to our geotechnical laboratory.

All samples obtained were taken to our geotechnical laboratory for storage and testing. Detailed logs of the trenches are presented on the enclosed Trench Logs, Enclosures B-1 through B-8. A Trench Log Legend and Soil Classification Chart are presented on Enclosures B-i and B-ii, respectively.

CONSISTENCY OF SOIL

SANDS

SPT BLOWS	CONSISTENCY
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
Over 50	Very Dense

COHESIVE SOILS

SPT BLOWS	CONSISTENCY
0-2	Very Soft
2-4	Soft
4-8	Medium
8-15	Stiff
15-30	Very Stiff
30-60	Hard
Over 60	Very Hard

SAMPLE KEY

Symbol	Description
	INDICATES CALIFORNIA SPLIT SPOON SOIL SAMPLE INDICATES BULK SAMPLE INDICATES SAND CONE OR NUCLEAR DENSITY TEST INDICATES STANDARD PENETRATION TEST (SPT) SOIL SAMPLE

TYPES OF LABORATORY TESTS

1	Atterberg Limits
2	Consolidation
3	Direct Shear (undisturbed or remolded)
4	Expansion Index
5	Hydrometer
6	Organic Content
7	Proctor (4", 6", or Cal216)
8	R-value
9	Sand Equivalent
10	Sieve Analysis
11	Soluble Sulfate Content
12	Swell
13	Wash 200 Sieve

TRENCH LOG LEGEND

PROJECT: PROPOSED ENCHANTED HILLS PARK, CITY OF PERRIS, CALIFORNIA	**PROJECT NO.: 63639.1**
CLIENT: COMMUNITY WORKS DESIGN GROUP	**ENCLOSURE: B-i**
LOR Geotechnical Group, Inc.	**DATE: MAY 2020**

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS — MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

PARTICLE SIZE LIMITS

BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

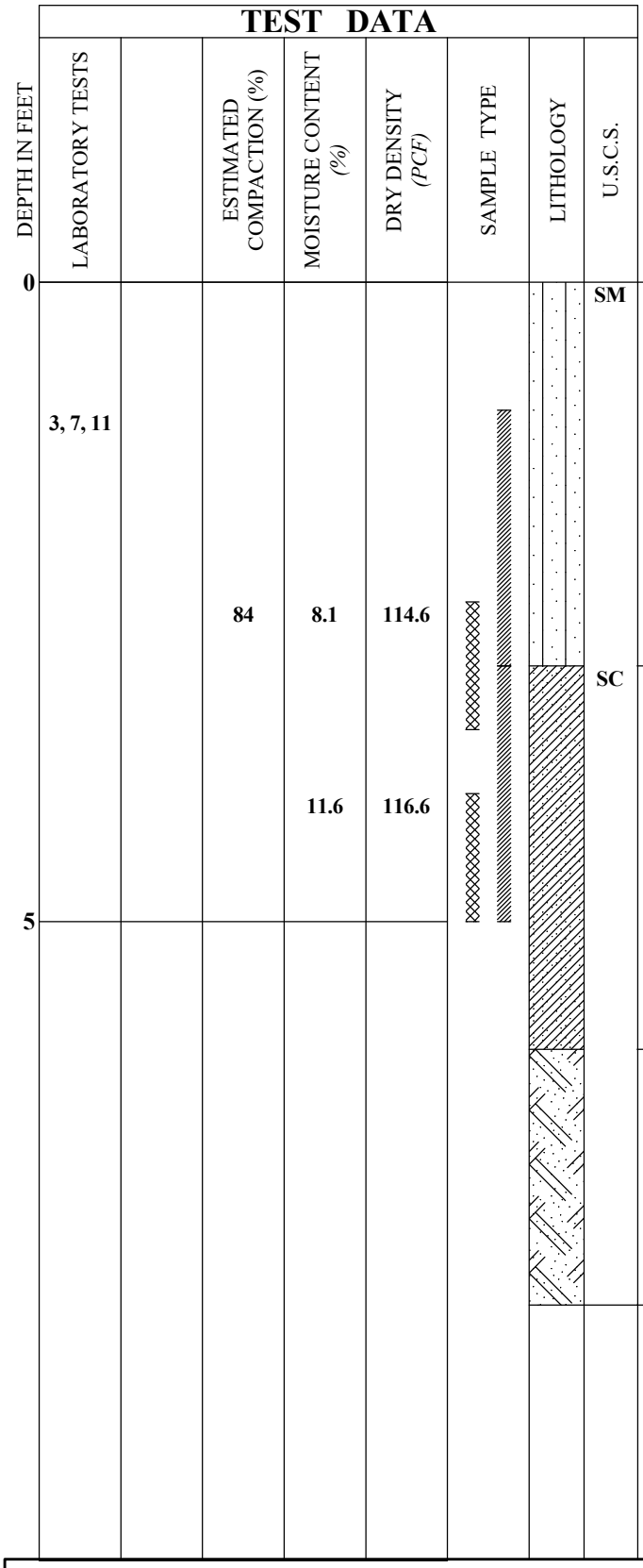
12" 3" 3/4" No. 4 No. 10 No. 40 200

(U.S. STANDARD SIEVE SIZE)

SOIL CLASSIFICATION CHART

PROJECT PROPOSED ENCHANTED HILLS PARK, CITY OF PERRIS, CALIFORNIA	PROJECT NO. 63639.1
CLIENT: COMMUNITY WORKS DESIGN GROUP	ENCLOSURE: B-ii
LOR Geotechnical Group, Inc.	DATE: MAY 2020

LOG OF TRENCH T-1



@ 0 feet, COLLUVIUM: **SILTY SAND, approximately 5% fine gravel, 15% coarse grained sand, 25% medium grained sand, 30% fine grained sand, 25% silty fines, brown, moist, loose to medium dense.**

@ 3± feet, CLAYEY SAND, approximately 10% coarse grained sand, 20% medium grained sand, 40% fine grained sand, 30% clay and silt, yellowish-brown, moist, medium dense to dense.

@ 6 feet, GRANITIC BEDROCK, medium to coarse grained, grayish-brown to yellowish brown, damp, hard to very hard below this depth, upper 6-12" moderately weathered and decomposed.

END TRENCH @ 8' due to practical refusal

No fill
No caving
No groundwater
Bedrock @ 6'

PROJECT:	**Proposed Enchanted Hills Park**	PROJECT NUMBER:	**63639.1**
CLIENT:	**Community Works Design Group**	ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE EXCAVATED:	**May 1, 2020**
		EQUIPMENT:	**New Holland LB-75B**
		BUCKET W.: **24**	ENCLOSURE: **B-1**

LOG OF TRENCH T-2

DEPTH IN FEET	TEST DATA: LABORATORY TESTS		ESTIMATED COMPACTION (%)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
0	8, 9, 10							SM	**@ 0 feet, COLLUVIUM: SILTY SAND, approximately 5% fine gravel, 15% coarse grained sand, 30% medium grained sand, 30% fine grained sand, 20% silty fines, brown, moist, loose to medium dense.**
									@ 3± feet, contains minor clay.
									@ 4± feet, GRANITIC BEDROCK, medium to coarse grained, yellowish-brown to grayish-brown, dry, hard below 1±' thick, moderately weathered zone.
5									**END TRENCH @ 7'** **No fill** **No caving** **No groundwater** **Bedrock @ 4±'**

PROJECT:	**Proposed Enchanted Hills Park**	PROJECT NUMBER:	**63639.1**
CLIENT:	**Community Works Design Group**	ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE EXCAVATED:	**May 1, 2020**
		EQUIPMENT:	**New Holland LB-75B**
		BUCKET W.: **24**	ENCLOSURE: **B-2**

LOG OF TRENCH T-3

DEPTH IN FEET	TEST DATA: LABORATORY TESTS		ESTIMATED COMPACTION (%)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
0								SM	**@ 0 feet,** COLLUVIUM: **SILTY SAND, approximately 5% fine gravel, 15% coarse grained sand, 25% medium grained sand, 40% fine grained sand, 15% silty fines, brown, damp, loose.**
									@ 1 to 1.5 feet, GRANITIC BEDROCK, medium to coarse grained, yellowish-brown to grayish-brown, dry, gradually becomes harder with increase in depth, moderately weathered in upper 1-2'.
5									**END TRENCH @ 6.5' due to practical refusal** **No fill** **No caving** **No groundwater** **Bedrock @ 1 to 1.5'**

PROJECT:	**Proposed Enchanted Hills Park**	PROJECT NUMBER:	**63639.1**
CLIENT:	**Community Works Design Group**	ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE EXCAVATED:	**May 1, 2020**
		EQUIPMENT:	**New Holland LB-75B**
		BUCKET W.: **24**	ENCLOSURE: **B-3**

LOG OF TRENCH T-4

DEPTH IN FEET	LABORATORY TESTS		ESTIMATED COMPACTION (%)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
0				10.7	108.8			SM	@ 0 feet, COLLUVIUM: SILTY SAND, approximately 5% fine gravel, 20% coarse grained sand, 25% medium grained sand, 25% fine grained sand, 25% silty fines, brown, damp, loose to medium dense.
									@ 2 feet, becomes dense to very dense; non-porous.
5									@ 7 feet, dark brown, more micaceous, very dense.
10									@ 9.5 feet, GRANITIC BEDROCK, medium to coarse grained, grayish-brown, damp, moderately weathered and decomposed.
									END TRENCH @ 12'

No fill
No caving
No groundwater
Bedrock @ 9.5'

PROJECT:	**Proposed Enchanted Hills Park**	PROJECT NUMBER:	**63639.1**
CLIENT:	**Community Works Design Group**	ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE EXCAVATED:	**May 1, 2020**
		EQUIPMENT:	**New Holland LB-75B**
		BUCKET W.: **24**	ENCLOSURE: **B-4**

LOG OF TRENCH T-5

DEPTH IN FEET	TEST DATA: LABORATORY TESTS		ESTIMATED COMPACTION (%)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
0	3, 7, 11		84	9.3	108.4			SM	@ 0 feet, ALLUVIUM: SILTY SAND, approximately 10% fine gravel, 20% coarse grained sand, 30% medium grained sand, 20% fine grained sand, 20% silty fines, brown, damp, loose to medium dense, gradually becomes sandier with increase in depth.
5			87	6.7	112.7				@ 6 feet, medium dense.
									@ 7.5 feet, GRANITIC BEDROCK, medium to coarse grained, grayish-brown, gradually becomes harder with increase in depth, moderately weathered.
10									END TRENCH @ 11' No fill No caving No groundwater Bedrock @ 7.5'

PROJECT:	**Proposed Enchanted Hills Park**	PROJECT NUMBER:	**63639.1**
CLIENT:	**Community Works Design Group**	ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE EXCAVATED:	**May 1, 2020**
		EQUIPMENT:	**New Holland LB-75B**
		BUCKET W.: **24**	ENCLOSURE: **B-5**

LOG OF TRENCH T-6

DEPTH IN FEET	TEST DATA: LABORATORY TESTS		ESTIMATED COMPACTION (%)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
0								SM	**@ 0 feet,** COLLUVIUM: **SILTY SAND, approximately 5% fine gravel, 15% coarse grained sand, 30% medium grained sand, 25% fine grained sand, and 25% silty fines, brown, damp, loose to medium dense.**
									@ 2.5 feet, GRANITIC BEDROCK, medium to coarse grained, yellowish-brown to grayish-brown, dry to damp, hard below, upper 0.5-1' moderately weathered.
5									**END TRENCH @ 6'** **No fill** **No caving** **No groundwater** **Bedrock @ 2.5'**

PROJECT:	**Proposed Enchanted Hills Park**	PROJECT NUMBER:	**63639.1**
CLIENT:	**Community Works Design Group**	ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE EXCAVATED:	**May 1, 2020**
		EQUIPMENT:	**New Holland LB-75B**
		BUCKET W.: **24**	ENCLOSURE: **B-6**

LOG OF TRENCH T-7

DEPTH IN FEET	LABORATORY TESTS		ESTIMATED COMPACTION (%)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
0			86	7.5	111.0			SM	**@ 0 feet,** ALLUVIUM: **SILTY SAND, approximately 5% fine gravel, 15% coarse grained sand, 20% medium grained sand, 30% fine grained sand, 30% silty fines, brown, moist, loose to medium dense.**
									@ 3± feet, sandier; subject to caving.
5									**@ 6± feet, becomes medium dense to dense; includes trace to minor amounts of clay, non-porous.**
10									**@ 10 feet, silty/micaceous, increase in moisture content.**
									@ 12.5 feet, GRANITIC BEDROCK, medium to coarse grained, yellowish-brown to grayish brown, moist, hard below, upper 2±' moderately weathered and decomposed.
15									**END TRENCH @ 14'** **No fill** **Moderate caving (below 3±')** **No groundwater** **Bedrock @ 12.5'**

PROJECT:	**Proposed Enchanted Hills Park**	PROJECT NUMBER:	**63639.1**
CLIENT:	**Community Works Design Group**	ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE EXCAVATED:	**May 1, 2020**
		EQUIPMENT:	**New Holland LB-75B**
		BUCKET W.: **24**	ENCLOSURE: **B-7**

LOG OF TRENCH T-8

DEPTH IN FEET	TEST DATA: LABORATORY TESTS		ESTIMATED COMPACTION (%)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
0	10, 11							SM	**@ 0 feet,** COLLUVIUM: **SILTY SAND, approximately 5% fine gravel, 15% coarse grained sand, 25% medium grained sand, 35% fine grained sand, brown, damp, loose to medium dense.**
									@ 2.5 feet, GRANITIC BEDROCK, medium to coarse grained, dry to damp, grayish-brown to yellowish-brown, hard below, moderately weathered in upper 1-2'.
5									**END TRENCH @ 6'** **No fill** **No caving** **No groundwater** **Bedrock @ 2.5'**

PROJECT:	**Proposed Enchanted Hills Park**	PROJECT NUMBER:	**63639.1**
CLIENT:	**Community Works Design Group**	ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE EXCAVATED:	**May 1, 2020**
		EQUIPMENT:	**New Holland LB-75B**
		BUCKET W.: **24**	ENCLOSURE: **B-8**

APPENDIX C

Laboratory Testing Program and Test Results

APPENDIX C
LABORATORY TESTING

General

Selected soil samples obtained from the trenches were tested in our geotechnical laboratory to evaluate their physical and engineering properties. The laboratory testing program performed in conjunction with our investigation included moisture content, dry density, laboratory compaction characteristics, direct shear, sieve analysis, sand equivalent, R-value, and soluble sulfate content. Descriptions of the laboratory tests are presented in the following paragraphs:

Moisture-Density Tests

The moisture content and dry density information provides an indirect measure of soil consistency for each stratum, and can also provide a correlation between soils on this site. The dry unit weight and field moisture content were determined in accordance with ASTM D 1556 and 2216, respectively, for selected undisturbed samples, and the results are shown on the soil investigation trench logs, Enclosures B-1 through B-8, within Appendix B, for convenient correlation with the soil profile.

Laboratory Compaction

Selected soil samples were tested in the laboratory to determine compaction characteristics using the ASTM D 1557 compaction test method. The results are presented in the following table:

LABORATORY COMPACTION				
Trench Number	**Sample Depth (ft)**	**Material Description (U.S.C.S.)**	**Maximum Dry Density (psf)**	**Optimum Moisture Content (percent)**
T-1	1-3	(SM) Silty Sand	136.5	7.0
T-5	2-5	(SM) Silty Sand	129.0	10.0

Direct Shear Tests

Shear tests are performed in general accordance with ASTM 3080 with a direct shear machine at a constant rate-of-strain (usually 0.04 inches/minute). The machine is designed to test a sample partially extruded from a sample ring in single shear.

Samples are tested at varying normal loads in order to evaluate the shear strength parameters, angle of internal friction and cohesion. Samples are tested in remolded condition (90 percent relative compaction per ASTM 1557) and soaked to represent the worse case scenario expected in the field.

The results of the shear tests are presented in the following table:

DIRECT SHEAR TESTS				
Trench Number	**Sample Depth (feet)**	**Material Description (U.S.C.S.)**	**Apparent Cohesion (psf)**	**Angle of Internal Friction (degrees)**
T-1	1-3	(SM) Silty Sand	100	29
T-5	2-5	(SM) Silty Sand	540	27

Sieve Analysis

A quantitative determination of the grain size distribution was performed for selected samples in accordance with the ASTM D 422 laboratory test procedure. The determination is performed by passing the soil through a series of sieves, and recording the weights of retained particles on each screen. The results of the sieve analyses are presented graphically on Enclosure C-1.

Sand Equivalent

The sand equivalent of selected soils were evaluated using the California Sand Equivalent Test Method, Caltrans Number 217. The results of the sand equivalent tests are presented with the grain size distribution analyses on Enclosure C-1.

R-Value Test

Soil samples were obtained at probable pavement subgrade levels and was tested to determine its R-value using the California R-Value Test Method, Caltrans Number 301. The results of the R-value test is presented on Enclosure C-1.

Soluble Sulfate Content Tests

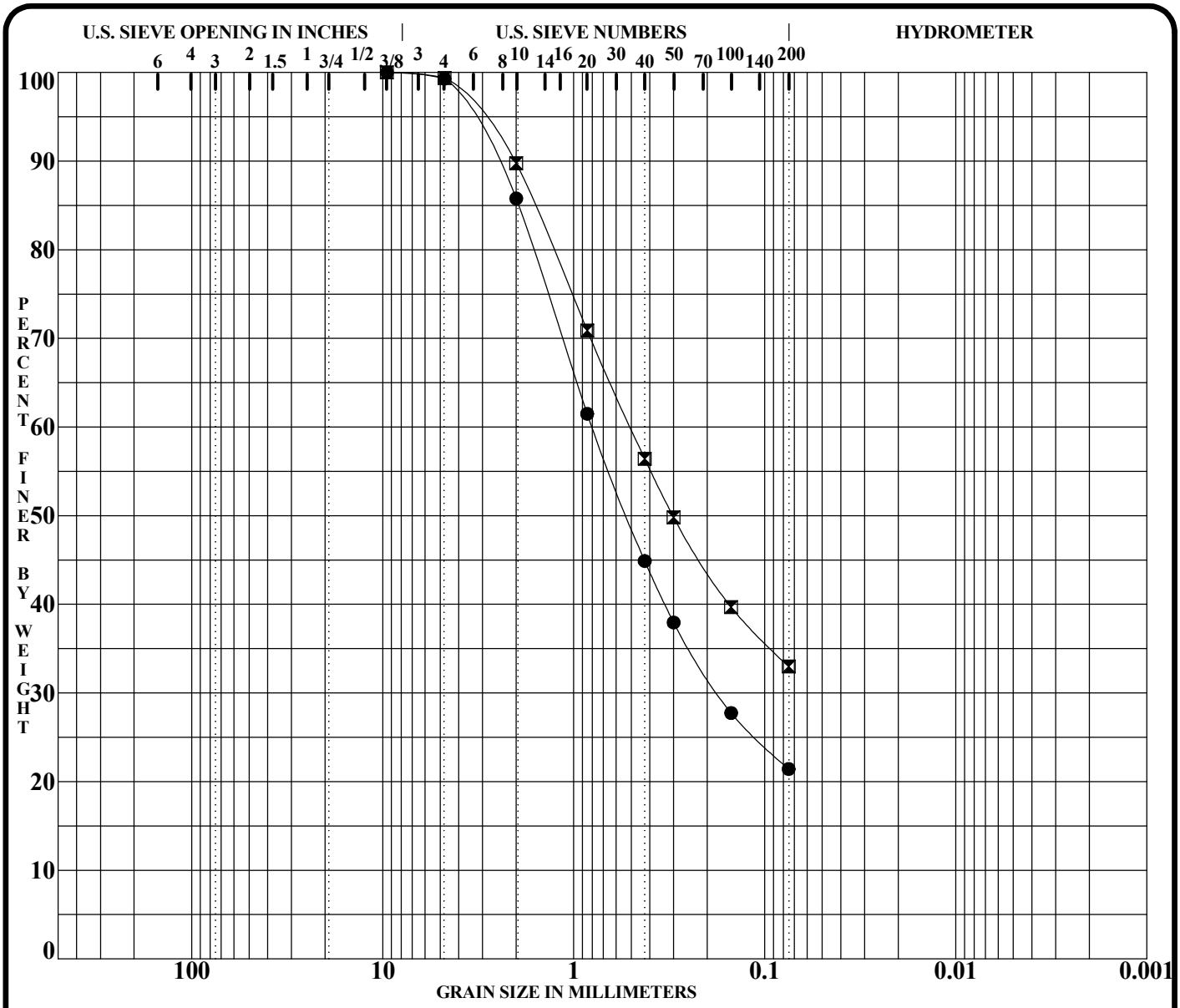
The soluble sulfate content of selected subgrade soils was evaluated at our office. The concentration of soluble sulfates in the soils was determined by measuring the optical density of a barium sulfate precipitate.

The precipitate results from a reaction of barium chloride with water extractions from the soil samples. The measured optical density is correlated with readings on precipitates of known sulfate concentrations.

The test results are presented on the following table:

SOLUBLE SULFATE CONTENT TESTS

Trench Number	Sample Depth (feet)	Material Description (U.S.C.S.)	Sulfate Content (% by weight)
T-1	1-3	(SM) Silty Sand	<0.005
T-5	2-5	(SM) Silty Sand	<0.005



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Soil Classification	SE	RV	PL	PI	Cc	Cu
● T-2 @ 0.5-2.5 ft	(SM) Silty Sand	18	27				
⊠ T-8 @ 0.5-2.5 ft	(SM) Silty Sand	24	--				

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● T-2 @ 0.5-2.5 ft	9.50	0.80	0.175		0.7	77.9	21.4	
⊠ T-8 @ 0.5-2.5 ft	9.50	0.50			0.6	66.4	33.0	

PROJECT *Proposed Encanted Hills Park* **PROJECT NO.** *63639.1*

DATE *5/13/20*

GRADATION CURVES

LOR Geotechnical Group, Inc.
Riverside, CA 92507

ENCLOSURE C-1

APPENDIX D

Infiltration Test Results

FALLING HEAD PERCOLATION TEST RESULTS

Project:	Proposed Enchanted Hills Park	Test Date:	May 1, 2020
Project No.:	63639.1	Test Hole No.:	FH-1
Soil Classificaiton:	(SP/SM) Poorly Graded Sand with Silt	Test Hole Diameter (in):	6
Depth of Test Hole (ft):	1.25	Date Excavated:	May 1, 2020
Tested By:	A.L.		

READING	TIME START	TIME STOP	TIME INTERVAL		TOTAL TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	INITIAL HOLE DEPTH	FINAL HOLE DEPTH	CHANGE IN WATER LEVEL	AVERAGE WETTED DEPTH	Q
			min	hr.	hr.	ft.	ft.	ft.	ft.	ft.	ft.	gal/sq.ft./day
1	9:34 AM	9:44 AM	10	0.17	0.17	0.25	0.78	1.25	1.25	0.53	0.74	97.3
2	9:44 AM	9:54 AM	10	0.17	0.33	0.25	0.65	1.25	1.25	0.40	0.80	67.5
3	9:54 AM	10:04 AM	10	0.17	0.50	0.25	0.56	1.25	1.25	0.31	0.85	49.5
4	10:04 AM	10:14 AM	10	0.17	0.67	0.25	0.52	1.25	1.25	0.27	0.87	42.1
5	10:14 AM	10:44 AM	30	0.50	1.17	0.25	0.83	1.25	1.25	0.58	0.71	36.8
6	10:44 AM	11:14 AM	30	0.50	1.67	0.25	0.83	1.25	1.25	0.58	0.71	36.8
7	11:14 AM	11:44 AM	30	0.50	2.17	0.25	0.92	1.25	1.25	0.67	0.67	45.3
8	11:44 AM	12:34 PM	50	0.83	3.00	0.25	0.96	1.25	1.25	0.71	0.65	29.7
9	12:14 PM	12:44 PM	30	0.50	3.50	0.25	0.96	1.25	1.25	0.71	0.65	49.5
10	12:44 PM	1:14 PM	30	0.50	4.00	0.25	0.96	1.25	1.25	0.71	0.65	49.5
11	1:14 PM	1:44 PM	30	0.50	4.50	0.25	0.96	1.25	1.25	0.71	0.65	49.5

Boring Depth:	1.25	ft
Initial Depth of Test Hole:	1.25	ft
Final Depth of Test Hole:	1.25	ft
Clear Water Application Rate (Q):	49.5	gal/sq. ft./day

PERCOLATION RATE CONVERSION (Porchet Method):

H_O	12.00
H_f	3.48
delta H	8.52
H_{avg}	7.74
I_t	**2.77** in/hr

FALLING HEAD PERCOLATION TEST RESULTS

Project:	Proposed Enchanted Hills Park	Test Date:	May 1, 2020
Project No.:	63639.1	Test Hole No.:	FH-2
Soil Classificaiton:	Decomposed Granite	Test Hole Diameter (in):	6
Depth of Test Hole (ft):	1.25	Date Excavated:	May 1, 2020
Tested By:	A.L.		

READING	TIME START	TIME STOP	TIME INTERVAL		TOTAL TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	INITIAL HOLE DEPTH	FINAL HOLE DEPTH	CHANGE IN WATER LEVEL	AVERAGE WETTED DEPTH	Q
			min	hr.	hr.	ft.	ft.	ft.	ft.	ft.	ft.	gal/sq.ft./day
1	10:10 AM	10:40 AM	30	0.50	0.50	0.25	0.67	1.25	1.25	0.42	0.79	23.9
2	10:40 AM	11:10 AM	30	0.50	1.00	0.42	0.69	1.25	1.25	0.27	0.70	17.5
3	11:10 AM	11:40 AM	30	0.50	1.50	0.69	0.88	1.25	1.25	0.19	0.47	18.4
4	11:40 AM	12:10 PM	30	0.50	2.00	0.75	0.92	1.25	1.25	0.17	0.42	18.4
5	12:10 PM	12:40 PM	30	0.50	2.50	0.75	0.90	1.25	1.25	0.15	0.43	15.9
6	12:40 PM	1:10 PM	30	0.50	3.00	0.75	0.88	1.25	1.25	0.13	0.44	13.4
7	1:10 PM	1:40 PM	30	0.50	3.50	0.75	0.88	1.25	1.25	0.13	0.44	13.4
8	1:40 PM	2:10 PM	30	0.50	4.00	0.75	0.88	1.25	1.25	0.13	0.44	13.4

Boring Depth:	1.25	ft
Initial Depth of Test Hole:	1.25	ft
Final Depth of Test Hole:	1.25	ft
Clear Water Application Rate (Q):	13.4	gal/sq. ft./day

PERCOLATION RATE CONVERSION (Porchet Method):

H_O	6.00
H_f	4.44
delta H	1.56
H_{avg}	5.22
I_t	**0.70** in/hr

FALLING HEAD PERCOLATION TEST RESULTS

Project:	Proposed Enchanted Hills Park	Test Date:	May 1, 2020
Project No.:	63639.1	Test Hole No.:	FH-3
Soil Classificaiton:	(SM/SC) Silty Sand to Clayey Sand	Test Hole Diameter (in):	6
Depth of Test Hole (ft):	1.17	Date Excavated:	May 1, 2020
Tested By:	A.L.		

READING	TIME START	TIME STOP	TIME INTERVAL		TOTAL TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	INITIAL HOLE DEPTH	FINAL HOLE DEPTH	CHANGE IN WATER LEVEL	AVERAGE WETTED DEPTH	Q
			min	hr.	hr.	ft.	ft.	ft.	ft.	ft.	ft.	gal/sq.ft./day
1	10:25 AM	10:50 AM	25	0.42	0.42	0.17	0.19	1.17	1.17	0.02	0.99	1.1
2	10:50 AM	11:20 AM	30	0.50	0.92	0.19	0.21	1.17	1.17	0.02	0.97	0.9
3	11:20 AM	11:50 AM	30	0.50	1.42	0.21	0.23	1.17	1.17	0.02	0.95	0.9
4	11:50 AM	12:20 PM	30	0.50	1.92	0.23	0.25	1.17	1.17	0.02	0.93	1.0
5	12:20 PM	12:50 PM	30	0.50	2.42	0.25	0.27	1.17	1.17	0.02	0.91	1.0
6	12:50 PM	1:20 PM	30	0.50	2.92	0.27	0.29	1.17	1.17	0.02	0.89	1.0
7	1:20 PM	1:50 PM	30	0.50	3.42	0.29	0.31	1.17	1.17	0.02	0.87	1.0
8	1:50 PM	2:20 PM	30	0.50	3.92	0.31	0.33	1.17	1.17	0.02	0.85	1.1

Boring Depth:	1.17	ft
Initial Depth of Test Hole:	1.17	ft
Final Depth of Test Hole:	1.17	ft
Clear Water Application Rate (Q):	1.1	gal/sq. ft./day

PERCOLATION RATE CONVERSION (Porchet Method):

H_O	10.32
H_f	10.08
delta H	0.24
H_{avg}	10.20
I_t	**0.06** in/hr

FALLING HEAD PERCOLATION TEST RESULTS

Project:	Proposed Enchanted Hills Park	Test Date:	May 1, 2020
Project No.:	63639.1	Test Hole No.:	FH-4
Soil Classificaiton:	Decomposed Granite	Test Hole Diameter (in):	6
Depth of Test Hole (ft):	1.00	Date Excavated:	May 1, 2020
Tested By:	A.L.		

READING	TIME START	TIME STOP	TIME INTERVAL		TOTAL TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	INITIAL HOLE DEPTH	FINAL HOLE DEPTH	CHANGE IN WATER LEVEL	AVERAGE WETTED DEPTH	Q
			min	hr.	hr.	ft.	ft.	ft.	ft.	ft.	ft.	gal/sq.ft./day
1	10:27 AM	10:52 AM	25	0.42	0.42	0.25	0.67	1.00	1.00	0.42	0.54	42.0
2	10:52 AM	11:22 AM	30	0.50	0.92	0.25	0.67	1.00	1.00	0.42	0.54	35.0
3	11:22 AM	11:52 AM	30	0.50	1.42	0.33	0.67	1.00	1.00	0.34	0.50	30.6
4	11:52 AM	12:22 PM	30	0.50	1.92	0.33	0.67	1.00	1.00	0.34	0.50	30.6
5	12:22 PM	12:52 PM	30	0.50	2.42	0.33	0.67	1.00	1.00	0.34	0.50	30.6
6	12:52 PM	1:22 PM	30	0.50	2.92	0.33	0.67	1.00	1.00	0.34	0.50	30.6
7	1:22 PM	1:52 PM	30	0.50	3.42	0.33	0.67	1.00	1.00	0.34	0.50	30.6
8	1:52 PM	2:22 PM	30	0.50	3.92	0.33	0.67	1.00	1.00	0.34	0.50	30.6

Boring Depth:	1.00	ft
Initial Depth of Test Hole:	1.00	ft
Final Depth of Test Hole:	1.00	ft
Clear Water Application Rate (Q):	30.6	gal/sq. ft./day

PERCOLATION RATE CONVERSION (Porchet Method):

H_O	8.04
H_f	3.96
delta H	4.08
H_{avg}	6.00
I_t	**1.63** in/hr

Appendix 4: Historical Site Conditions

Phase I Environmental Site Assessment or Other Information on Past Site Use

"Not Applicable"

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

“Not Applicable”

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: ADKAN ENGINEERS — Date: 8/13/2020

Designed by: Casanova Matulionis — Case No:

Company Project Number/Name: Enchanted Hills Park

BMP Identification

BMP NAME / ID: Bio-Retention 1

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth,
from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.60 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
1-A	*99,752.00*	*Concrete or Asphalt*	*1*	*0.89*	*88978.8*			
1-B	*117,706.00*	*Ornamental Landscaping*	*0.1*	*0.11*	*13001.6*			
1-C	*146,430.00*	*Natural (D Soil)*	*0.4*	*0.28*	*40958.2*			
1-D	*6,697.00*	*Decomposed Granite*	*0.4*	*0.28*	*1873.2*			
1-E	*15,250.00*	*Gravel or Class 2 Permeable Base*	*0.1*	*0.11*	*1684.5*			
	385835	***Total***			**146496.3**	**0.60**	***7324.8***	***20,435***

Notes:

Bioretention Facility - Design Procedure	BMP ID: Bio-1	Legend:	Required Entries / Calculated Cells

Company Name: Adkan Engineers | Date: 8/13/2020

Designed by: Casanova Matulionis | County/City Case No.:

Design Volume

Enter the area tributary to this feature — A_T = 8.86 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook — V_{BMP} = 7,325 ft^3

Type of Bioretention Facility Design

(●) Side slopes required (parallel to parking spaces or adjacent to walkways)

( ) No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer — d_S = 1.5 ft

Top Width of Bioretention Facility, excluding curb — w_T = 111.0 ft

Total Effective Depth, d_E

$d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$ — d_E = 1.34 ft

Minimum Surface Area, A_m

$$A_M\,(ft^2) = \frac{V_{BMP}\,(ft^3)}{d_E\,(ft)}$$

A_M = 5,452 ft^2

Proposed Surface Area — A= 15,250 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility — z = 4 :1

Diameter of Underdrain — 6 inches

Longitudinal Slope of Site (3% maximum) — 1 %

6" Check Dam Spacing — 25 feet

Describe Vegetation:

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries | Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: ADKAN ENGINEERS — Date: 8/13/2020

Designed by: Casanova Matulionis — Case No:

Company Project Number/Name: Enchanted Hills Park

BMP Identification

BMP NAME / ID: Bio-Retention 2

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E — D_{85}= 0.60 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
2-A	86,743.00	Concrete or Asphalt	1	0.89	77374.8			
2-B	15,266.00	Ornamental Landscaping	0.1	0.11	1686.3			
2-C	177,018.00	Natural (D Soil)	0.4	0.28	49514.1			
2-D	0.00	Decomposed Granite	0.4	0.28	0			
2-E	6,594.00	Gravel or Class 2 Permeable Base	0.1	0.11	728.4			
	285621	Total			129303.6	0.60	6465.2	8,902

Notes:

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries	
	Bio-2		Calculated Cells	

Company Name:	Adkan Engineers	Date:	8/13/2020
Designed by:	Casanova Matulionis	County/City Case No.:	

Design Volume

Enter the area tributary to this feature	A_T=	6.56	acres
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	6,465	ft^3

Type of Bioretention Facility Design

(●) Side slopes required (parallel to parking spaces or adjacent to walkways)

( ) No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	1.5	ft
Top Width of Bioretention Facility, excluding curb	w_T =	163.0	ft
Total Effective Depth, d_E $d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$	d_E =	1.35	ft
Minimum Surface Area, A_m $A_M\,(ft^2) = \frac{V_{BMP}\,(ft^3)}{d_E\,(ft)}$	A_M =	4,805	ft^2
Proposed Surface Area	A=	6,594	ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain		6	inches
Longitudinal Slope of Site (3% maximum)		1	%
6" Check Dam Spacing		25	feet
Describe Vegetation:			

Notes:

3.5 Bioretention Facility

Type of BMP	LID – Bioretention
Treatment Mechanisms	Infiltration, Evapotranspiration, Evaporation, Biofiltration
Maximum Drainage Area	This BMP is intended to be integrated into a project's landscaped area in a distributed manner. Typically, contributing drainage areas to Bioretention Facilities range from less than 1 acre to a maximum of around 10 acres.
Other Names	Rain Garden, Bioretention Cell, Bioretention Basin, Biofiltration Basin, Landscaped Filter Basin, Porous Landscape Detention

Description

Bioretention Facilities are shallow, vegetated basins underlain by an engineered soil media. Healthy plant and biological activity in the root zone maintain and renew the macro-pore space in the soil and maximize plant uptake of pollutants and runoff. This keeps the Best Management Practice (BMP) from becoming clogged and allows more of the soil column to function as both a sponge (retaining water) and a highly effective and self-maintaining biofilter. In most cases, the bottom of a Bioretention Facility is unlined, which also provides an opportunity for infiltration to the extent the underlying onsite soil can accommodate. When the infiltration rate of the underlying soil is exceeded, fully biotreated flows are discharged via underdrains. Bioretention Facilities therefore will inherently achieve the maximum feasible level of infiltration and evapotranspiration and achieve the minimum feasible (but highly biotreated) discharge to the storm drain system.

Siting Considerations

These facilities work best when they are designed in a relatively level area. Unlike other BMPs, Bioretention Facilities can be used in smaller landscaped spaces on the site, such as:

- ✓ Parking islands
- ✓ Medians
- ✓ Site entrances

Landscaped areas on the site (such as may otherwise be required through minimum landscaping ordinances), can often be designed as Bioretention Facilities. This can be accomplished by:

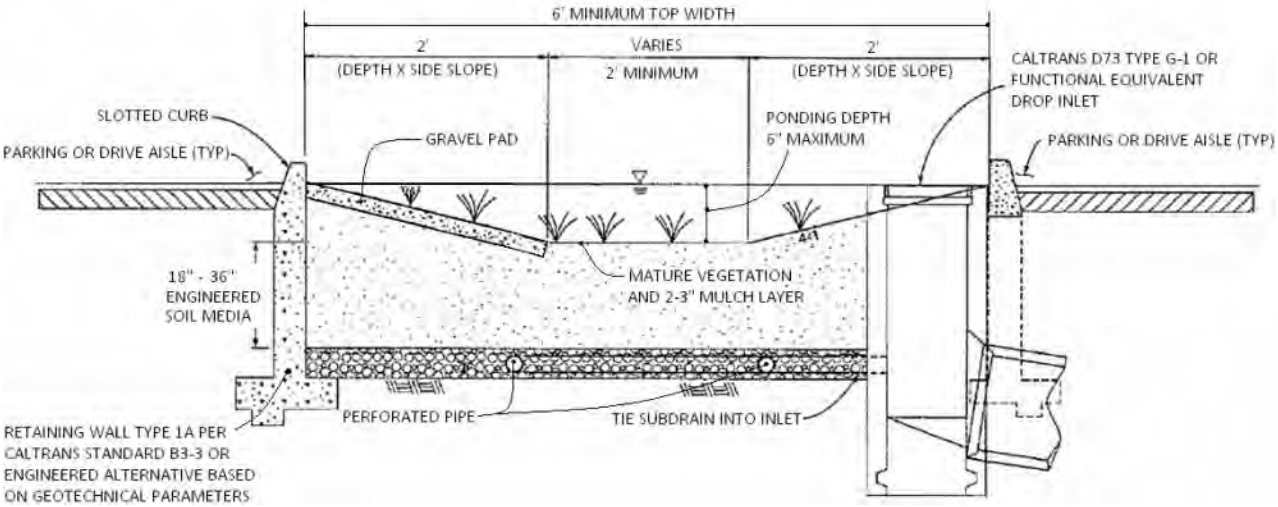
- *Depressing* landscaped areas below adjacent impervious surfaces, rather than elevating those areas
- Grading the site to direct runoff from those impervious surfaces *into* the Bioretention Facility, rather than away from the landscaping
- Sizing and designing the depressed landscaped area as a Bioretention Facility as described in this Fact Sheet

Bioretention Facilities should however not be used downstream of areas where large amounts of sediment can clog the system. Placing a Bioretention Facility at the toe of a steep slope should also be avoided due to the potential for clogging the engineered soil media with erosion from the slope, as well as the potential for damaging the vegetation.

Design and Sizing Criteria

The recommended cross section necessary for a Bioretention Facility includes:

- Vegetated area
- 18' minimum depth of engineered soil media
- 12' minimum gravel layer depth with 6' perforated pipes (added flow control features such as orifice plates may be required to mitigate for HCOC conditions)



While the 18-inch minimum engineered soil media depth can be used in some cases, it is recommended to use 24 inches or a preferred 36 inches to provide an adequate root zone for the chosen plant palate. Such a design also provides for improved removal effectiveness for nutrients. The recommended ponding depth inside of a Bioretention Facility is 6 inches; measured from the flat bottom surface to the top of the water surface as shown in Figure 1.

Because this BMP is filled with an engineered soil media, pore space in the soil and gravel layer is assumed to provide storage volume. However, several considerations must be noted:

- Surcharge storage above the soil surface (6 inches) is important to assure that design flows do not bypass the BMP when runoff exceeds the soil's absorption rate.
- In cases where the Bioretention Facility contains engineered soil media deeper than 36 inches, the pore space within the engineered soil media can only be counted to the 36-inch depth.
- A maximum of 30 percent pore space can be used for the soil media whereas a maximum of 40 percent pore space can be use for the gravel layer.

Figure 1: Standard Layout for a Bioretention Facility

Engineered Soil Media Requirements

The engineered soil media shall be comprised of 85 percent mineral component and 15 percent organic component, by volume, drum mixed prior to placement. The mineral component shall be a Class A sandy loam topsoil that meets the range specified in Table 1 below. The organic component shall be nitrogen stabilized compost[1], such that nitrogen does not leach from the media.

Table 1: Mineral Component Range Requirements

Percent Range	Component
70-80	Sand
15-20	Silt
5-10	Clay

The trip ticket, or certificate of compliance, shall be made available to the inspector to prove the engineered mix meets this specification.

Vegetation Requirements

Vegetative cover is important to minimize erosion and ensure that treatment occurs in the Bioretention Facility. The area should be designed for at least 70 percent mature coverage throughout the Bioretention Facility. To prevent the BMP from being used as walkways, Bioretention Facilities shall be planted with a combination of small trees, densely planted shrubs, and natural grasses. Grasses shall be native or ornamental; preferably ones that do not need to be mowed. The application of fertilizers and pesticides should be minimal. To maintain oxygen levels for the vegetation and promote biodegradation, it is important that vegetation not be completely submerged for any extended period of time. Therefore, a maximum of 6 inches of ponded water shall be used in the design to ensure that plants within the Bioretention Facility remain healthy.

A 2 to 3-inch layer of standard shredded aged hardwood mulch shall be placed as the top layer inside the Bioretention Facility. The 6-inch ponding depth shown in Figure 1 above shall be measured from the top surface of the 2 to 3-inch mulch layer.

Curb Cuts

To allow water to flow into the Bioretention Facility, 1-foot-wide (minimum) curb cuts should be placed approximately every 10 feet around the perimeter of the Bioretention Facility. Figure 2 shows a curb cut in a Bioretention Facility. Curb cut flow lines must be at or above the V_{BMP} water surface level.

[1] For more information on compost, visit the US Composting Council website at: http://compostingcouncil.org/

Figure 2: Curb Cut located in a Bioretention Facility

To reduce erosion, a gravel pad shall be placed at each inlet point to the Bioretention Facility. The gravel should be 1- to 1.5-inch diameter in size. The gravel should overlap the curb cut opening a minimum of 6 inches. The gravel pad inside the Bioretention Facility should be flush with the finished surface at the curb cut and extend to the bottom of the slope.

In addition, place an apron of stone or concrete, a foot square or larger, inside each inlet to prevent vegetation from growing up and blocking the inlet. See Figure 3.

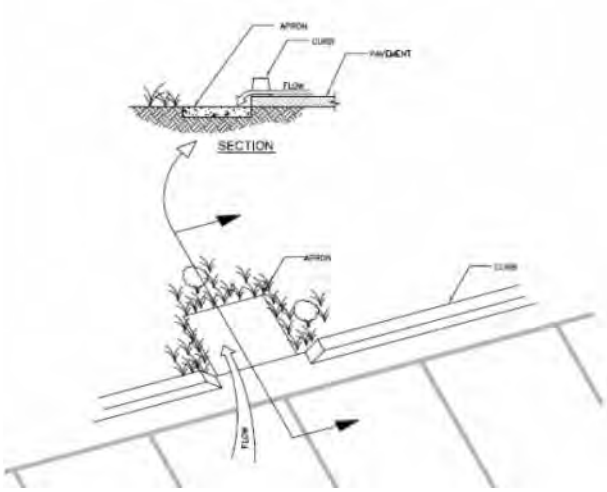


Figure 3: Apron located in a Bioretention Facility

Terracing the Landscaped Filter Basin

It is recommended that Bioretention Facilities be level. In the event the facility site slopes and lacks proper design, water would fill the lowest point of the BMP and then discharge from the basin without being treated. To ensure that the water will be held within the Bioretention Facility on sloped sites, the BMP must be terraced with nonporous check dams to provide the required storage and treatment capacity.

The terraced version of this BMP shall be used on non-flat sites with no more than a 3 percent slope. The surcharge depth cannot exceed 0.5 feet, and side slopes shall not exceed 4:1. Table 2 below shows the spacing of the check dams, and slopes shall be rounded up (i.e., 2.5 percent slope shall use 10' spacing for check dams).

Table 2: Check Dam Spacing

6" Check Dam Spacing	
Slope	**Spacing**
1%	*25'*
2%	*15'*
3%	*10'*

Roof Runoff

Roof downspouts may be directed towards Bioretention Facilities. However, the downspouts must discharge onto a concrete splash block to protect the Bioretention Facility from erosion.

Retaining Walls

It is recommended that Retaining Wall Type 1A, per Caltrans Standard B3-3 or equivalent, be constructed around the entire perimeter of the Bioretention Facility. This practice will protect the sides of the Bioretention Facility from collapsing during construction and maintenance or from high service loads adjacent to the BMP. Where such service loads would not exist adjacent to the BMP, an engineered alternative may be used if signed by a licensed civil engineer.

Side Slope Requirements

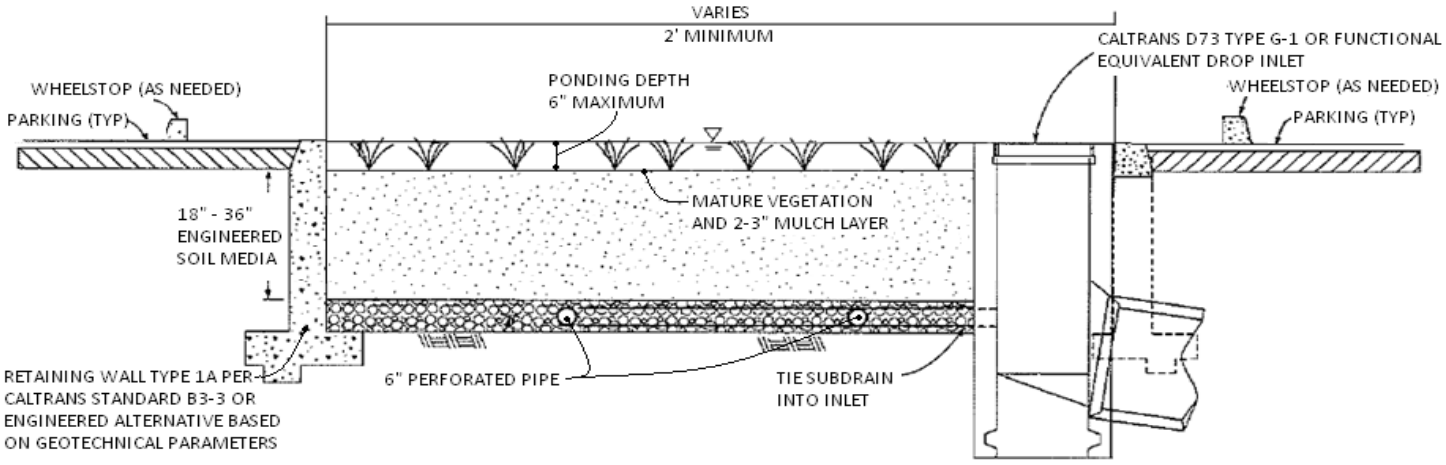
Bioretention Facilities Requiring Side Slopes

The design should assure that the Bioretention Facility does not present a tripping hazard. Bioretention Facilities proposed near pedestrian areas, such as areas parallel to parking spaces or along a walkway, must have a gentle slope to the bottom of the facility. Side slopes inside of a Bioretention Facility shall be 4:1. A typical cross section for the Bioretention Facility is shown in Figure 1.

Bioretention Facilities Not Requiring Side Slopes

Where cars park perpendicular to the Bioretention Facility, side slopes are not required. A 6-inch maximum drop may be used, and the Bioretention Facility must be planted with trees and shrubs to prevent pedestrian access. In this case, a curb is not placed around the Bioretention Facility,

but wheel stops shall be used to prevent vehicles from entering the Bioretention Facility, as shown in Figure 4.



Planter Boxes

Bioretention Facilities can also be placed above ground as planter boxes. Planter boxes must have a minimum width of 2 feet, a maximum surcharge depth of 6 inches, and no side slopes are necessary. Planter boxes must be constructed so as to ensure that the top surface of the engineered soil media will remain level. This option may be constructed of concrete, brick, stone or other stable materials that will not warp or bend. Chemically treated wood or galvanized steel, which has the ability to contaminate stormwater, should not be used. Planter boxes must be lined with an impermeable liner on all sides, including the bottom. Due to the impermeable liner, the inside bottom of the planter box shall be designed and constructed with a cross fall, directing treated flows within the subdrain layer toward the point where subdrain exits the planter box, and subdrains shall be oriented with drain holes oriented down. These provisions will help avoid excessive stagnant water within the gravel underdrain layer. Similar to the in-ground Bioretention Facility versions, this BMP benefits from healthy plants and biological activity in the root zone. Planter boxes should be planted with appropriately selected vegetation.

Figure 5: Planter Box
Source: LA Team Effort

Overflow

An overflow route is needed in the Bioretention Facility design to bypass stored runoff from storm events larger than V_{BMP} or in the event of facility or subdrain clogging. Overflow systems must connect to an acceptable discharge point, such as a downstream conveyance system as shown in Figure 1 and Figure 4. The inlet to the overflow structure shall be elevated inside the Bioretention Facility to be flush with the ponding surface for the design capture volume (V_{BMP}) as shown in Figure 4. This will allow the design capture volume to be fully treated by the Bioretention Facility, and for larger events to safely be conveyed to downstream systems. The overflow inlet shall **not** be located in the entrance of a Bioretention Facility, as shown in Figure 6.

Underdrain Gravel and Pipes

An underdrain gravel layer and pipes shall be provided in accordance with Appendix B – Underdrains.

Figure 6: Incorrect Placement of an Overflow Inlet.

Inspection and Maintenance Schedule

The Bioretention Facility area shall be inspected for erosion, dead vegetation, soggy soils, or standing water. The use of fertilizers and pesticides on the plants inside the Bioretention Facility should be minimized.

Schedule	Activity
Ongoing	• Keep adjacent landscape areas maintained. Remove clippings from landscape maintenance activities. • Remove trash and debris • Replace damaged grass and/or plants • Replace surface mulch layer as needed to maintain a 2-3 inch soil cover.
After storm events	• Inspect areas for ponding
Annually	• Inspect/clean inlets and outlets

Bioretention Facility Design Procedure

1) Enter the area tributary, A_T, to the Bioretention Facility.

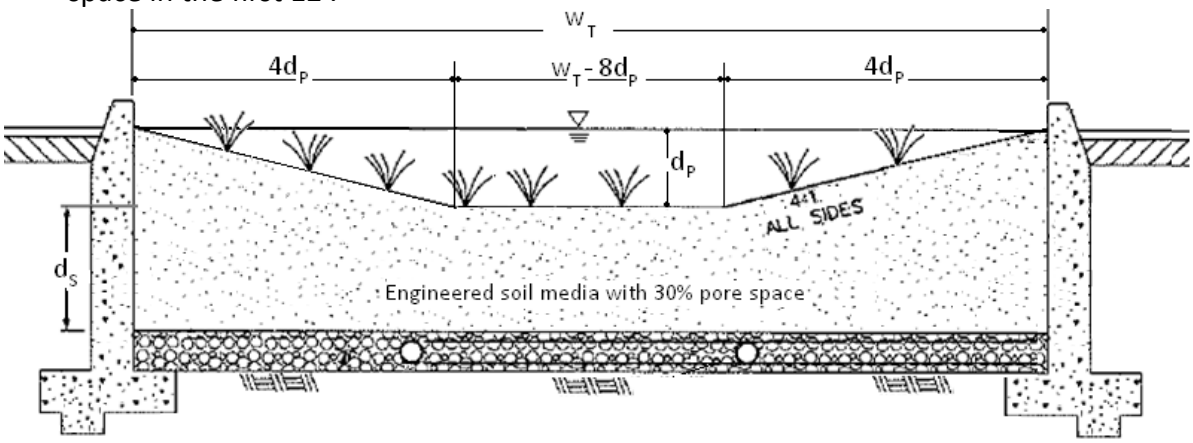
2) Enter the Design Volume, $V_{BMP,}$ determined from Section 2.1 of this Handbook.

3) Select the type of design used. There are two types of Bioretention Facility designs: the standard design used for most project sites that include side slopes, and the modified design used when the BMP is located perpendicular to the parking spaces or with planter boxes that do not use side slopes.

4) Enter the depth of the engineered soil media, d_S. The minimum depth for the engineered soil media can be 18' in limited cases, but it is recommended to use 24' or a preferred 36' to provide an adequate root zone for the chosen plant palette. Engineered soil media deeper than 36' will only get credit for the pore space in the first 36'.

5) Enter the top width of the Bioretention Facility.

6) Calculate the total effective depth, d_E, within the Bioretention Facility. The maximum allowable pore space of the soil media is 30% while the maximum allowable pore space for the gravel layer is 40%. Gravel layer deeper than 12' will only get credit for the pore space in the first 12'.



a. For the design with side slopes the following equation shall be used to determine the total effective depth. Where, d_P is the depth of ponding within the basin.

$$d_E(\text{ft}) = \frac{0.3 \times \left[\left(w_T(\text{ft}) \times d_S(\text{ft})\right) + 4\left(d_P(\text{ft})\right)^2\right] + 0.4 \times 1(\text{ft}) + d_P(\text{ft})\left[4d_P(\text{ft}) + \left(w_T(\text{ft}) - 8d_P(\text{ft})\right)\right]}{w_T(\text{ft})}$$

This above equation can be simplified if the maximum ponding depth of 0.5' is used. The equation below is used on the worksheet to find the minimum area required for the Bioretention Facility:

$$d_E(\text{ft}) = (0.3 \times d_S(\text{ft}) + 0.4 \text{ x } 1(\text{ft})) - \left(\frac{0.7\ (\text{ft}^2)}{w_T(\text{ft})}\right) + 0.5(\text{ft})$$

b. For the design without side slopes the following equation shall be used to determine the total effective depth:

$$d_E(\text{ft}) = d_P(\text{ft}) + [(0.3) \times d_S(\text{ft}) + (0.4) \times 1(\text{ft})]$$

The equation below, using the maximum ponding depth of 0.5', is used on the worksheet to find the minimum area required for the Bioretention Facility:

$$d_E(\text{ft}) = 0.5\ (\text{ft}) + [(0.3) \times d_S(\text{ft}) + (0.4) \times 1(\text{ft})]$$

7) Calculate the minimum surface area, A_M, required for the Bioretention Facility. This does not include the curb surrounding the Bioretention Facility or side slopes.

$$A_M(\text{ft}^2) = \frac{V_{BMP}(\text{ft}^3)}{d_E\ (\text{ft})}$$

8) Enter the proposed surface area. This area shall not be less than the minimum required surface area.

9) Verify that side slopes are no steeper than 4:1 in the standard design, and are not required in the modified design.

10) Provide the diameter, minimum 6 inches, of the perforated underdrain used in the Bioretention Facility. See Appendix B for specific information regarding perforated pipes.

11) Provide the slope of the site around the Bioretention Facility, if used. The maximum slope is 3 percent for a standard design.

12) Provide the check dam spacing, if the site around the Bioretention Facility is sloped.

13) Describe the vegetation used within the Bioretention Facility.

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Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

Basin Size and Flow Calculations

BIORETENTION 1

	BASIN PARAMETERS					OUTLET								
Basin Elevation	Depth	Area S.F.	Volume C.F.	Volume AC-FT	Effective Volume AC-FT	Q_1 Orrifice Plate (cfs)	Q_2 Orrifice Plate (cfs)	Q_3 Orrifice Plate (cfs)	Q_4 Orrifice Plate (cfs)	Q_5Orrifice Plate (cfs)	Q_6 Orrifice Plate (cfs)	Q_7Orrifice Plate (cfs)	Q Weir 1 (cfs)	Q Total (cfs)
0.00	0.00	6,600.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.50	0.50	6,600.00	3,300.00	0.076	0.076	0.107	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.107
1.00	1.00	6,600.00	6,600.00	0.152	0.152	0.175	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.175
1.50	1.50	13,200.00	14,850.00	0.341	0.341	0.223	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.223
2.00	2.00	14,545.50	21,145.50	0.485	0.485	0.262	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.262
2.50	2.50	15,891.00	28,113.75	0.645	0.645	0.296	0.000	0.000	0.000	0.000	0.000	0.000	14.128	14.424
3.00	3.00	17,287.00	35,830.50	0.823	0.823	0.327	0.000	0.000	0.000	0.000	0.000	0.000	39.960	40.287
3.50	3.50	18,683.00	44,245.25	1.016	1.016	0.355	0.000	0.000	0.000	0.000	0.000	0.000	73.411	73.766

SUPPORTING DESIGN PARAMETERS

Orifice Coefficient	0.66		Dia of Orrifice	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravimetric Constant	32.2	ft/s^2	Eff Dia of Orrifice	0.2167	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of Rows	1		Area of Orrifice	0.0369	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Minimum Orrifice Plate Height			Number of Orrifeces	1	1	1	1	1	1	1	1
Minimum Orrifice Plate Width			Elev	0.2	0	0	0	0	0	0	0

Weir	Sharp Crest Weir Coefficient	3.33	
	Length of Weir	12.00	
	Elev. at Crest of Weir	2	

Orifice Equation
$Q=Cd(1/4\pi D2)\sqrt{2gh}$
Weir Equation
(Q/(Weir Length* Weir Coefficent))^(2/3)

Q100 Elevation Weir Calc		
Inlet Weir Calc		
Crest Wier Elev.	2.00	
Q100	16.52	cfs
Weir Length	12	
Weir Coeff.	3.33	
H Weir	0.55495	
Q100 Elevation	**2.55**	

Q100 Elevation Weir Calc		
Emergency Spillway Weir Calc		
Crest Wier Elev.	2.60	
Q100	16.52	cfs
Weir Length	30	
Weir Coeff.	3.33	
H Weir	0.30127	
Q100 Elevation	**2.90**	

Basin Size and Flow Calculations

BIORETENTION 2

	BASIN PARAMETERS					OUTLET								
Basin Elevation	Depth	Area S.F.	Volume C.F.	Volume AC-FT	Effective Volume AC-FT	Q_1 Orrifice Plate (cfs)	Q_2 Orrifice Plate (cfs)	Q_3 Orrifice Plate (cfs)	Q_4 Orrifice Plate (cfs)	Q_5Orrifice Plate (cfs)	Q_6 Orrifice Plate (cfs)	Q_7Orrifice Plate (cfs)	Q Weir 1 (cfs)	Q Total (cfs)
0.00	0.00	3,133.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.50	0.50	3,133.00	1,566.50	0.036	0.036	0.111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.111
1.00	1.00	3,133.00	3,133.00	0.072	0.072	0.169	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.169
1.50	1.50	6,267.00	7,050.00	0.162	0.162	0.212	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.212
2.00	2.00	7,085.00	10,218.00	0.235	0.235	0.248	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.248
2.50	2.50	7,903.00	13,795.00	0.317	0.317	0.279	0.086	0.000	0.000	0.000	0.000	0.000	2.321	2.686
3.00	3.00	8,771.50	17,856.75	0.410	0.410	0.306	0.131	0.000	0.000	0.000	0.000	0.000	20.941	21.378
3.50	3.50	9,640.00	22,352.75	0.513	0.513	0.332	0.164	0.000	0.000	0.000	0.000	0.000	49.280	49.776

SUPPORTING DESIGN PARAMETERS

Orifice Coefficient	0.66		Dia of Orrifice	2.50	2.20	0.00	0.00	0.00	0.00	0.00	0.00
Gravimetric Constant	32.2	ft/s^2	Eff Dia of Orrifice	0.2083	0.1833	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of Rows	1		Area of Orrifice	0.0341	0.0264	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Minimum Orrifice Plate Height			Number of Orrifeces	1	1	1	1	1	1	1	1
Minimum Orrifice Plate Width			Elev	0.12	2.125		0	0	0	0	0

.

Weir	Sharp Crest Weir Coefficient		3.33
	Length of Weir		12.00
	Elev. at Crest of Weir		2.35

Orifice Equation
$Q=Cd(1/4\pi D2)\sqrt{2gh}$
Weir Equation
(Q/(Weir Length* Weir Coefficent))^(2/3)

Q100 Elevation Weir Calc		
Inlet Weir Calc		
Crest Wier Elev.	2.35	
Q100	12.24	cfs
Weir Length	12	
Weir Coeff.	3.33	
H Weir	0.4544	
Q100 Elevation	**2.80**	

Q100 Elevation Weir Calc		
Emergency Spillway Weir Calc		
Crest Wier Elev.	2.80	
Q100	12.24	cfs
Weir Length	41	
Weir Coeff.	3.33	
H Weir	0.20031	
Q100 Elevation	**3.00**	

U n i t H y d r o g r a p h A n a l y s i s

Study date 10/27/20 File: EX12242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

Drainage Area = 6.56(Ac.) = 0.010 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 6.56(Ac.) = 0.010 Sq. Mi.
Length along longest watercourse = 1340.00(Ft.)
Length along longest watercourse measured to centroid = 670.00(Ft.)
Length along longest watercourse = 0.254 Mi.
Length along longest watercourse measured to centroid = 0.127 Mi.
Difference in elevation = 38.00(Ft.)
Slope along watercourse = 149.7313 Ft./Mi.
Average Manning's 'N' = 0.030
Lag time = 0.075 Hr.
Lag time = 4.52 Min.
25% of lag time = 1.13 Min.
40% of lag time = 1.81 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.56	2.00	13.12

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.56	6.00	39.36

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 2.000(In)
Area Averaged 100-Year Rainfall = 6.000(In)

Point rain (area averaged) = 2.000(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.000(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
6.560	85.50	0.000

Total Area Entered = 6.56(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
85.5	70.8	0.353	0.000	0.353	1.000	0.353
					Sum (F) =	0.353

Area averaged mean soil loss (F) (In/Hr) = 0.353
Minimum soil loss rate ((In/Hr)) = 0.176
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.900

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	110.609	22.422	1.482
2	0.167	221.217	48.840	3.229
3	0.250	331.826	14.238	0.941
4	0.333	442.435	6.513	0.431
5	0.417	553.043	3.618	0.239
6	0.500	663.652	2.244	0.148
7	0.583	774.261	1.316	0.087
8	0.667	884.869	0.810	0.054
			Sum = 100.000	Sum= 6.611

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.016	(0.625)	0.014	0.002
2	0.17	0.07	0.016	(0.623)	0.014	0.002
3	0.25	0.07	0.016	(0.620)	0.014	0.002
4	0.33	0.10	0.024	(0.618)	0.022	0.002
5	0.42	0.10	0.024	(0.615)	0.022	0.002
6	0.50	0.10	0.024	(0.613)	0.022	0.002
7	0.58	0.10	0.024	(0.611)	0.022	0.002
8	0.67	0.10	0.024	(0.608)	0.022	0.002
9	0.75	0.10	0.024	(0.606)	0.022	0.002
10	0.83	0.13	0.032	(0.603)	0.029	0.003
11	0.92	0.13	0.032	(0.601)	0.029	0.003
12	1.00	0.13	0.032	(0.599)	0.029	0.003
13	1.08	0.10	0.024	(0.596)	0.022	0.002
14	1.17	0.10	0.024	(0.594)	0.022	0.002
15	1.25	0.10	0.024	(0.592)	0.022	0.002
16	1.33	0.10	0.024	(0.589)	0.022	0.002
17	1.42	0.10	0.024	(0.587)	0.022	0.002
18	1.50	0.10	0.024	(0.585)	0.022	0.002
19	1.58	0.10	0.024	(0.582)	0.022	0.002
20	1.67	0.10	0.024	(0.580)	0.022	0.002
21	1.75	0.10	0.024	(0.578)	0.022	0.002
22	1.83	0.13	0.032	(0.575)	0.029	0.003
23	1.92	0.13	0.032	(0.573)	0.029	0.003
24	2.00	0.13	0.032	(0.571)	0.029	0.003
25	2.08	0.13	0.032	(0.568)	0.029	0.003
26	2.17	0.13	0.032	(0.566)	0.029	0.003
27	2.25	0.13	0.032	(0.564)	0.029	0.003
28	2.33	0.13	0.032	(0.561)	0.029	0.003
29	2.42	0.13	0.032	(0.559)	0.029	0.003
30	2.50	0.13	0.032	(0.557)	0.029	0.003
31	2.58	0.17	0.040	(0.555)	0.036	0.004
32	2.67	0.17	0.040	(0.552)	0.036	0.004
33	2.75	0.17	0.040	(0.550)	0.036	0.004
34	2.83	0.17	0.040	(0.548)	0.036	0.004
35	2.92	0.17	0.040	(0.545)	0.036	0.004
36	3.00	0.17	0.040	(0.543)	0.036	0.004
37	3.08	0.17	0.040	(0.541)	0.036	0.004
38	3.17	0.17	0.040	(0.539)	0.036	0.004
39	3.25	0.17	0.040	(0.536)	0.036	0.004
40	3.33	0.17	0.040	(0.534)	0.036	0.004
41	3.42	0.17	0.040	(0.532)	0.036	0.004
42	3.50	0.17	0.040	(0.530)	0.036	0.004
43	3.58	0.17	0.040	(0.528)	0.036	0.004
44	3.67	0.17	0.040	(0.525)	0.036	0.004
45	3.75	0.17	0.040	(0.523)	0.036	0.004
46	3.83	0.20	0.048	(0.521)	0.043	0.005
47	3.92	0.20	0.048	(0.519)	0.043	0.005
48	4.00	0.20	0.048	(0.517)	0.043	0.005
49	4.08	0.20	0.048	(0.514)	0.043	0.005
50	4.17	0.20	0.048	(0.512)	0.043	0.005
51	4.25	0.20	0.048	(0.510)	0.043	0.005
52	4.33	0.23	0.056	(0.508)	0.050	0.006
53	4.42	0.23	0.056	(0.506)	0.050	0.006
54	4.50	0.23	0.056	(0.503)	0.050	0.006
55	4.58	0.23	0.056	(0.501)	0.050	0.006
56	4.67	0.23	0.056	(0.499)	0.050	0.006
57	4.75	0.23	0.056	(0.497)	0.050	0.006
58	4.83	0.27	0.064	(0.495)	0.058	0.006

59	4.92	0.27	0.064	(0.493)	0.058	0.006
60	5.00	0.27	0.064	(0.491)	0.058	0.006
61	5.08	0.20	0.048	(0.488)	0.043	0.005
62	5.17	0.20	0.048	(0.486)	0.043	0.005
63	5.25	0.20	0.048	(0.484)	0.043	0.005
64	5.33	0.23	0.056	(0.482)	0.050	0.006
65	5.42	0.23	0.056	(0.480)	0.050	0.006
66	5.50	0.23	0.056	(0.478)	0.050	0.006
67	5.58	0.27	0.064	(0.476)	0.058	0.006
68	5.67	0.27	0.064	(0.474)	0.058	0.006
69	5.75	0.27	0.064	(0.472)	0.058	0.006
70	5.83	0.27	0.064	(0.470)	0.058	0.006
71	5.92	0.27	0.064	(0.467)	0.058	0.006
72	6.00	0.27	0.064	(0.465)	0.058	0.006
73	6.08	0.30	0.072	(0.463)	0.065	0.007
74	6.17	0.30	0.072	(0.461)	0.065	0.007
75	6.25	0.30	0.072	(0.459)	0.065	0.007
76	6.33	0.30	0.072	(0.457)	0.065	0.007
77	6.42	0.30	0.072	(0.455)	0.065	0.007
78	6.50	0.30	0.072	(0.453)	0.065	0.007
79	6.58	0.33	0.080	(0.451)	0.072	0.008
80	6.67	0.33	0.080	(0.449)	0.072	0.008
81	6.75	0.33	0.080	(0.447)	0.072	0.008
82	6.83	0.33	0.080	(0.445)	0.072	0.008
83	6.92	0.33	0.080	(0.443)	0.072	0.008
84	7.00	0.33	0.080	(0.441)	0.072	0.008
85	7.08	0.33	0.080	(0.439)	0.072	0.008
86	7.17	0.33	0.080	(0.437)	0.072	0.008
87	7.25	0.33	0.080	(0.435)	0.072	0.008
88	7.33	0.37	0.088	(0.433)	0.079	0.009
89	7.42	0.37	0.088	(0.431)	0.079	0.009
90	7.50	0.37	0.088	(0.429)	0.079	0.009
91	7.58	0.40	0.096	(0.427)	0.086	0.010
92	7.67	0.40	0.096	(0.425)	0.086	0.010
93	7.75	0.40	0.096	(0.423)	0.086	0.010
94	7.83	0.43	0.104	(0.421)	0.094	0.010
95	7.92	0.43	0.104	(0.419)	0.094	0.010
96	8.00	0.43	0.104	(0.417)	0.094	0.010
97	8.08	0.50	0.120	(0.415)	0.108	0.012
98	8.17	0.50	0.120	(0.413)	0.108	0.012
99	8.25	0.50	0.120	(0.411)	0.108	0.012
100	8.33	0.50	0.120	(0.410)	0.108	0.012
101	8.42	0.50	0.120	(0.408)	0.108	0.012
102	8.50	0.50	0.120	(0.406)	0.108	0.012
103	8.58	0.53	0.128	(0.404)	0.115	0.013
104	8.67	0.53	0.128	(0.402)	0.115	0.013
105	8.75	0.53	0.128	(0.400)	0.115	0.013
106	8.83	0.57	0.136	(0.398)	0.122	0.014
107	8.92	0.57	0.136	(0.396)	0.122	0.014
108	9.00	0.57	0.136	(0.394)	0.122	0.014
109	9.08	0.63	0.152	(0.392)	0.137	0.015
110	9.17	0.63	0.152	(0.391)	0.137	0.015
111	9.25	0.63	0.152	(0.389)	0.137	0.015
112	9.33	0.67	0.160	(0.387)	0.144	0.016
113	9.42	0.67	0.160	(0.385)	0.144	0.016
114	9.50	0.67	0.160	(0.383)	0.144	0.016
115	9.58	0.70	0.168	(0.381)	0.151	0.017
116	9.67	0.70	0.168	(0.380)	0.151	0.017
117	9.75	0.70	0.168	(0.378)	0.151	0.017
118	9.83	0.73	0.176	(0.376)	0.158	0.018
119	9.92	0.73	0.176	(0.374)	0.158	0.018
120	10.00	0.73	0.176	(0.372)	0.158	0.018
121	10.08	0.50	0.120	(0.371)	0.108	0.012
122	10.17	0.50	0.120	(0.369)	0.108	0.012
123	10.25	0.50	0.120	(0.367)	0.108	0.012
124	10.33	0.50	0.120	(0.365)	0.108	0.012
125	10.42	0.50	0.120	(0.363)	0.108	0.012
126	10.50	0.50	0.120	(0.362)	0.108	0.012
127	10.58	0.67	0.160	(0.360)	0.144	0.016
128	10.67	0.67	0.160	(0.358)	0.144	0.016
129	10.75	0.67	0.160	(0.356)	0.144	0.016
130	10.83	0.67	0.160	(0.355)	0.144	0.016
131	10.92	0.67	0.160	(0.353)	0.144	0.016
132	11.00	0.67	0.160	(0.351)	0.144	0.016
133	11.08	0.63	0.152	(0.349)	0.137	0.015
134	11.17	0.63	0.152	(0.348)	0.137	0.015
135	11.25	0.63	0.152	(0.346)	0.137	0.015
136	11.33	0.63	0.152	(0.344)	0.137	0.015
137	11.42	0.63	0.152	(0.343)	0.137	0.015
138	11.50	0.63	0.152	(0.341)	0.137	0.015
139	11.58	0.57	0.136	(0.339)	0.122	0.014

140	11.67	0.57	0.136	(0.337)	0.122	0.014
141	11.75	0.57	0.136	(0.336)	0.122	0.014
142	11.83	0.60	0.144	(0.334)	0.130	0.014
143	11.92	0.60	0.144	(0.332)	0.130	0.014
144	12.00	0.60	0.144	(0.331)	0.130	0.014
145	12.08	0.83	0.200	(0.329)	0.180	0.020
146	12.17	0.83	0.200	(0.327)	0.180	0.020
147	12.25	0.83	0.200	(0.326)	0.180	0.020
148	12.33	0.87	0.208	(0.324)	0.187	0.021
149	12.42	0.87	0.208	(0.323)	0.187	0.021
150	12.50	0.87	0.208	(0.321)	0.187	0.021
151	12.58	0.93	0.224	(0.319)	0.202	0.022
152	12.67	0.93	0.224	(0.318)	0.202	0.022
153	12.75	0.93	0.224	(0.316)	0.202	0.022
154	12.83	0.97	0.232	(0.315)	0.209	0.023
155	12.92	0.97	0.232	(0.313)	0.209	0.023
156	13.00	0.97	0.232	(0.311)	0.209	0.023
157	13.08	1.13	0.272	(0.310)	0.245	0.027
158	13.17	1.13	0.272	(0.308)	0.245	0.027
159	13.25	1.13	0.272	(0.307)	0.245	0.027
160	13.33	1.13	0.272	(0.305)	0.245	0.027
161	13.42	1.13	0.272	(0.304)	0.245	0.027
162	13.50	1.13	0.272	(0.302)	0.245	0.027
163	13.58	0.77	0.184	(0.300)	0.166	0.018
164	13.67	0.77	0.184	(0.299)	0.166	0.018
165	13.75	0.77	0.184	(0.297)	0.166	0.018
166	13.83	0.77	0.184	(0.296)	0.166	0.018
167	13.92	0.77	0.184	(0.294)	0.166	0.018
168	14.00	0.77	0.184	(0.293)	0.166	0.018
169	14.08	0.90	0.216	(0.291)	0.194	0.022
170	14.17	0.90	0.216	(0.290)	0.194	0.022
171	14.25	0.90	0.216	(0.288)	0.194	0.022
172	14.33	0.87	0.208	(0.287)	0.187	0.021
173	14.42	0.87	0.208	(0.285)	0.187	0.021
174	14.50	0.87	0.208	(0.284)	0.187	0.021
175	14.58	0.87	0.208	(0.283)	0.187	0.021
176	14.67	0.87	0.208	(0.281)	0.187	0.021
177	14.75	0.87	0.208	(0.280)	0.187	0.021
178	14.83	0.83	0.200	(0.278)	0.180	0.020
179	14.92	0.83	0.200	(0.277)	0.180	0.020
180	15.00	0.83	0.200	(0.275)	0.180	0.020
181	15.08	0.80	0.192	(0.274)	0.173	0.019
182	15.17	0.80	0.192	(0.273)	0.173	0.019
183	15.25	0.80	0.192	(0.271)	0.173	0.019
184	15.33	0.77	0.184	(0.270)	0.166	0.018
185	15.42	0.77	0.184	(0.268)	0.166	0.018
186	15.50	0.77	0.184	(0.267)	0.166	0.018
187	15.58	0.63	0.152	(0.266)	0.137	0.015
188	15.67	0.63	0.152	(0.264)	0.137	0.015
189	15.75	0.63	0.152	(0.263)	0.137	0.015
190	15.83	0.63	0.152	(0.262)	0.137	0.015
191	15.92	0.63	0.152	(0.260)	0.137	0.015
192	16.00	0.63	0.152	(0.259)	0.137	0.015
193	16.08	0.13	0.032	(0.258)	0.029	0.003
194	16.17	0.13	0.032	(0.256)	0.029	0.003
195	16.25	0.13	0.032	(0.255)	0.029	0.003
196	16.33	0.13	0.032	(0.254)	0.029	0.003
197	16.42	0.13	0.032	(0.252)	0.029	0.003
198	16.50	0.13	0.032	(0.251)	0.029	0.003
199	16.58	0.10	0.024	(0.250)	0.022	0.002
200	16.67	0.10	0.024	(0.249)	0.022	0.002
201	16.75	0.10	0.024	(0.247)	0.022	0.002
202	16.83	0.10	0.024	(0.246)	0.022	0.002
203	16.92	0.10	0.024	(0.245)	0.022	0.002
204	17.00	0.10	0.024	(0.244)	0.022	0.002
205	17.08	0.17	0.040	(0.242)	0.036	0.004
206	17.17	0.17	0.040	(0.241)	0.036	0.004
207	17.25	0.17	0.040	(0.240)	0.036	0.004
208	17.33	0.17	0.040	(0.239)	0.036	0.004
209	17.42	0.17	0.040	(0.237)	0.036	0.004
210	17.50	0.17	0.040	(0.236)	0.036	0.004
211	17.58	0.17	0.040	(0.235)	0.036	0.004
212	17.67	0.17	0.040	(0.234)	0.036	0.004
213	17.75	0.17	0.040	(0.233)	0.036	0.004
214	17.83	0.13	0.032	(0.232)	0.029	0.003
215	17.92	0.13	0.032	(0.230)	0.029	0.003
216	18.00	0.13	0.032	(0.229)	0.029	0.003
217	18.08	0.13	0.032	(0.228)	0.029	0.003
218	18.17	0.13	0.032	(0.227)	0.029	0.003
219	18.25	0.13	0.032	(0.226)	0.029	0.003
220	18.33	0.13	0.032	(0.225)	0.029	0.003

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221  18.42     0.13      0.032       (  0.224)       0.029        0.003
222  18.50     0.13      0.032       (  0.223)       0.029        0.003
223  18.58     0.10      0.024       (  0.222)       0.022        0.002
224  18.67     0.10      0.024       (  0.221)       0.022        0.002
225  18.75     0.10      0.024       (  0.219)       0.022        0.002
226  18.83     0.07      0.016       (  0.218)       0.014        0.002
227  18.92     0.07      0.016       (  0.217)       0.014        0.002
228  19.00     0.07      0.016       (  0.216)       0.014        0.002
229  19.08     0.10      0.024       (  0.215)       0.022        0.002
230  19.17     0.10      0.024       (  0.214)       0.022        0.002
231  19.25     0.10      0.024       (  0.213)       0.022        0.002
232  19.33     0.13      0.032       (  0.212)       0.029        0.003
233  19.42     0.13      0.032       (  0.211)       0.029        0.003
234  19.50     0.13      0.032       (  0.210)       0.029        0.003
235  19.58     0.10      0.024       (  0.209)       0.022        0.002
236  19.67     0.10      0.024       (  0.208)       0.022        0.002
237  19.75     0.10      0.024       (  0.207)       0.022        0.002
238  19.83     0.07      0.016       (  0.207)       0.014        0.002
239  19.92     0.07      0.016       (  0.206)       0.014        0.002
240  20.00     0.07      0.016       (  0.205)       0.014        0.002
241  20.08     0.10      0.024       (  0.204)       0.022        0.002
242  20.17     0.10      0.024       (  0.203)       0.022        0.002
243  20.25     0.10      0.024       (  0.202)       0.022        0.002
244  20.33     0.10      0.024       (  0.201)       0.022        0.002
245  20.42     0.10      0.024       (  0.200)       0.022        0.002
246  20.50     0.10      0.024       (  0.199)       0.022        0.002
247  20.58     0.10      0.024       (  0.199)       0.022        0.002
248  20.67     0.10      0.024       (  0.198)       0.022        0.002
249  20.75     0.10      0.024       (  0.197)       0.022        0.002
250  20.83     0.07      0.016       (  0.196)       0.014        0.002
251  20.92     0.07      0.016       (  0.195)       0.014        0.002
252  21.00     0.07      0.016       (  0.195)       0.014        0.002
253  21.08     0.10      0.024       (  0.194)       0.022        0.002
254  21.17     0.10      0.024       (  0.193)       0.022        0.002
255  21.25     0.10      0.024       (  0.192)       0.022        0.002
256  21.33     0.07      0.016       (  0.192)       0.014        0.002
257  21.42     0.07      0.016       (  0.191)       0.014        0.002
258  21.50     0.07      0.016       (  0.190)       0.014        0.002
259  21.58     0.10      0.024       (  0.189)       0.022        0.002
260  21.67     0.10      0.024       (  0.189)       0.022        0.002
261  21.75     0.10      0.024       (  0.188)       0.022        0.002
262  21.83     0.07      0.016       (  0.187)       0.014        0.002
263  21.92     0.07      0.016       (  0.187)       0.014        0.002
264  22.00     0.07      0.016       (  0.186)       0.014        0.002
265  22.08     0.10      0.024       (  0.186)       0.022        0.002
266  22.17     0.10      0.024       (  0.185)       0.022        0.002
267  22.25     0.10      0.024       (  0.184)       0.022        0.002
268  22.33     0.07      0.016       (  0.184)       0.014        0.002
269  22.42     0.07      0.016       (  0.183)       0.014        0.002
270  22.50     0.07      0.016       (  0.183)       0.014        0.002
271  22.58     0.07      0.016       (  0.182)       0.014        0.002
272  22.67     0.07      0.016       (  0.182)       0.014        0.002
273  22.75     0.07      0.016       (  0.181)       0.014        0.002
274  22.83     0.07      0.016       (  0.181)       0.014        0.002
275  22.92     0.07      0.016       (  0.180)       0.014        0.002
276  23.00     0.07      0.016       (  0.180)       0.014        0.002
277  23.08     0.07      0.016       (  0.179)       0.014        0.002
278  23.17     0.07      0.016       (  0.179)       0.014        0.002
279  23.25     0.07      0.016       (  0.179)       0.014        0.002
280  23.33     0.07      0.016       (  0.178)       0.014        0.002
281  23.42     0.07      0.016       (  0.178)       0.014        0.002
282  23.50     0.07      0.016       (  0.178)       0.014        0.002
283  23.58     0.07      0.016       (  0.177)       0.014        0.002
284  23.67     0.07      0.016       (  0.177)       0.014        0.002
285  23.75     0.07      0.016       (  0.177)       0.014        0.002
286  23.83     0.07      0.016       (  0.177)       0.014        0.002
287  23.92     0.07      0.016       (  0.176)       0.014        0.002
288  24.00     0.07      0.016       (  0.176)       0.014        0.002
               (Loss Rate Not Used)
    Sum =     100.0                                  Sum =      2.4
      Flood volume = Effective rainfall      0.20(In)
       times area       6.6(Ac.)/[(In)/(Ft.)] =       0.1(Ac.Ft)
      Total soil loss =      1.80(In)
      Total soil loss =     0.984(Ac.Ft)
      Total rainfall =      2.00(In)
      Flood volume =        4762.5 Cubic Feet
      Total soil loss =       42862.5 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      0.179(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0000	0.00	Q				
0+10	0.0001	0.01	Q				
0+15	0.0001	0.01	Q				
0+20	0.0002	0.01	Q				
0+25	0.0003	0.01	Q				
0+30	0.0004	0.01	Q				
0+35	0.0005	0.02	Q				
0+40	0.0006	0.02	Q				
0+45	0.0007	0.02	Q				
0+50	0.0008	0.02	Q				
0+55	0.0010	0.02	Q				
1+ 0	0.0011	0.02	Q				
1+ 5	0.0013	0.02	Q				
1+10	0.0014	0.02	Q				
1+15	0.0015	0.02	Q				
1+20	0.0016	0.02	Q				
1+25	0.0017	0.02	Q				
1+30	0.0018	0.02	Q				
1+35	0.0019	0.02	Q				
1+40	0.0020	0.02	Q				
1+45	0.0021	0.02	Q				
1+50	0.0023	0.02	Q				
1+55	0.0024	0.02	Q				
2+ 0	0.0025	0.02	Q				
2+ 5	0.0027	0.02	Q				
2+10	0.0028	0.02	QV				
2+15	0.0030	0.02	QV				
2+20	0.0031	0.02	QV				
2+25	0.0033	0.02	QV				
2+30	0.0034	0.02	QV				
2+35	0.0036	0.02	QV				
2+40	0.0037	0.02	QV				
2+45	0.0039	0.03	QV				
2+50	0.0041	0.03	QV				
2+55	0.0043	0.03	QV				
3+ 0	0.0045	0.03	QV				
3+ 5	0.0046	0.03	QV				
3+10	0.0048	0.03	QV				
3+15	0.0050	0.03	QV				
3+20	0.0052	0.03	QV				
3+25	0.0054	0.03	QV				
3+30	0.0055	0.03	Q V				
3+35	0.0057	0.03	Q V				
3+40	0.0059	0.03	Q V				
3+45	0.0061	0.03	Q V				
3+50	0.0063	0.03	Q V				
3+55	0.0065	0.03	Q V				
4+ 0	0.0067	0.03	Q V				
4+ 5	0.0069	0.03	Q V				
4+10	0.0071	0.03	Q V				
4+15	0.0074	0.03	Q V				
4+20	0.0076	0.03	Q V				
4+25	0.0078	0.04	Q V				
4+30	0.0081	0.04	Q V				
4+35	0.0083	0.04	Q V				
4+40	0.0086	0.04	Q V				
4+45	0.0088	0.04	Q V				
4+50	0.0091	0.04	Q V				
4+55	0.0094	0.04	Q V				
5+ 0	0.0097	0.04	Q V				
5+ 5	0.0099	0.04	Q V				
5+10	0.0102	0.03	Q V				
5+15	0.0104	0.03	Q V				
5+20	0.0106	0.03	Q V				
5+25	0.0109	0.04	Q V				
5+30	0.0111	0.04	Q V				
5+35	0.0114	0.04	Q V				
5+40	0.0117	0.04	Q V				
5+45	0.0120	0.04	Q V				
5+50	0.0123	0.04	Q V				
5+55	0.0125	0.04	Q V				
6+ 0	0.0128	0.04	Q V				
6+ 5	0.0131	0.04	Q V				

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 6+10       0.0134      0.05  Q   V     |          |          |          |
 6+15       0.0138      0.05  Q    V    |          |          |          |
 6+20       0.0141      0.05  Q    V    |          |          |          |
 6+25       0.0144      0.05  Q    V    |          |          |          |
 6+30       0.0148      0.05  Q    V    |          |          |          |
 6+35       0.0151      0.05  Q    V    |          |          |          |
 6+40       0.0154      0.05  Q    V    |          |          |          |
 6+45       0.0158      0.05  Q    V    |          |          |          |
 6+50       0.0162      0.05  Q    V    |          |          |          |
 6+55       0.0165      0.05  Q     V   |          |          |          |
 7+ 0       0.0169      0.05  Q     V   |          |          |          |
 7+ 5       0.0173      0.05  Q     V   |          |          |          |
 7+10       0.0176      0.05  Q     V   |          |          |          |
 7+15       0.0180      0.05  Q     V   |          |          |          |
 7+20       0.0184      0.05  Q     V   |          |          |          |
 7+25       0.0187      0.06  Q     V   |          |          |          |
 7+30       0.0191      0.06  Q      V  |          |          |          |
 7+35       0.0195      0.06  Q      V  |          |          |          |
 7+40       0.0200      0.06  Q      V  |          |          |          |
 7+45       0.0204      0.06  Q      V  |          |          |          |
 7+50       0.0208      0.06  Q      V  |          |          |          |
 7+55       0.0213      0.07  Q      V  |          |          |          |
 8+ 0       0.0218      0.07  Q      V  |          |          |          |
 8+ 5       0.0223      0.07  Q       V |          |          |          |
 8+10       0.0228      0.08  Q       V |          |          |          |
 8+15       0.0233      0.08  Q       V |          |          |          |
 8+20       0.0239      0.08  Q       V |          |          |          |
 8+25       0.0244      0.08  Q       V |          |          |          |
 8+30       0.0249      0.08  Q        V|          |          |          |
 8+35       0.0255      0.08  Q        V|          |          |          |
 8+40       0.0261      0.08  Q        V|          |          |          |
 8+45       0.0267      0.08  Q        V|          |          |          |
 8+50       0.0272      0.09  Q        V|          |          |          |
 8+55       0.0279      0.09  Q         V          |          |          |
 9+ 0       0.0285      0.09  Q         V          |          |          |
 9+ 5       0.0291      0.09  Q         V          |          |          |
 9+10       0.0298      0.10  Q         V          |          |          |
 9+15       0.0304      0.10  Q         |V         |          |          |
 9+20       0.0311      0.10  Q         |V         |          |          |
 9+25       0.0319      0.10  Q         |V         |          |          |
 9+30       0.0326      0.10  Q         |V         |          |          |
 9+35       0.0333      0.11  Q          V         |          |          |
 9+40       0.0341      0.11  Q          V         |          |          |
 9+45       0.0348      0.11  Q          V         |          |          |
 9+50       0.0356      0.11  Q          |V        |          |          |
 9+55       0.0364      0.11  Q          |V        |          |          |
10+ 0       0.0372      0.12  Q          |V        |          |          |
10+ 5       0.0379      0.11  Q          |V        |          |          |
10+10       0.0385      0.09  Q          |  V      |          |          |
10+15       0.0391      0.08  Q          |  V      |          |          |
10+20       0.0397      0.08  Q          |  V      |          |          |
10+25       0.0402      0.08  Q          |  V      |          |          |
10+30       0.0408      0.08  Q          |  V      |          |          |
10+35       0.0414      0.09  Q          |   V     |          |          |
10+40       0.0421      0.10  Q          |   V     |          |          |
10+45       0.0428      0.10  Q          |   V     |          |          |
10+50       0.0435      0.10  Q          |   V     |          |          |
10+55       0.0442      0.10  Q          |    V    |          |          |
11+ 0       0.0449      0.11  Q          |    V    |          |          |
11+ 5       0.0456      0.10  Q          |    V    |          |          |
11+10       0.0464      0.10  Q          |    V    |          |          |
11+15       0.0470      0.10  Q          |     V   |          |          |
11+20       0.0477      0.10  Q          |     V   |          |          |
11+25       0.0484      0.10  Q          |     V   |          |          |
11+30       0.0491      0.10  Q          |     V   |          |          |
11+35       0.0498      0.10  Q          |      V  |          |          |
11+40       0.0504      0.09  Q          |      V  |          |          |
11+45       0.0511      0.09  Q          |      V  |          |          |
11+50       0.0517      0.09  Q          |      V  |          |          |
11+55       0.0524      0.09  Q          |       V |          |          |
12+ 0       0.0530      0.09  Q          |       V |          |          |
12+ 5       0.0537      0.10  Q          |       V |          |          |
12+10       0.0546      0.12  Q          |       V |          |          |
12+15       0.0554      0.13  Q          |        V |         |          |
12+20       0.0563      0.13  Q          |        V |         |          |
12+25       0.0573      0.13  Q          |        V |         |          |
12+30       0.0582      0.14  Q          |        |V         |          |
12+35       0.0592      0.14  Q          |        |V         |          |
12+40       0.0602      0.14  Q          |        | V        |          |
12+45       0.0612      0.15  Q          |        | V        |          |
12+50       0.0622      0.15  Q          |        | V        |          |
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12+55       0.0632      0.15  Q          |          |  V       |          |
13+ 0       0.0643      0.15  Q          |          |  V       |          |
13+ 5       0.0654      0.16  Q          |          |  V       |          |
13+10       0.0666      0.17  Q          |          |   V      |          |
13+15       0.0678      0.18  Q          |          |   V      |          |
13+20       0.0690      0.18  Q          |          |    V     |          |
13+25       0.0702      0.18  Q          |          |    V     |          |
13+30       0.0715      0.18  Q          |          |     V    |          |
13+35       0.0726      0.17  Q          |          |     V    |          |
13+40       0.0736      0.14  Q          |          |     V    |          |
13+45       0.0745      0.13  Q          |          |      V   |          |
13+50       0.0753      0.13  Q          |          |      V   |          |
13+55       0.0762      0.12  Q          |          |      V   |          |
14+ 0       0.0770      0.12  Q          |          |       V  |          |
14+ 5       0.0779      0.13  Q          |          |       V  |          |
14+10       0.0788      0.14  Q          |          |       V  |          |
14+15       0.0798      0.14  Q          |          |        V |          |
14+20       0.0808      0.14  Q          |          |        V |          |
14+25       0.0817      0.14  Q          |          |        V |          |
14+30       0.0827      0.14  Q          |          |         V          |
14+35       0.0836      0.14  Q          |          |         V          |
14+40       0.0846      0.14  Q          |          |         V          |
14+45       0.0855      0.14  Q          |          |          V         |
14+50       0.0865      0.14  Q          |          |          V         |
14+55       0.0874      0.13  Q          |          |          V         |
15+ 0       0.0883      0.13  Q          |          |           V        |
15+ 5       0.0892      0.13  Q          |          |           V        |
15+10       0.0901      0.13  Q          |          |           V        |
15+15       0.0910      0.13  Q          |          |            V       |
15+20       0.0918      0.13  Q          |          |            V       |
15+25       0.0927      0.12  Q          |          |            V       |
15+30       0.0935      0.12  Q          |          |             V      |
15+35       0.0943      0.12  Q          |          |             V      |
15+40       0.0951      0.11  Q          |          |             V      |
15+45       0.0958      0.10  Q          |          |              V     |
15+50       0.0965      0.10  Q          |          |              V     |
15+55       0.0972      0.10  Q          |          |              V     |
16+ 0       0.0979      0.10  Q          |          |              V     |
16+ 5       0.0985      0.08  Q          |          |               V    |
16+10       0.0988      0.04  Q          |          |               V    |
16+15       0.0990      0.03  Q          |          |               V    |
16+20       0.0992      0.03  Q          |          |               V    |
16+25       0.0994      0.02  Q          |          |               V    |
16+30       0.0995      0.02  Q          |          |               V    |
16+35       0.0996      0.02  Q          |          |               V    |
16+40       0.0998      0.02  Q          |          |               V    |
16+45       0.0999      0.02  Q          |          |               V    |
16+50       0.1000      0.02  Q          |          |               V    |
16+55       0.1001      0.02  Q          |          |               V    |
17+ 0       0.1002      0.02  Q          |          |               V    |
17+ 5       0.1003      0.02  Q          |          |               V    |
17+10       0.1005      0.02  Q          |          |               V    |
17+15       0.1007      0.02  Q          |          |               V    |
17+20       0.1009      0.03  Q          |          |               V    |
17+25       0.1010      0.03  Q          |          |               V    |
17+30       0.1012      0.03  Q          |          |                V   |
17+35       0.1014      0.03  Q          |          |                V   |
17+40       0.1016      0.03  Q          |          |                V   |
17+45       0.1018      0.03  Q          |          |                V   |
17+50       0.1019      0.03  Q          |          |                V   |
17+55       0.1021      0.02  Q          |          |                V   |
18+ 0       0.1022      0.02  Q          |          |                V   |
18+ 5       0.1024      0.02  Q          |          |                V   |
18+10       0.1025      0.02  Q          |          |                V   |
18+15       0.1027      0.02  Q          |          |                V   |
18+20       0.1028      0.02  Q          |          |                V   |
18+25       0.1030      0.02  Q          |          |                V   |
18+30       0.1031      0.02  Q          |          |                V   |
18+35       0.1033      0.02  Q          |          |                V   |
18+40       0.1034      0.02  Q          |          |                V   |
18+45       0.1035      0.02  Q          |          |                V   |
18+50       0.1036      0.02  Q          |          |                V   |
18+55       0.1037      0.01  Q          |          |                V   |
19+ 0       0.1038      0.01  Q          |          |                V   |
19+ 5       0.1038      0.01  Q          |          |                V   |
19+10       0.1039      0.01  Q          |          |                 V  |
19+15       0.1040      0.02  Q          |          |                 V  |
19+20       0.1042      0.02  Q          |          |                 V  |
19+25       0.1043      0.02  Q          |          |                 V  |
19+30       0.1044      0.02  Q          |          |                 V  |
19+35       0.1046      0.02  Q          |          |                 V  |
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   19+40       0.1047      0.02  Q          |          |          |        V |
   19+45       0.1048      0.02  Q          |          |          |        V |
   19+50       0.1049      0.02  Q          |          |          |        V |
   19+55       0.1050      0.01  Q          |          |          |        V |
   20+ 0       0.1051      0.01  Q          |          |          |        V |
   20+ 5       0.1052      0.01  Q          |          |          |        V |
   20+10       0.1053      0.01  Q          |          |          |        V |
   20+15       0.1054      0.02  Q          |          |          |        V |
   20+20       0.1055      0.02  Q          |          |          |        V |
   20+25       0.1056      0.02  Q          |          |          |        V |
   20+30       0.1057      0.02  Q          |          |          |        V |
   20+35       0.1058      0.02  Q          |          |          |        V |
   20+40       0.1059      0.02  Q          |          |          |        V |
   20+45       0.1060      0.02  Q          |          |          |        V |
   20+50       0.1061      0.01  Q          |          |          |        V |
   20+55       0.1062      0.01  Q          |          |          |        V |
   21+ 0       0.1063      0.01  Q          |          |          |        V |
   21+ 5       0.1064      0.01  Q          |          |          |        V |
   21+10       0.1065      0.01  Q          |          |          |        V |
   21+15       0.1066      0.02  Q          |          |          |        V |
   21+20       0.1067      0.01  Q          |          |          |         V|
   21+25       0.1067      0.01  Q          |          |          |         V|
   21+30       0.1068      0.01  Q          |          |          |         V|
   21+35       0.1069      0.01  Q          |          |          |         V|
   21+40       0.1070      0.01  Q          |          |          |         V|
   21+45       0.1071      0.02  Q          |          |          |         V|
   21+50       0.1072      0.01  Q          |          |          |         V|
   21+55       0.1073      0.01  Q          |          |          |         V|
   22+ 0       0.1074      0.01  Q          |          |          |         V|
   22+ 5       0.1075      0.01  Q          |          |          |         V|
   22+10       0.1076      0.01  Q          |          |          |         V|
   22+15       0.1077      0.02  Q          |          |          |         V|
   22+20       0.1078      0.01  Q          |          |          |         V|
   22+25       0.1078      0.01  Q          |          |          |         V|
   22+30       0.1079      0.01  Q          |          |          |         V|
   22+35       0.1080      0.01  Q          |          |          |         V|
   22+40       0.1081      0.01  Q          |          |          |         V|
   22+45       0.1081      0.01  Q          |          |          |         V|
   22+50       0.1082      0.01  Q          |          |          |         V|
   22+55       0.1083      0.01  Q          |          |          |         V|
   23+ 0       0.1084      0.01  Q          |          |          |         V|
   23+ 5       0.1084      0.01  Q          |          |          |         V|
   23+10       0.1085      0.01  Q          |          |          |         V|
   23+15       0.1086      0.01  Q          |          |          |         V|
   23+20       0.1086      0.01  Q          |          |          |         V|
   23+25       0.1087      0.01  Q          |          |          |         V|
   23+30       0.1088      0.01  Q          |          |          |         V|
   23+35       0.1089      0.01  Q          |          |          |         V|
   23+40       0.1089      0.01  Q          |          |          |         V|
   23+45       0.1090      0.01  Q          |          |          |         V|
   23+50       0.1091      0.01  Q          |          |          |         V|
   23+55       0.1092      0.01  Q          |          |          |         V|
   24+ 0       0.1092      0.01  Q          |          |          |         V|
   24+ 5       0.1093      0.01  Q          |          |          |         V|
   24+10       0.1093      0.00  Q          |          |          |         V|
   24+15       0.1093      0.00  Q          |          |          |         V|
   24+20       0.1093      0.00  Q          |          |          |         V|
   24+25       0.1093      0.00  Q          |          |          |         V|
   24+30       0.1093      0.00  Q          |          |          |         V|
   24+35       0.1093      0.00  Q          |          |          |         V|
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U n i t H y d r o g r a p h A n a l y s i s

Study date 10/26/20 File: PRO12242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

Drainage Area = 6.56(Ac.) = 0.010 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 6.56(Ac.) = 0.010 Sq. Mi.
Length along longest watercourse = 1546.00(Ft.)
Length along longest watercourse measured to centroid = 773.00(Ft.)
Length along longest watercourse = 0.293 Mi.
Length along longest watercourse measured to centroid = 0.146 Mi.
Difference in elevation = 37.50(Ft.)
Slope along watercourse = 128.0724 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time = 0.072 Hr.
Lag time = 4.33 Min.
25% of lag time = 1.08 Min.
40% of lag time = 1.73 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.56	2.00	13.12

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.56	6.00	39.36

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 2.000(In)
Area Averaged 100-Year Rainfall = 6.000(In)

Point rain (area averaged) = 2.000(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.000(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
6.560	85.50	0.300

Total Area Entered = 6.56(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
85.5	70.8	0.353	0.300	0.257	1.000	0.257
					Sum (F) =	0.257

Area averaged mean soil loss (F) (In/Hr) = 0.257
Minimum soil loss rate ((In/Hr)) = 0.129
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.660

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)

1	0.083	115.579	23.904		1.580
2	0.167	231.158	48.822		3.228
3	0.250	346.736	13.713		0.907
4	0.333	462.315	6.256		0.414
5	0.417	577.894	3.484		0.230
6	0.500	693.473	2.079		0.137
7	0.583	809.051	1.742		0.115
			Sum = 100.000	Sum=	6.611

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.016	(0.456)	0.011	0.005
2	0.17	0.07	0.016	(0.454)	0.011	0.005
3	0.25	0.07	0.016	(0.453)	0.011	0.005
4	0.33	0.10	0.024	(0.451)	0.016	0.008
5	0.42	0.10	0.024	(0.449)	0.016	0.008
6	0.50	0.10	0.024	(0.447)	0.016	0.008
7	0.58	0.10	0.024	(0.446)	0.016	0.008
8	0.67	0.10	0.024	(0.444)	0.016	0.008
9	0.75	0.10	0.024	(0.442)	0.016	0.008
10	0.83	0.13	0.032	(0.440)	0.021	0.011
11	0.92	0.13	0.032	(0.439)	0.021	0.011
12	1.00	0.13	0.032	(0.437)	0.021	0.011
13	1.08	0.10	0.024	(0.435)	0.016	0.008
14	1.17	0.10	0.024	(0.434)	0.016	0.008
15	1.25	0.10	0.024	(0.432)	0.016	0.008
16	1.33	0.10	0.024	(0.430)	0.016	0.008
17	1.42	0.10	0.024	(0.428)	0.016	0.008
18	1.50	0.10	0.024	(0.427)	0.016	0.008
19	1.58	0.10	0.024	(0.425)	0.016	0.008
20	1.67	0.10	0.024	(0.423)	0.016	0.008
21	1.75	0.10	0.024	(0.422)	0.016	0.008
22	1.83	0.13	0.032	(0.420)	0.021	0.011
23	1.92	0.13	0.032	(0.418)	0.021	0.011
24	2.00	0.13	0.032	(0.417)	0.021	0.011
25	2.08	0.13	0.032	(0.415)	0.021	0.011
26	2.17	0.13	0.032	(0.413)	0.021	0.011
27	2.25	0.13	0.032	(0.411)	0.021	0.011
28	2.33	0.13	0.032	(0.410)	0.021	0.011
29	2.42	0.13	0.032	(0.408)	0.021	0.011
30	2.50	0.13	0.032	(0.406)	0.021	0.011
31	2.58	0.17	0.040	(0.405)	0.026	0.014
32	2.67	0.17	0.040	(0.403)	0.026	0.014
33	2.75	0.17	0.040	(0.401)	0.026	0.014
34	2.83	0.17	0.040	(0.400)	0.026	0.014
35	2.92	0.17	0.040	(0.398)	0.026	0.014
36	3.00	0.17	0.040	(0.397)	0.026	0.014
37	3.08	0.17	0.040	(0.395)	0.026	0.014
38	3.17	0.17	0.040	(0.393)	0.026	0.014
39	3.25	0.17	0.040	(0.392)	0.026	0.014
40	3.33	0.17	0.040	(0.390)	0.026	0.014
41	3.42	0.17	0.040	(0.388)	0.026	0.014
42	3.50	0.17	0.040	(0.387)	0.026	0.014
43	3.58	0.17	0.040	(0.385)	0.026	0.014
44	3.67	0.17	0.040	(0.384)	0.026	0.014
45	3.75	0.17	0.040	(0.382)	0.026	0.014
46	3.83	0.20	0.048	(0.380)	0.032	0.016
47	3.92	0.20	0.048	(0.379)	0.032	0.016
48	4.00	0.20	0.048	(0.377)	0.032	0.016
49	4.08	0.20	0.048	(0.375)	0.032	0.016
50	4.17	0.20	0.048	(0.374)	0.032	0.016
51	4.25	0.20	0.048	(0.372)	0.032	0.016
52	4.33	0.23	0.056	(0.371)	0.037	0.019
53	4.42	0.23	0.056	(0.369)	0.037	0.019
54	4.50	0.23	0.056	(0.368)	0.037	0.019
55	4.58	0.23	0.056	(0.366)	0.037	0.019
56	4.67	0.23	0.056	(0.364)	0.037	0.019
57	4.75	0.23	0.056	(0.363)	0.037	0.019
58	4.83	0.27	0.064	(0.361)	0.042	0.022
59	4.92	0.27	0.064	(0.360)	0.042	0.022
60	5.00	0.27	0.064	(0.358)	0.042	0.022
61	5.08	0.20	0.048	(0.357)	0.032	0.016
62	5.17	0.20	0.048	(0.355)	0.032	0.016
63	5.25	0.20	0.048	(0.353)	0.032	0.016
64	5.33	0.23	0.056	(0.352)	0.037	0.019
65	5.42	0.23	0.056	(0.350)	0.037	0.019
66	5.50	0.23	0.056	(0.349)	0.037	0.019
67	5.58	0.27	0.064	(0.347)	0.042	0.022
68	5.67	0.27	0.064	(0.346)	0.042	0.022
69	5.75	0.27	0.064	(0.344)	0.042	0.022
70	5.83	0.27	0.064	(0.343)	0.042	0.022
71	5.92	0.27	0.064	(0.341)	0.042	0.022

72	6.00	0.27	0.064	(0.340)	0.042	0.022
73	6.08	0.30	0.072	(0.338)	0.048	0.024
74	6.17	0.30	0.072	(0.337)	0.048	0.024
75	6.25	0.30	0.072	(0.335)	0.048	0.024
76	6.33	0.30	0.072	(0.334)	0.048	0.024
77	6.42	0.30	0.072	(0.332)	0.048	0.024
78	6.50	0.30	0.072	(0.331)	0.048	0.024
79	6.58	0.33	0.080	(0.329)	0.053	0.027
80	6.67	0.33	0.080	(0.328)	0.053	0.027
81	6.75	0.33	0.080	(0.326)	0.053	0.027
82	6.83	0.33	0.080	(0.325)	0.053	0.027
83	6.92	0.33	0.080	(0.323)	0.053	0.027
84	7.00	0.33	0.080	(0.322)	0.053	0.027
85	7.08	0.33	0.080	(0.320)	0.053	0.027
86	7.17	0.33	0.080	(0.319)	0.053	0.027
87	7.25	0.33	0.080	(0.317)	0.053	0.027
88	7.33	0.37	0.088	(0.316)	0.058	0.030
89	7.42	0.37	0.088	(0.315)	0.058	0.030
90	7.50	0.37	0.088	(0.313)	0.058	0.030
91	7.58	0.40	0.096	(0.312)	0.063	0.033
92	7.67	0.40	0.096	(0.310)	0.063	0.033
93	7.75	0.40	0.096	(0.309)	0.063	0.033
94	7.83	0.43	0.104	(0.307)	0.069	0.035
95	7.92	0.43	0.104	(0.306)	0.069	0.035
96	8.00	0.43	0.104	(0.305)	0.069	0.035
97	8.08	0.50	0.120	(0.303)	0.079	0.041
98	8.17	0.50	0.120	(0.302)	0.079	0.041
99	8.25	0.50	0.120	(0.300)	0.079	0.041
100	8.33	0.50	0.120	(0.299)	0.079	0.041
101	8.42	0.50	0.120	(0.298)	0.079	0.041
102	8.50	0.50	0.120	(0.296)	0.079	0.041
103	8.58	0.53	0.128	(0.295)	0.084	0.044
104	8.67	0.53	0.128	(0.293)	0.084	0.044
105	8.75	0.53	0.128	(0.292)	0.084	0.044
106	8.83	0.57	0.136	(0.291)	0.090	0.046
107	8.92	0.57	0.136	(0.289)	0.090	0.046
108	9.00	0.57	0.136	(0.288)	0.090	0.046
109	9.08	0.63	0.152	(0.287)	0.100	0.052
110	9.17	0.63	0.152	(0.285)	0.100	0.052
111	9.25	0.63	0.152	(0.284)	0.100	0.052
112	9.33	0.67	0.160	(0.282)	0.106	0.054
113	9.42	0.67	0.160	(0.281)	0.106	0.054
114	9.50	0.67	0.160	(0.280)	0.106	0.054
115	9.58	0.70	0.168	(0.278)	0.111	0.057
116	9.67	0.70	0.168	(0.277)	0.111	0.057
117	9.75	0.70	0.168	(0.276)	0.111	0.057
118	9.83	0.73	0.176	(0.274)	0.116	0.060
119	9.92	0.73	0.176	(0.273)	0.116	0.060
120	10.00	0.73	0.176	(0.272)	0.116	0.060
121	10.08	0.50	0.120	(0.270)	0.079	0.041
122	10.17	0.50	0.120	(0.269)	0.079	0.041
123	10.25	0.50	0.120	(0.268)	0.079	0.041
124	10.33	0.50	0.120	(0.267)	0.079	0.041
125	10.42	0.50	0.120	(0.265)	0.079	0.041
126	10.50	0.50	0.120	(0.264)	0.079	0.041
127	10.58	0.67	0.160	(0.263)	0.106	0.054
128	10.67	0.67	0.160	(0.261)	0.106	0.054
129	10.75	0.67	0.160	(0.260)	0.106	0.054
130	10.83	0.67	0.160	(0.259)	0.106	0.054
131	10.92	0.67	0.160	(0.258)	0.106	0.054
132	11.00	0.67	0.160	(0.256)	0.106	0.054
133	11.08	0.63	0.152	(0.255)	0.100	0.052
134	11.17	0.63	0.152	(0.254)	0.100	0.052
135	11.25	0.63	0.152	(0.253)	0.100	0.052
136	11.33	0.63	0.152	(0.251)	0.100	0.052
137	11.42	0.63	0.152	(0.250)	0.100	0.052
138	11.50	0.63	0.152	(0.249)	0.100	0.052
139	11.58	0.57	0.136	(0.248)	0.090	0.046
140	11.67	0.57	0.136	(0.246)	0.090	0.046
141	11.75	0.57	0.136	(0.245)	0.090	0.046
142	11.83	0.60	0.144	(0.244)	0.095	0.049
143	11.92	0.60	0.144	(0.243)	0.095	0.049
144	12.00	0.60	0.144	(0.241)	0.095	0.049
145	12.08	0.83	0.200	(0.240)	0.132	0.068
146	12.17	0.83	0.200	(0.239)	0.132	0.068
147	12.25	0.83	0.200	(0.238)	0.132	0.068
148	12.33	0.87	0.208	(0.237)	0.137	0.071
149	12.42	0.87	0.208	(0.235)	0.137	0.071
150	12.50	0.87	0.208	(0.234)	0.137	0.071
151	12.58	0.93	0.224	(0.233)	0.148	0.076
152	12.67	0.93	0.224	(0.232)	0.148	0.076
153	12.75	0.93	0.224	(0.231)	0.148	0.076
154	12.83	0.97	0.232	(0.230)	0.153	0.079
155	12.92	0.97	0.232	(0.228)	0.153	0.079
156	13.00	0.97	0.232	(0.227)	0.153	0.079
157	13.08	1.13	0.272	(0.226)	0.180	0.092
158	13.17	1.13	0.272	(0.225)	0.180	0.092

159	13.25	1.13	0.272	(0.224)	0.180	0.092
160	13.33	1.13	0.272	(0.223)	0.180	0.092
161	13.42	1.13	0.272	(0.222)	0.180	0.092
162	13.50	1.13	0.272	(0.220)	0.180	0.092
163	13.58	0.77	0.184	(0.219)	0.121	0.063
164	13.67	0.77	0.184	(0.218)	0.121	0.063
165	13.75	0.77	0.184	(0.217)	0.121	0.063
166	13.83	0.77	0.184	(0.216)	0.121	0.063
167	13.92	0.77	0.184	(0.215)	0.121	0.063
168	14.00	0.77	0.184	(0.214)	0.121	0.063
169	14.08	0.90	0.216	(0.213)	0.143	0.073
170	14.17	0.90	0.216	(0.212)	0.143	0.073
171	14.25	0.90	0.216	(0.211)	0.143	0.073
172	14.33	0.87	0.208	(0.209)	0.137	0.071
173	14.42	0.87	0.208	(0.208)	0.137	0.071
174	14.50	0.87	0.208	(0.207)	0.137	0.071
175	14.58	0.87	0.208	(0.206)	0.137	0.071
176	14.67	0.87	0.208	(0.205)	0.137	0.071
177	14.75	0.87	0.208	(0.204)	0.137	0.071
178	14.83	0.83	0.200	(0.203)	0.132	0.068
179	14.92	0.83	0.200	(0.202)	0.132	0.068
180	15.00	0.83	0.200	(0.201)	0.132	0.068
181	15.08	0.80	0.192	(0.200)	0.127	0.065
182	15.17	0.80	0.192	(0.199)	0.127	0.065
183	15.25	0.80	0.192	(0.198)	0.127	0.065
184	15.33	0.77	0.184	(0.197)	0.121	0.063
185	15.42	0.77	0.184	(0.196)	0.121	0.063
186	15.50	0.77	0.184	(0.195)	0.121	0.063
187	15.58	0.63	0.152	(0.194)	0.100	0.052
188	15.67	0.63	0.152	(0.193)	0.100	0.052
189	15.75	0.63	0.152	(0.192)	0.100	0.052
190	15.83	0.63	0.152	(0.191)	0.100	0.052
191	15.92	0.63	0.152	(0.190)	0.100	0.052
192	16.00	0.63	0.152	(0.189)	0.100	0.052
193	16.08	0.13	0.032	(0.188)	0.021	0.011
194	16.17	0.13	0.032	(0.187)	0.021	0.011
195	16.25	0.13	0.032	(0.186)	0.021	0.011
196	16.33	0.13	0.032	(0.185)	0.021	0.011
197	16.42	0.13	0.032	(0.184)	0.021	0.011
198	16.50	0.13	0.032	(0.183)	0.021	0.011
199	16.58	0.10	0.024	(0.182)	0.016	0.008
200	16.67	0.10	0.024	(0.181)	0.016	0.008
201	16.75	0.10	0.024	(0.181)	0.016	0.008
202	16.83	0.10	0.024	(0.180)	0.016	0.008
203	16.92	0.10	0.024	(0.179)	0.016	0.008
204	17.00	0.10	0.024	(0.178)	0.016	0.008
205	17.08	0.17	0.040	(0.177)	0.026	0.014
206	17.17	0.17	0.040	(0.176)	0.026	0.014
207	17.25	0.17	0.040	(0.175)	0.026	0.014
208	17.33	0.17	0.040	(0.174)	0.026	0.014
209	17.42	0.17	0.040	(0.173)	0.026	0.014
210	17.50	0.17	0.040	(0.172)	0.026	0.014
211	17.58	0.17	0.040	(0.172)	0.026	0.014
212	17.67	0.17	0.040	(0.171)	0.026	0.014
213	17.75	0.17	0.040	(0.170)	0.026	0.014
214	17.83	0.13	0.032	(0.169)	0.021	0.011
215	17.92	0.13	0.032	(0.168)	0.021	0.011
216	18.00	0.13	0.032	(0.167)	0.021	0.011
217	18.08	0.13	0.032	(0.167)	0.021	0.011
218	18.17	0.13	0.032	(0.166)	0.021	0.011
219	18.25	0.13	0.032	(0.165)	0.021	0.011
220	18.33	0.13	0.032	(0.164)	0.021	0.011
221	18.42	0.13	0.032	(0.163)	0.021	0.011
222	18.50	0.13	0.032	(0.163)	0.021	0.011
223	18.58	0.10	0.024	(0.162)	0.016	0.008
224	18.67	0.10	0.024	(0.161)	0.016	0.008
225	18.75	0.10	0.024	(0.160)	0.016	0.008
226	18.83	0.07	0.016	(0.159)	0.011	0.005
227	18.92	0.07	0.016	(0.159)	0.011	0.005
228	19.00	0.07	0.016	(0.158)	0.011	0.005
229	19.08	0.10	0.024	(0.157)	0.016	0.008
230	19.17	0.10	0.024	(0.156)	0.016	0.008
231	19.25	0.10	0.024	(0.156)	0.016	0.008
232	19.33	0.13	0.032	(0.155)	0.021	0.011
233	19.42	0.13	0.032	(0.154)	0.021	0.011
234	19.50	0.13	0.032	(0.154)	0.021	0.011
235	19.58	0.10	0.024	(0.153)	0.016	0.008
236	19.67	0.10	0.024	(0.152)	0.016	0.008
237	19.75	0.10	0.024	(0.151)	0.016	0.008
238	19.83	0.07	0.016	(0.151)	0.011	0.005
239	19.92	0.07	0.016	(0.150)	0.011	0.005
240	20.00	0.07	0.016	(0.149)	0.011	0.005
241	20.08	0.10	0.024	(0.149)	0.016	0.008
242	20.17	0.10	0.024	(0.148)	0.016	0.008
243	20.25	0.10	0.024	(0.147)	0.016	0.008
244	20.33	0.10	0.024	(0.147)	0.016	0.008
245	20.42	0.10	0.024	(0.146)	0.016	0.008

246	20.50	0.10	0.024	(	0.146)	0.016	0.008
247	20.58	0.10	0.024	(	0.145)	0.016	0.008
248	20.67	0.10	0.024	(	0.144)	0.016	0.008
249	20.75	0.10	0.024	(	0.144)	0.016	0.008
250	20.83	0.07	0.016	(	0.143)	0.011	0.005
251	20.92	0.07	0.016	(	0.143)	0.011	0.005
252	21.00	0.07	0.016	(	0.142)	0.011	0.005
253	21.08	0.10	0.024	(	0.141)	0.016	0.008
254	21.17	0.10	0.024	(	0.141)	0.016	0.008
255	21.25	0.10	0.024	(	0.140)	0.016	0.008
256	21.33	0.07	0.016	(	0.140)	0.011	0.005
257	21.42	0.07	0.016	(	0.139)	0.011	0.005
258	21.50	0.07	0.016	(	0.139)	0.011	0.005
259	21.58	0.10	0.024	(	0.138)	0.016	0.008
260	21.67	0.10	0.024	(	0.138)	0.016	0.008
261	21.75	0.10	0.024	(	0.137)	0.016	0.008
262	21.83	0.07	0.016	(	0.137)	0.011	0.005
263	21.92	0.07	0.016	(	0.136)	0.011	0.005
264	22.00	0.07	0.016	(	0.136)	0.011	0.005
265	22.08	0.10	0.024	(	0.135)	0.016	0.008
266	22.17	0.10	0.024	(	0.135)	0.016	0.008
267	22.25	0.10	0.024	(	0.135)	0.016	0.008
268	22.33	0.07	0.016	(	0.134)	0.011	0.005
269	22.42	0.07	0.016	(	0.134)	0.011	0.005
270	22.50	0.07	0.016	(	0.133)	0.011	0.005
271	22.58	0.07	0.016	(	0.133)	0.011	0.005
272	22.67	0.07	0.016	(	0.133)	0.011	0.005
273	22.75	0.07	0.016	(	0.132)	0.011	0.005
274	22.83	0.07	0.016	(	0.132)	0.011	0.005
275	22.92	0.07	0.016	(	0.132)	0.011	0.005
276	23.00	0.07	0.016	(	0.131)	0.011	0.005
277	23.08	0.07	0.016	(	0.131)	0.011	0.005
278	23.17	0.07	0.016	(	0.131)	0.011	0.005
279	23.25	0.07	0.016	(	0.130)	0.011	0.005
280	23.33	0.07	0.016	(	0.130)	0.011	0.005
281	23.42	0.07	0.016	(	0.130)	0.011	0.005
282	23.50	0.07	0.016	(	0.130)	0.011	0.005
283	23.58	0.07	0.016	(	0.129)	0.011	0.005
284	23.67	0.07	0.016	(	0.129)	0.011	0.005
285	23.75	0.07	0.016	(	0.129)	0.011	0.005
286	23.83	0.07	0.016	(	0.129)	0.011	0.005
287	23.92	0.07	0.016	(	0.129)	0.011	0.005
288	24.00	0.07	0.016	(	0.129)	0.011	0.005

(Loss Rate Not Used)

Sum = 100.0 Sum = 8.2

Flood volume = Effective rainfall 0.68(In)
times area 6.6(Ac.)/[(In)/(Ft.)] = 0.4(Ac.Ft)
Total soil loss = 1.32(In)
Total soil loss = 0.722(Ac.Ft)
Total rainfall = 2.00(In)
Flood volume = 16192.5 Cubic Feet
Total soil loss = 31432.5 Cubic Feet

Peak flow rate of this hydrograph = 0.610(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0001	0.01	Q	|	|	|	|
0+10	0.0002	0.03	Q	|	|	|	|
0+15	0.0005	0.03	Q	|	|	|	|
0+20	0.0007	0.04	Q	|	|	|	|
0+25	0.0010	0.05	Q	|	|	|	|
0+30	0.0014	0.05	Q	|	|	|	|
0+35	0.0018	0.05	Q	|	|	|	|
0+40	0.0021	0.05	Q	|	|	|	|
0+45	0.0025	0.05	Q	|	|	|	|
0+50	0.0029	0.06	Q	|	|	|	|
0+55	0.0034	0.07	Q	|	|	|	|
1+ 0	0.0038	0.07	Q	|	|	|	|
1+ 5	0.0043	0.07	Q	|	|	|	|
1+10	0.0047	0.06	Q	|	|	|	|
1+15	0.0051	0.06	Q	|	|	|	|
1+20	0.0055	0.06	Q	|	|	|	|
1+25	0.0058	0.05	Q	|	|	|	|
1+30	0.0062	0.05	Q	|	|	|	|
1+35	0.0066	0.05	Q	|	|	|	|
1+40	0.0070	0.05	Q	|	|	|	|
1+45	0.0073	0.05	Q	|	|	|	|
1+50	0.0077	0.06	Q	|	|	|	|
1+55	0.0082	0.07	Q	|	|	|	|

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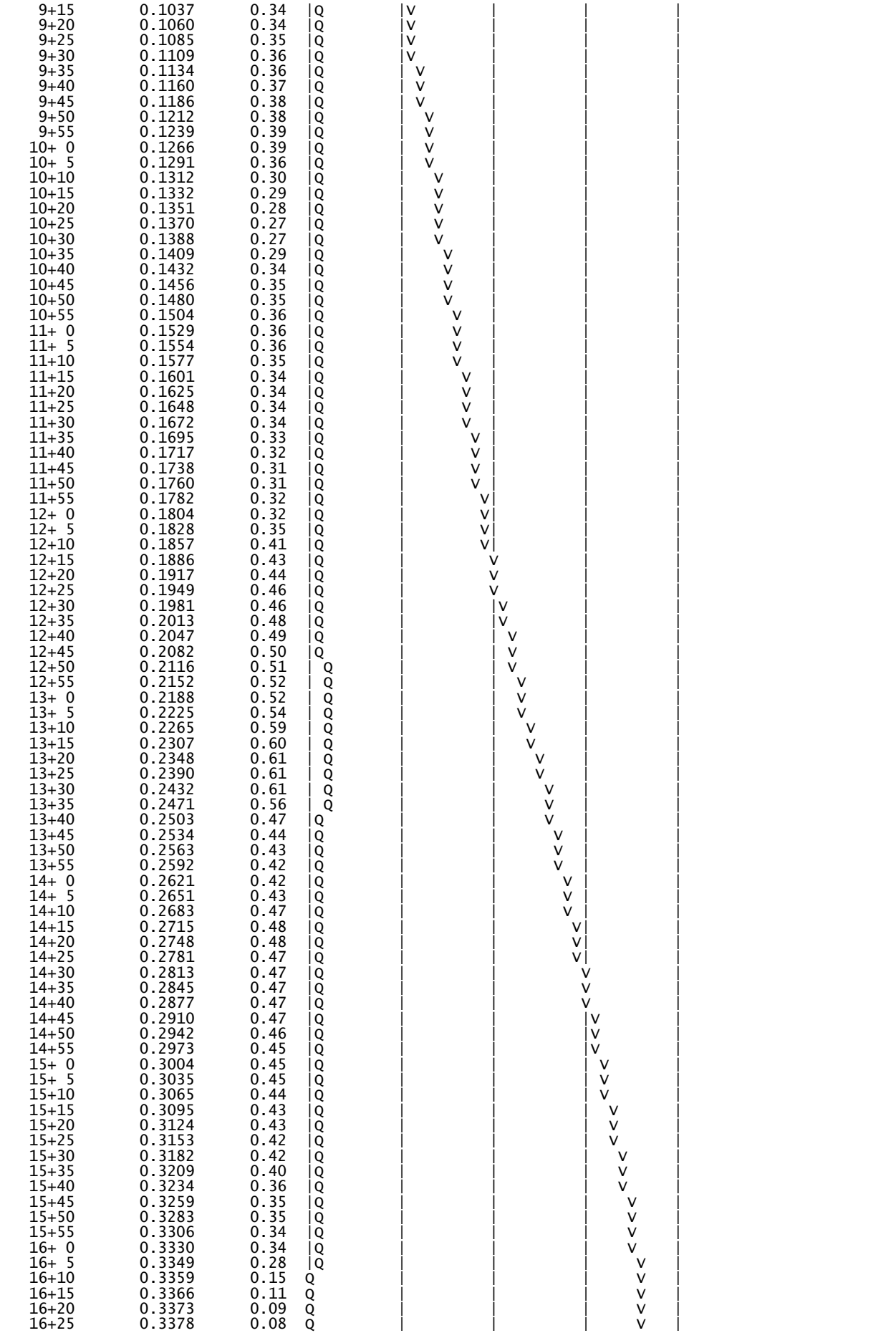
2+ 0       0.0087      0.07  Q          |          |          |          |
2+ 5       0.0092      0.07  Q          |          |          |          |
2+10       0.0096      0.07  QV         |          |          |          |
2+15       0.0101      0.07  QV         |          |          |          |
2+20       0.0106      0.07  QV         |          |          |          |
2+25       0.0111      0.07  QV         |          |          |          |
2+30       0.0116      0.07  QV         |          |          |          |
2+35       0.0121      0.08  QV         |          |          |          |
2+40       0.0127      0.09  QV         |          |          |          |
2+45       0.0133      0.09  QV         |          |          |          |
2+50       0.0139      0.09  QV         |          |          |          |
2+55       0.0146      0.09  QV         |          |          |          |
3+ 0       0.0152      0.09  QV         |          |          |          |
3+ 5       0.0158      0.09  QV         |          |          |          |
3+10       0.0164      0.09  QV         |          |          |          |
3+15       0.0170      0.09  QV         |          |          |          |
3+20       0.0177      0.09  QV         |          |          |          |
3+25       0.0183      0.09  QV         |          |          |          |
3+30       0.0189      0.09  Q V        |          |          |          |
3+35       0.0195      0.09  Q V        |          |          |          |
3+40       0.0201      0.09  Q V        |          |          |          |
3+45       0.0208      0.09  Q V        |          |          |          |
3+50       0.0214      0.09  Q V        |          |          |          |
3+55       0.0221      0.10  Q V        |          |          |          |
4+ 0       0.0228      0.11  Q V        |          |          |          |
4+ 5       0.0236      0.11  Q V        |          |          |          |
4+10       0.0243      0.11  Q V        |          |          |          |
4+15       0.0251      0.11  Q V        |          |          |          |
4+20       0.0258      0.11  Q V        |          |          |          |
4+25       0.0267      0.12  Q V        |          |          |          |
4+30       0.0275      0.12  Q V        |          |          |          |
4+35       0.0284      0.12  Q  V       |          |          |          |
4+40       0.0292      0.13  Q  V       |          |          |          |
4+45       0.0301      0.13  Q  V       |          |          |          |
4+50       0.0310      0.13  Q  V       |          |          |          |
4+55       0.0320      0.14  Q  V       |          |          |          |
5+ 0       0.0329      0.14  Q  V       |          |          |          |
5+ 5       0.0339      0.13  Q  V       |          |          |          |
5+10       0.0347      0.12  Q  V       |          |          |          |
5+15       0.0354      0.11  Q  V       |          |          |          |
5+20       0.0362      0.11  Q  V       |          |          |          |
5+25       0.0371      0.12  Q  V       |          |          |          |
5+30       0.0379      0.12  Q   V      |          |          |          |
5+35       0.0388      0.13  Q   V      |          |          |          |
5+40       0.0398      0.14  Q   V      |          |          |          |
5+45       0.0407      0.14  Q   V      |          |          |          |
5+50       0.0417      0.14  Q   V      |          |          |          |
5+55       0.0427      0.14  Q   V      |          |          |          |
6+ 0       0.0437      0.14  Q   V      |          |          |          |
6+ 5       0.0447      0.15  Q   V      |          |          |          |
6+10       0.0458      0.16  Q   V      |          |          |          |
6+15       0.0469      0.16  Q    V     |          |          |          |
6+20       0.0480      0.16  Q    V     |          |          |          |
6+25       0.0491      0.16  Q    V     |          |          |          |
6+30       0.0502      0.16  Q    V     |          |          |          |
6+35       0.0514      0.17  Q    V     |          |          |          |
6+40       0.0526      0.18  Q    V     |          |          |          |
6+45       0.0538      0.18  Q    V     |          |          |          |
6+50       0.0550      0.18  Q    V     |          |          |          |
6+55       0.0563      0.18  Q     V    |          |          |          |
7+ 0       0.0575      0.18  Q     V    |          |          |          |
7+ 5       0.0587      0.18  Q     V    |          |          |          |
7+10       0.0600      0.18  Q     V    |          |          |          |
7+15       0.0612      0.18  Q     V    |          |          |          |
7+20       0.0625      0.18  Q     V    |          |          |          |
7+25       0.0638      0.19  Q     V    |          |          |          |
7+30       0.0652      0.20  Q      V   |          |          |          |
7+35       0.0665      0.20  Q      V   |          |          |          |
7+40       0.0680      0.21  Q      V   |          |          |          |
7+45       0.0695      0.21  Q      V   |          |          |          |
7+50       0.0710      0.22  Q      V   |          |          |          |
7+55       0.0725      0.23  Q      V   |          |          |          |
8+ 0       0.0741      0.23  Q      V   |          |          |          |
8+ 5       0.0758      0.24  Q       V  |          |          |          |
8+10       0.0776      0.26  |Q      V  |          |          |          |
8+15       0.0794      0.26  |Q      V  |          |          |          |
8+20       0.0812      0.27  |Q      V  |          |          |          |
8+25       0.0831      0.27  |Q      V  |          |          |          |
8+30       0.0849      0.27  |Q       V|          |          |          |
8+35       0.0868      0.27  |Q       V|          |          |          |
8+40       0.0888      0.28  |Q       V|          |          |          |
8+45       0.0907      0.29  |Q       V|          |          |          |
8+50       0.0927      0.29  |Q       V|          |          |          |
8+55       0.0948      0.30  |Q        V          |          |          |
9+ 0       0.0969      0.30  |Q        V          |          |          |
9+ 5       0.0991      0.31  |Q        V          |          |          |
9+10       0.1013      0.33  |Q        V          |          |          |
```



9+15	0.1037	0.34	Q	V			
9+20	0.1060	0.34	Q	V			
9+25	0.1085	0.35	Q	V			
9+30	0.1109	0.36	Q	V			
9+35	0.1134	0.36	Q	V			
9+40	0.1160	0.37	Q	V			
9+45	0.1186	0.38	Q	V			
9+50	0.1212	0.38	Q	V			
9+55	0.1239	0.39	Q	V			
10+ 0	0.1266	0.39	Q	V			
10+ 5	0.1291	0.36	Q	V			
10+10	0.1312	0.30	Q	V			
10+15	0.1332	0.29	Q	V			
10+20	0.1351	0.28	Q	V			
10+25	0.1370	0.27	Q	V			
10+30	0.1388	0.27	Q	V			
10+35	0.1409	0.29	Q	V			
10+40	0.1432	0.34	Q	V			
10+45	0.1456	0.35	Q	V			
10+50	0.1480	0.35	Q	V			
10+55	0.1504	0.36	Q	V			
11+ 0	0.1529	0.36	Q	V			
11+ 5	0.1554	0.36	Q	V			
11+10	0.1577	0.35	Q	V			
11+15	0.1601	0.34	Q	V			
11+20	0.1625	0.34	Q	V			
11+25	0.1648	0.34	Q	V			
11+30	0.1672	0.34	Q	V			
11+35	0.1695	0.33	Q	V			
11+40	0.1717	0.32	Q	V			
11+45	0.1738	0.31	Q	V			
11+50	0.1760	0.31	Q	V			
11+55	0.1782	0.32	Q	V			
12+ 0	0.1804	0.32	Q	V			
12+ 5	0.1828	0.35	Q	V			
12+10	0.1857	0.41	Q	V			
12+15	0.1886	0.43	Q	V			
12+20	0.1917	0.44	Q	V			
12+25	0.1949	0.46	Q	V			
12+30	0.1981	0.46	Q	V			
12+35	0.2013	0.48	Q	V			
12+40	0.2047	0.49	Q	V			
12+45	0.2082	0.50	Q	V			
12+50	0.2116	0.51	Q	V			
12+55	0.2152	0.52	Q	V			
13+ 0	0.2188	0.52	Q	V			
13+ 5	0.2225	0.54	Q	V			
13+10	0.2265	0.59	Q	V			
13+15	0.2307	0.60	Q	V			
13+20	0.2348	0.61	Q	V			
13+25	0.2390	0.61	Q	V			
13+30	0.2432	0.61	Q	V			
13+35	0.2471	0.56	Q	V			
13+40	0.2503	0.47	Q	V			
13+45	0.2534	0.44	Q	V			
13+50	0.2563	0.43	Q	V			
13+55	0.2592	0.42	Q	V			
14+ 0	0.2621	0.42	Q	V			
14+ 5	0.2651	0.43	Q	V			
14+10	0.2683	0.47	Q	V			
14+15	0.2715	0.48	Q	V			
14+20	0.2748	0.48	Q	V			
14+25	0.2781	0.47	Q	V			
14+30	0.2813	0.47	Q	V			
14+35	0.2845	0.47	Q	V			
14+40	0.2877	0.47	Q	V			
14+45	0.2910	0.47	Q	V			
14+50	0.2942	0.46	Q	V			
14+55	0.2973	0.45	Q	V			
15+ 0	0.3004	0.45	Q	V			
15+ 5	0.3035	0.45	Q	V			
15+10	0.3065	0.44	Q	V			
15+15	0.3095	0.43	Q	V			
15+20	0.3124	0.43	Q	V			
15+25	0.3153	0.42	Q	V			
15+30	0.3182	0.42	Q	V			
15+35	0.3209	0.40	Q	V			
15+40	0.3234	0.36	Q	V			
15+45	0.3259	0.35	Q	V			
15+50	0.3283	0.35	Q	V			
15+55	0.3306	0.34	Q	V			
16+ 0	0.3330	0.34	Q	V			
16+ 5	0.3349	0.28	Q	V			
16+10	0.3359	0.15	Q	V			
16+15	0.3366	0.11	Q	V			
16+20	0.3373	0.09	Q	V			
16+25	0.3378	0.08	Q	V			

16+30	0.3384	0.08	Q	|	|	|	V |
16+35	0.3388	0.07	Q	|	|	|	V |
16+40	0.3392	0.06	Q	|	|	|	V |
16+45	0.3396	0.06	Q	|	|	|	V |
16+50	0.3400	0.06	Q	|	|	|	V |
16+55	0.3404	0.05	Q	|	|	|	V |
17+ 0	0.3408	0.05	Q	|	|	|	V |
17+ 5	0.3412	0.06	Q	|	|	|	V |
17+10	0.3417	0.08	Q	|	|	|	V |
17+15	0.3423	0.09	Q	|	|	|	V |
17+20	0.3429	0.09	Q	|	|	|	V |
17+25	0.3435	0.09	Q	|	|	|	V |
17+30	0.3442	0.09	Q	|	|	|	V |
17+35	0.3448	0.09	Q	|	|	|	V |
17+40	0.3454	0.09	Q	|	|	|	V |
17+45	0.3460	0.09	Q	|	|	|	V |
17+50	0.3466	0.09	Q	|	|	|	V |
17+55	0.3471	0.08	Q	|	|	|	V |
18+ 0	0.3477	0.07	Q	|	|	|	V |
18+ 5	0.3482	0.07	Q	|	|	|	V |
18+10	0.3487	0.07	Q	|	|	|	V |
18+15	0.3492	0.07	Q	|	|	|	V |
18+20	0.3496	0.07	Q	|	|	|	V |
18+25	0.3501	0.07	Q	|	|	|	V |
18+30	0.3506	0.07	Q	|	|	|	V |
18+35	0.3511	0.07	Q	|	|	|	V |
18+40	0.3515	0.06	Q	|	|	|	V |
18+45	0.3519	0.06	Q	|	|	|	V |
18+50	0.3523	0.05	Q	|	|	|	V |
18+55	0.3525	0.04	Q	|	|	|	V |
19+ 0	0.3528	0.04	Q	|	|	|	V |
19+ 5	0.3531	0.04	Q	|	|	|	V |
19+10	0.3534	0.05	Q	|	|	|	V |
19+15	0.3538	0.05	Q	|	|	|	V |
19+20	0.3542	0.06	Q	|	|	|	V |
19+25	0.3546	0.07	Q	|	|	|	V |
19+30	0.3551	0.07	Q	|	|	|	V |
19+35	0.3556	0.07	Q	|	|	|	V |
19+40	0.3560	0.06	Q	|	|	|	V |
19+45	0.3564	0.06	Q	|	|	|	V |
19+50	0.3567	0.05	Q	|	|	|	V |
19+55	0.3570	0.04	Q	|	|	|	V |
20+ 0	0.3573	0.04	Q	|	|	|	V |
20+ 5	0.3576	0.04	Q	|	|	|	V |
20+10	0.3579	0.05	Q	|	|	|	V |
20+15	0.3583	0.05	Q	|	|	|	V |
20+20	0.3586	0.05	Q	|	|	|	V |
20+25	0.3590	0.05	Q	|	|	|	V |
20+30	0.3594	0.05	Q	|	|	|	V |
20+35	0.3597	0.05	Q	|	|	|	V |
20+40	0.3601	0.05	Q	|	|	|	V |
20+45	0.3605	0.05	Q	|	|	|	V |
20+50	0.3608	0.05	Q	|	|	|	V |
20+55	0.3611	0.04	Q	|	|	|	V |
21+ 0	0.3614	0.04	Q	|	|	|	V |
21+ 5	0.3616	0.04	Q	|	|	|	V |
21+10	0.3620	0.05	Q	|	|	|	V |
21+15	0.3623	0.05	Q	|	|	|	V |
21+20	0.3627	0.05	Q	|	|	|	V|
21+25	0.3630	0.04	Q	|	|	|	V|
21+30	0.3632	0.04	Q	|	|	|	V|
21+35	0.3635	0.04	Q	|	|	|	V|
21+40	0.3638	0.05	Q	|	|	|	V|
21+45	0.3642	0.05	Q	|	|	|	V|
21+50	0.3645	0.05	Q	|	|	|	V|
21+55	0.3648	0.04	Q	|	|	|	V|
22+ 0	0.3651	0.04	Q	|	|	|	V|
22+ 5	0.3654	0.04	Q	|	|	|	V|
22+10	0.3657	0.05	Q	|	|	|	V|
22+15	0.3661	0.05	Q	|	|	|	V|
22+20	0.3664	0.05	Q	|	|	|	V|
22+25	0.3667	0.04	Q	|	|	|	V|
22+30	0.3669	0.04	Q	|	|	|	V|
22+35	0.3672	0.04	Q	|	|	|	V|
22+40	0.3674	0.04	Q	|	|	|	V|
22+45	0.3677	0.04	Q	|	|	|	V|
22+50	0.3679	0.04	Q	|	|	|	V|
22+55	0.3682	0.04	Q	|	|	|	V|
23+ 0	0.3684	0.04	Q	|	|	|	V|
23+ 5	0.3687	0.04	Q	|	|	|	V|
23+10	0.3689	0.04	Q	|	|	|	V|
23+15	0.3692	0.04	Q	|	|	|	V|
23+20	0.3694	0.04	Q	|	|	|	V|
23+25	0.3697	0.04	Q	|	|	|	V|
23+30	0.3699	0.04	Q	|	|	|	V|
23+35	0.3702	0.04	Q	|	|	|	V|
23+40	0.3704	0.04	Q	|	|	|	V|

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   23+45       0.3707      0.04  Q          |          |          |         V|
   23+50       0.3709      0.04  Q          |          |          |         V|
   23+55       0.3712      0.04  Q          |          |          |         V|
   24+ 0       0.3714      0.04  Q          |          |          |         V|
   24+ 5       0.3716      0.03  Q          |          |          |         V|
   24+10       0.3717      0.01  Q          |          |          |         V|
   24+15       0.3717      0.00  Q          |          |          |         V|
   24+20       0.3717      0.00  Q          |          |          |         V|
   24+25       0.3717      0.00  Q          |          |          |         V|
   24+30       0.3717      0.00  Q          |          |          |          V
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U n i t H y d r o g r a p h A n a l y s i s

Study date 10/26/20 File: EX22242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

Drainage Area = 8.85(Ac.) = 0.014 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 8.85(Ac.) = 0.014 Sq. Mi.
Length along longest watercourse = 850.00(Ft.)
Length along longest watercourse measured to centroid = 425.00(Ft.)
Length along longest watercourse = 0.161 Mi.
Length along longest watercourse measured to centroid = 0.080 Mi.
Difference in elevation = 28.00(Ft.)
Slope along watercourse = 173.9294 Ft./Mi.
Average Manning's 'N' = 0.030
Lag time = 0.052 Hr.
Lag time = 3.11 Min.
25% of lag time = 0.78 Min.
40% of lag time = 1.24 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
8.85	2.00	17.70

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
8.85	6.00	53.10

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 2.000(In)
Area Averaged 100-Year Rainfall = 6.000(In)

Point rain (area averaged) = 2.000(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.000(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
8.850	85.50	0.000

Total Area Entered = 8.85(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
85.5	70.8	0.353	0.000	0.353	1.000	0.353
					Sum (F) =	0.353

Area averaged mean soil loss (F) (In/Hr) = 0.353
Minimum soil loss rate ((In/Hr)) = 0.176
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.900

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	160.839	35.698	3.184
2	0.167	321.678	46.205	4.121
3	0.250	482.518	10.589	0.944
4	0.333	643.357	4.553	0.406
5	0.417	804.196	2.955	0.264
			Sum = 100.000	Sum= 8.919

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.016	(0.625)	0.014	0.002
2	0.17	0.07	0.016	(0.623)	0.014	0.002
3	0.25	0.07	0.016	(0.620)	0.014	0.002
4	0.33	0.10	0.024	(0.618)	0.022	0.002
5	0.42	0.10	0.024	(0.615)	0.022	0.002
6	0.50	0.10	0.024	(0.613)	0.022	0.002
7	0.58	0.10	0.024	(0.611)	0.022	0.002
8	0.67	0.10	0.024	(0.608)	0.022	0.002
9	0.75	0.10	0.024	(0.606)	0.022	0.002
10	0.83	0.13	0.032	(0.603)	0.029	0.003
11	0.92	0.13	0.032	(0.601)	0.029	0.003
12	1.00	0.13	0.032	(0.599)	0.029	0.003
13	1.08	0.10	0.024	(0.596)	0.022	0.002
14	1.17	0.10	0.024	(0.594)	0.022	0.002
15	1.25	0.10	0.024	(0.592)	0.022	0.002
16	1.33	0.10	0.024	(0.589)	0.022	0.002
17	1.42	0.10	0.024	(0.587)	0.022	0.002
18	1.50	0.10	0.024	(0.585)	0.022	0.002
19	1.58	0.10	0.024	(0.582)	0.022	0.002
20	1.67	0.10	0.024	(0.580)	0.022	0.002
21	1.75	0.10	0.024	(0.578)	0.022	0.002
22	1.83	0.13	0.032	(0.575)	0.029	0.003
23	1.92	0.13	0.032	(0.573)	0.029	0.003
24	2.00	0.13	0.032	(0.571)	0.029	0.003
25	2.08	0.13	0.032	(0.568)	0.029	0.003
26	2.17	0.13	0.032	(0.566)	0.029	0.003
27	2.25	0.13	0.032	(0.564)	0.029	0.003
28	2.33	0.13	0.032	(0.561)	0.029	0.003
29	2.42	0.13	0.032	(0.559)	0.029	0.003
30	2.50	0.13	0.032	(0.557)	0.029	0.003
31	2.58	0.17	0.040	(0.555)	0.036	0.004
32	2.67	0.17	0.040	(0.552)	0.036	0.004
33	2.75	0.17	0.040	(0.550)	0.036	0.004
34	2.83	0.17	0.040	(0.548)	0.036	0.004
35	2.92	0.17	0.040	(0.545)	0.036	0.004
36	3.00	0.17	0.040	(0.543)	0.036	0.004
37	3.08	0.17	0.040	(0.541)	0.036	0.004
38	3.17	0.17	0.040	(0.539)	0.036	0.004
39	3.25	0.17	0.040	(0.536)	0.036	0.004
40	3.33	0.17	0.040	(0.534)	0.036	0.004
41	3.42	0.17	0.040	(0.532)	0.036	0.004
42	3.50	0.17	0.040	(0.530)	0.036	0.004
43	3.58	0.17	0.040	(0.528)	0.036	0.004
44	3.67	0.17	0.040	(0.525)	0.036	0.004
45	3.75	0.17	0.040	(0.523)	0.036	0.004
46	3.83	0.20	0.048	(0.521)	0.043	0.005
47	3.92	0.20	0.048	(0.519)	0.043	0.005
48	4.00	0.20	0.048	(0.517)	0.043	0.005
49	4.08	0.20	0.048	(0.514)	0.043	0.005
50	4.17	0.20	0.048	(0.512)	0.043	0.005
51	4.25	0.20	0.048	(0.510)	0.043	0.005
52	4.33	0.23	0.056	(0.508)	0.050	0.006
53	4.42	0.23	0.056	(0.506)	0.050	0.006
54	4.50	0.23	0.056	(0.503)	0.050	0.006
55	4.58	0.23	0.056	(0.501)	0.050	0.006
56	4.67	0.23	0.056	(0.499)	0.050	0.006
57	4.75	0.23	0.056	(0.497)	0.050	0.006
58	4.83	0.27	0.064	(0.495)	0.058	0.006
59	4.92	0.27	0.064	(0.493)	0.058	0.006
60	5.00	0.27	0.064	(0.491)	0.058	0.006
61	5.08	0.20	0.048	(0.488)	0.043	0.005

62	5.17	0.20	0.048	(0.486)	0.043	0.005
63	5.25	0.20	0.048	(0.484)	0.043	0.005
64	5.33	0.23	0.056	(0.482)	0.050	0.006
65	5.42	0.23	0.056	(0.480)	0.050	0.006
66	5.50	0.23	0.056	(0.478)	0.050	0.006
67	5.58	0.27	0.064	(0.476)	0.058	0.006
68	5.67	0.27	0.064	(0.474)	0.058	0.006
69	5.75	0.27	0.064	(0.472)	0.058	0.006
70	5.83	0.27	0.064	(0.470)	0.058	0.006
71	5.92	0.27	0.064	(0.467)	0.058	0.006
72	6.00	0.27	0.064	(0.465)	0.058	0.006
73	6.08	0.30	0.072	(0.463)	0.065	0.007
74	6.17	0.30	0.072	(0.461)	0.065	0.007
75	6.25	0.30	0.072	(0.459)	0.065	0.007
76	6.33	0.30	0.072	(0.457)	0.065	0.007
77	6.42	0.30	0.072	(0.455)	0.065	0.007
78	6.50	0.30	0.072	(0.453)	0.065	0.007
79	6.58	0.33	0.080	(0.451)	0.072	0.008
80	6.67	0.33	0.080	(0.449)	0.072	0.008
81	6.75	0.33	0.080	(0.447)	0.072	0.008
82	6.83	0.33	0.080	(0.445)	0.072	0.008
83	6.92	0.33	0.080	(0.443)	0.072	0.008
84	7.00	0.33	0.080	(0.441)	0.072	0.008
85	7.08	0.33	0.080	(0.439)	0.072	0.008
86	7.17	0.33	0.080	(0.437)	0.072	0.008
87	7.25	0.33	0.080	(0.435)	0.072	0.008
88	7.33	0.37	0.088	(0.433)	0.079	0.009
89	7.42	0.37	0.088	(0.431)	0.079	0.009
90	7.50	0.37	0.088	(0.429)	0.079	0.009
91	7.58	0.40	0.096	(0.427)	0.086	0.010
92	7.67	0.40	0.096	(0.425)	0.086	0.010
93	7.75	0.40	0.096	(0.423)	0.086	0.010
94	7.83	0.43	0.104	(0.421)	0.094	0.010
95	7.92	0.43	0.104	(0.419)	0.094	0.010
96	8.00	0.43	0.104	(0.417)	0.094	0.010
97	8.08	0.50	0.120	(0.415)	0.108	0.012
98	8.17	0.50	0.120	(0.413)	0.108	0.012
99	8.25	0.50	0.120	(0.411)	0.108	0.012
100	8.33	0.50	0.120	(0.410)	0.108	0.012
101	8.42	0.50	0.120	(0.408)	0.108	0.012
102	8.50	0.50	0.120	(0.406)	0.108	0.012
103	8.58	0.53	0.128	(0.404)	0.115	0.013
104	8.67	0.53	0.128	(0.402)	0.115	0.013
105	8.75	0.53	0.128	(0.400)	0.115	0.013
106	8.83	0.57	0.136	(0.398)	0.122	0.014
107	8.92	0.57	0.136	(0.396)	0.122	0.014
108	9.00	0.57	0.136	(0.394)	0.122	0.014
109	9.08	0.63	0.152	(0.392)	0.137	0.015
110	9.17	0.63	0.152	(0.391)	0.137	0.015
111	9.25	0.63	0.152	(0.389)	0.137	0.015
112	9.33	0.67	0.160	(0.387)	0.144	0.016
113	9.42	0.67	0.160	(0.385)	0.144	0.016
114	9.50	0.67	0.160	(0.383)	0.144	0.016
115	9.58	0.70	0.168	(0.381)	0.151	0.017
116	9.67	0.70	0.168	(0.380)	0.151	0.017
117	9.75	0.70	0.168	(0.378)	0.151	0.017
118	9.83	0.73	0.176	(0.376)	0.158	0.018
119	9.92	0.73	0.176	(0.374)	0.158	0.018
120	10.00	0.73	0.176	(0.372)	0.158	0.018
121	10.08	0.50	0.120	(0.371)	0.108	0.012
122	10.17	0.50	0.120	(0.369)	0.108	0.012
123	10.25	0.50	0.120	(0.367)	0.108	0.012
124	10.33	0.50	0.120	(0.365)	0.108	0.012
125	10.42	0.50	0.120	(0.363)	0.108	0.012
126	10.50	0.50	0.120	(0.362)	0.108	0.012
127	10.58	0.67	0.160	(0.360)	0.144	0.016
128	10.67	0.67	0.160	(0.358)	0.144	0.016
129	10.75	0.67	0.160	(0.356)	0.144	0.016
130	10.83	0.67	0.160	(0.355)	0.144	0.016
131	10.92	0.67	0.160	(0.353)	0.144	0.016
132	11.00	0.67	0.160	(0.351)	0.144	0.016
133	11.08	0.63	0.152	(0.349)	0.137	0.015
134	11.17	0.63	0.152	(0.348)	0.137	0.015
135	11.25	0.63	0.152	(0.346)	0.137	0.015
136	11.33	0.63	0.152	(0.344)	0.137	0.015
137	11.42	0.63	0.152	(0.343)	0.137	0.015
138	11.50	0.63	0.152	(0.341)	0.137	0.015
139	11.58	0.57	0.136	(0.339)	0.122	0.014
140	11.67	0.57	0.136	(0.337)	0.122	0.014
141	11.75	0.57	0.136	(0.336)	0.122	0.014
142	11.83	0.60	0.144	(0.334)	0.130	0.014

143	11.92	0.60	0.144	(0.332)	0.130	0.014
144	12.00	0.60	0.144	(0.331)	0.130	0.014
145	12.08	0.83	0.200	(0.329)	0.180	0.020
146	12.17	0.83	0.200	(0.327)	0.180	0.020
147	12.25	0.83	0.200	(0.326)	0.180	0.020
148	12.33	0.87	0.208	(0.324)	0.187	0.021
149	12.42	0.87	0.208	(0.323)	0.187	0.021
150	12.50	0.87	0.208	(0.321)	0.187	0.021
151	12.58	0.93	0.224	(0.319)	0.202	0.022
152	12.67	0.93	0.224	(0.318)	0.202	0.022
153	12.75	0.93	0.224	(0.316)	0.202	0.022
154	12.83	0.97	0.232	(0.315)	0.209	0.023
155	12.92	0.97	0.232	(0.313)	0.209	0.023
156	13.00	0.97	0.232	(0.311)	0.209	0.023
157	13.08	1.13	0.272	(0.310)	0.245	0.027
158	13.17	1.13	0.272	(0.308)	0.245	0.027
159	13.25	1.13	0.272	(0.307)	0.245	0.027
160	13.33	1.13	0.272	(0.305)	0.245	0.027
161	13.42	1.13	0.272	(0.304)	0.245	0.027
162	13.50	1.13	0.272	(0.302)	0.245	0.027
163	13.58	0.77	0.184	(0.300)	0.166	0.018
164	13.67	0.77	0.184	(0.299)	0.166	0.018
165	13.75	0.77	0.184	(0.297)	0.166	0.018
166	13.83	0.77	0.184	(0.296)	0.166	0.018
167	13.92	0.77	0.184	(0.294)	0.166	0.018
168	14.00	0.77	0.184	(0.293)	0.166	0.018
169	14.08	0.90	0.216	(0.291)	0.194	0.022
170	14.17	0.90	0.216	(0.290)	0.194	0.022
171	14.25	0.90	0.216	(0.288)	0.194	0.022
172	14.33	0.87	0.208	(0.287)	0.187	0.021
173	14.42	0.87	0.208	(0.285)	0.187	0.021
174	14.50	0.87	0.208	(0.284)	0.187	0.021
175	14.58	0.87	0.208	(0.283)	0.187	0.021
176	14.67	0.87	0.208	(0.281)	0.187	0.021
177	14.75	0.87	0.208	(0.280)	0.187	0.021
178	14.83	0.83	0.200	(0.278)	0.180	0.020
179	14.92	0.83	0.200	(0.277)	0.180	0.020
180	15.00	0.83	0.200	(0.275)	0.180	0.020
181	15.08	0.80	0.192	(0.274)	0.173	0.019
182	15.17	0.80	0.192	(0.273)	0.173	0.019
183	15.25	0.80	0.192	(0.271)	0.173	0.019
184	15.33	0.77	0.184	(0.270)	0.166	0.018
185	15.42	0.77	0.184	(0.268)	0.166	0.018
186	15.50	0.77	0.184	(0.267)	0.166	0.018
187	15.58	0.63	0.152	(0.266)	0.137	0.015
188	15.67	0.63	0.152	(0.264)	0.137	0.015
189	15.75	0.63	0.152	(0.263)	0.137	0.015
190	15.83	0.63	0.152	(0.262)	0.137	0.015
191	15.92	0.63	0.152	(0.260)	0.137	0.015
192	16.00	0.63	0.152	(0.259)	0.137	0.015
193	16.08	0.13	0.032	(0.258)	0.029	0.003
194	16.17	0.13	0.032	(0.256)	0.029	0.003
195	16.25	0.13	0.032	(0.255)	0.029	0.003
196	16.33	0.13	0.032	(0.254)	0.029	0.003
197	16.42	0.13	0.032	(0.252)	0.029	0.003
198	16.50	0.13	0.032	(0.251)	0.029	0.003
199	16.58	0.10	0.024	(0.250)	0.022	0.002
200	16.67	0.10	0.024	(0.249)	0.022	0.002
201	16.75	0.10	0.024	(0.247)	0.022	0.002
202	16.83	0.10	0.024	(0.246)	0.022	0.002
203	16.92	0.10	0.024	(0.245)	0.022	0.002
204	17.00	0.10	0.024	(0.244)	0.022	0.002
205	17.08	0.17	0.040	(0.242)	0.036	0.004
206	17.17	0.17	0.040	(0.241)	0.036	0.004
207	17.25	0.17	0.040	(0.240)	0.036	0.004
208	17.33	0.17	0.040	(0.239)	0.036	0.004
209	17.42	0.17	0.040	(0.237)	0.036	0.004
210	17.50	0.17	0.040	(0.236)	0.036	0.004
211	17.58	0.17	0.040	(0.235)	0.036	0.004
212	17.67	0.17	0.040	(0.234)	0.036	0.004
213	17.75	0.17	0.040	(0.233)	0.036	0.004
214	17.83	0.13	0.032	(0.232)	0.029	0.003
215	17.92	0.13	0.032	(0.230)	0.029	0.003
216	18.00	0.13	0.032	(0.229)	0.029	0.003
217	18.08	0.13	0.032	(0.228)	0.029	0.003
218	18.17	0.13	0.032	(0.227)	0.029	0.003
219	18.25	0.13	0.032	(0.226)	0.029	0.003
220	18.33	0.13	0.032	(0.225)	0.029	0.003
221	18.42	0.13	0.032	(0.224)	0.029	0.003
222	18.50	0.13	0.032	(0.223)	0.029	0.003
223	18.58	0.10	0.024	(0.222)	0.022	0.002

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224  18.67     0.10      0.024       (  0.221)       0.022        0.002
225  18.75     0.10      0.024       (  0.219)       0.022        0.002
226  18.83     0.07      0.016       (  0.218)       0.014        0.002
227  18.92     0.07      0.016       (  0.217)       0.014        0.002
228  19.00     0.07      0.016       (  0.216)       0.014        0.002
229  19.08     0.10      0.024       (  0.215)       0.022        0.002
230  19.17     0.10      0.024       (  0.214)       0.022        0.002
231  19.25     0.10      0.024       (  0.213)       0.022        0.002
232  19.33     0.13      0.032       (  0.212)       0.029        0.003
233  19.42     0.13      0.032       (  0.211)       0.029        0.003
234  19.50     0.13      0.032       (  0.210)       0.029        0.003
235  19.58     0.10      0.024       (  0.209)       0.022        0.002
236  19.67     0.10      0.024       (  0.208)       0.022        0.002
237  19.75     0.10      0.024       (  0.207)       0.022        0.002
238  19.83     0.07      0.016       (  0.207)       0.014        0.002
239  19.92     0.07      0.016       (  0.206)       0.014        0.002
240  20.00     0.07      0.016       (  0.205)       0.014        0.002
241  20.08     0.10      0.024       (  0.204)       0.022        0.002
242  20.17     0.10      0.024       (  0.203)       0.022        0.002
243  20.25     0.10      0.024       (  0.202)       0.022        0.002
244  20.33     0.10      0.024       (  0.201)       0.022        0.002
245  20.42     0.10      0.024       (  0.200)       0.022        0.002
246  20.50     0.10      0.024       (  0.199)       0.022        0.002
247  20.58     0.10      0.024       (  0.199)       0.022        0.002
248  20.67     0.10      0.024       (  0.198)       0.022        0.002
249  20.75     0.10      0.024       (  0.197)       0.022        0.002
250  20.83     0.07      0.016       (  0.196)       0.014        0.002
251  20.92     0.07      0.016       (  0.195)       0.014        0.002
252  21.00     0.07      0.016       (  0.195)       0.014        0.002
253  21.08     0.10      0.024       (  0.194)       0.022        0.002
254  21.17     0.10      0.024       (  0.193)       0.022        0.002
255  21.25     0.10      0.024       (  0.192)       0.022        0.002
256  21.33     0.07      0.016       (  0.192)       0.014        0.002
257  21.42     0.07      0.016       (  0.191)       0.014        0.002
258  21.50     0.07      0.016       (  0.190)       0.014        0.002
259  21.58     0.10      0.024       (  0.189)       0.022        0.002
260  21.67     0.10      0.024       (  0.189)       0.022        0.002
261  21.75     0.10      0.024       (  0.188)       0.022        0.002
262  21.83     0.07      0.016       (  0.187)       0.014        0.002
263  21.92     0.07      0.016       (  0.187)       0.014        0.002
264  22.00     0.07      0.016       (  0.186)       0.014        0.002
265  22.08     0.10      0.024       (  0.186)       0.022        0.002
266  22.17     0.10      0.024       (  0.185)       0.022        0.002
267  22.25     0.10      0.024       (  0.184)       0.022        0.002
268  22.33     0.07      0.016       (  0.184)       0.014        0.002
269  22.42     0.07      0.016       (  0.183)       0.014        0.002
270  22.50     0.07      0.016       (  0.183)       0.014        0.002
271  22.58     0.07      0.016       (  0.182)       0.014        0.002
272  22.67     0.07      0.016       (  0.182)       0.014        0.002
273  22.75     0.07      0.016       (  0.181)       0.014        0.002
274  22.83     0.07      0.016       (  0.181)       0.014        0.002
275  22.92     0.07      0.016       (  0.180)       0.014        0.002
276  23.00     0.07      0.016       (  0.180)       0.014        0.002
277  23.08     0.07      0.016       (  0.179)       0.014        0.002
278  23.17     0.07      0.016       (  0.179)       0.014        0.002
279  23.25     0.07      0.016       (  0.179)       0.014        0.002
280  23.33     0.07      0.016       (  0.178)       0.014        0.002
281  23.42     0.07      0.016       (  0.178)       0.014        0.002
282  23.50     0.07      0.016       (  0.178)       0.014        0.002
283  23.58     0.07      0.016       (  0.177)       0.014        0.002
284  23.67     0.07      0.016       (  0.177)       0.014        0.002
285  23.75     0.07      0.016       (  0.177)       0.014        0.002
286  23.83     0.07      0.016       (  0.177)       0.014        0.002
287  23.92     0.07      0.016       (  0.176)       0.014        0.002
288  24.00     0.07      0.016       (  0.176)       0.014        0.002
               (Loss Rate Not Used)
    Sum =     100.0                                  Sum =     2.4
      Flood volume = Effective rainfall      0.20(In)
       times area       8.8(Ac.)/[(In)/(Ft.)] =       0.1(Ac.Ft)
      Total soil loss =      1.80(In)
      Total soil loss =     1.327(Ac.Ft)
      Total rainfall =      2.00(In)
      Flood volume =        6425.0 Cubic Feet
      Total soil loss =       57824.9 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      0.243(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
      ---------------------------------------------------------------------
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Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0000	0.01	Q				
0+10	0.0001	0.01	Q				
0+15	0.0002	0.01	Q				
0+20	0.0003	0.02	Q				
0+25	0.0005	0.02	Q				
0+30	0.0006	0.02	Q				
0+35	0.0007	0.02	Q				
0+40	0.0009	0.02	Q				
0+45	0.0010	0.02	Q				
0+50	0.0012	0.02	Q				
0+55	0.0014	0.03	Q				
1+ 0	0.0016	0.03	Q				
1+ 5	0.0018	0.03	Q				
1+10	0.0019	0.02	Q				
1+15	0.0021	0.02	Q				
1+20	0.0022	0.02	Q				
1+25	0.0024	0.02	Q				
1+30	0.0025	0.02	Q				
1+35	0.0027	0.02	Q				
1+40	0.0028	0.02	Q				
1+45	0.0030	0.02	Q				
1+50	0.0031	0.02	Q				
1+55	0.0033	0.03	Q				
2+ 0	0.0035	0.03	Q				
2+ 5	0.0037	0.03	QV				
2+10	0.0039	0.03	QV				
2+15	0.0041	0.03	QV				
2+20	0.0043	0.03	QV				
2+25	0.0045	0.03	QV				
2+30	0.0047	0.03	QV				
2+35	0.0049	0.03	QV				
2+40	0.0051	0.03	QV				
2+45	0.0054	0.04	QV				
2+50	0.0056	0.04	QV				
2+55	0.0059	0.04	QV				
3+ 0	0.0061	0.04	QV				
3+ 5	0.0064	0.04	QV				
3+10	0.0066	0.04	QV				
3+15	0.0069	0.04	QV				
3+20	0.0071	0.04	QV				
3+25	0.0073	0.04	QV				
3+30	0.0076	0.04	Q V				
3+35	0.0078	0.04	Q V				
3+40	0.0081	0.04	Q V				
3+45	0.0083	0.04	Q V				
3+50	0.0086	0.04	Q V				
3+55	0.0089	0.04	Q V				
4+ 0	0.0092	0.04	Q V				
4+ 5	0.0095	0.04	Q V				
4+10	0.0098	0.04	Q V				
4+15	0.0101	0.04	Q V				
4+20	0.0104	0.05	Q V				
4+25	0.0107	0.05	Q V				
4+30	0.0110	0.05	Q V				
4+35	0.0114	0.05	Q V				
4+40	0.0117	0.05	Q V				
4+45	0.0121	0.05	Q V				
4+50	0.0124	0.05	Q V				
4+55	0.0128	0.06	Q V				
5+ 0	0.0132	0.06	Q V				
5+ 5	0.0136	0.05	Q V				
5+10	0.0139	0.05	Q V				
5+15	0.0142	0.04	Q V				
5+20	0.0145	0.05	Q V				
5+25	0.0148	0.05	Q V				
5+30	0.0152	0.05	Q V				
5+35	0.0155	0.05	Q V				
5+40	0.0159	0.06	Q V				
5+45	0.0163	0.06	Q V				
5+50	0.0167	0.06	Q V				
5+55	0.0171	0.06	Q V				
6+ 0	0.0175	0.06	Q V				
6+ 5	0.0179	0.06	Q V				
6+10	0.0183	0.06	Q V				
6+15	0.0188	0.06	Q V				
6+20	0.0192	0.06	Q V				

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 6+25       0.0196      0.06  Q    V    |          |          |          |
 6+30       0.0201      0.06  Q    V    |          |          |          |
 6+35       0.0206      0.07  Q    V    |          |          |          |
 6+40       0.0210      0.07  Q    V    |          |          |          |
 6+45       0.0215      0.07  Q    V    |          |          |          |
 6+50       0.0220      0.07  Q    V    |          |          |          |
 6+55       0.0225      0.07  Q     V   |          |          |          |
 7+ 0       0.0230      0.07  Q     V   |          |          |          |
 7+ 5       0.0235      0.07  Q     V   |          |          |          |
 7+10       0.0240      0.07  Q     V   |          |          |          |
 7+15       0.0245      0.07  Q     V   |          |          |          |
 7+20       0.0250      0.07  Q     V   |          |          |          |
 7+25       0.0255      0.08  Q     V   |          |          |          |
 7+30       0.0260      0.08  Q      V  |          |          |          |
 7+35       0.0266      0.08  Q      V  |          |          |          |
 7+40       0.0272      0.08  Q      V  |          |          |          |
 7+45       0.0278      0.09  Q      V  |          |          |          |
 7+50       0.0284      0.09  Q      V  |          |          |          |
 7+55       0.0290      0.09  Q      V  |          |          |          |
 8+ 0       0.0296      0.09  Q       V |          |          |          |
 8+ 5       0.0303      0.10  Q       V |          |          |          |
 8+10       0.0310      0.10  Q       V |          |          |          |
 8+15       0.0318      0.11  Q       V |          |          |          |
 8+20       0.0325      0.11  Q       V |          |          |          |
 8+25       0.0332      0.11  Q        V|          |          |          |
 8+30       0.0340      0.11  Q        V|          |          |          |
 8+35       0.0347      0.11  Q        V|          |          |          |
 8+40       0.0355      0.11  Q        V|          |          |          |
 8+45       0.0363      0.11  Q        V|          |          |          |
 8+50       0.0371      0.12  Q         V          |          |          |
 8+55       0.0379      0.12  Q         V          |          |          |
 9+ 0       0.0388      0.12  Q         V          |          |          |
 9+ 5       0.0396      0.13  Q         V          |          |          |
 9+10       0.0405      0.13  Q         V          |          |          |
 9+15       0.0415      0.13  Q         |V         |          |          |
 9+20       0.0424      0.14  Q         |V         |          |          |
 9+25       0.0434      0.14  Q         V          |          |          |
 9+30       0.0444      0.14  Q          V         |          |          |
 9+35       0.0454      0.15  Q          V         |          |          |
 9+40       0.0464      0.15  Q          V         |          |          |
 9+45       0.0474      0.15  Q          V         |          |          |
 9+50       0.0485      0.15  Q           V        |          |          |
 9+55       0.0495      0.16  Q           V        |          |          |
10+ 0       0.0506      0.16  Q           V        |          |          |
10+ 5       0.0516      0.14  Q           V        |          |          |
10+10       0.0524      0.12  Q            V       |          |          |
10+15       0.0531      0.11  Q            V       |          |          |
10+20       0.0539      0.11  Q            V       |          |          |
10+25       0.0546      0.11  Q            V       |          |          |
10+30       0.0554      0.11  Q             V      |          |          |
10+35       0.0562      0.12  Q             V      |          |          |
10+40       0.0571      0.14  Q             V      |          |          |
10+45       0.0581      0.14  Q             V      |          |          |
10+50       0.0591      0.14  Q              V     |          |          |
10+55       0.0601      0.14  Q              V     |          |          |
11+ 0       0.0610      0.14  Q              V     |          |          |
11+ 5       0.0620      0.14  Q              V     |          |          |
11+10       0.0629      0.14  Q               V    |          |          |
11+15       0.0639      0.14  Q               V    |          |          |
11+20       0.0648      0.14  Q               V    |          |          |
11+25       0.0658      0.14  Q               V    |          |          |
11+30       0.0667      0.14  Q                V   |          |          |
11+35       0.0676      0.13  Q                V   |          |          |
11+40       0.0684      0.12  Q                V   |          |          |
11+45       0.0693      0.12  Q                V   |          |          |
11+50       0.0701      0.12  Q                 V  |          |          |
11+55       0.0710      0.13  Q                 V  |          |          |
12+ 0       0.0719      0.13  Q                 V  |          |          |
12+ 5       0.0729      0.15  Q                 V  |          |          |
12+10       0.0741      0.17  Q                  V |          |          |
12+15       0.0753      0.17  Q                  V |          |          |
12+20       0.0765      0.18  Q                  V |          |          |
12+25       0.0778      0.18  Q                  |V|          |          |
12+30       0.0791      0.19  Q                  |V|          |          |
12+35       0.0804      0.19  Q                  |V|          |          |
12+40       0.0817      0.20  Q                  | V          |          |
12+45       0.0831      0.20  Q                  | V          |          |
12+50       0.0845      0.20  Q                  | V          |          |
12+55       0.0859      0.21  Q                  |  V         |          |
13+ 0       0.0873      0.21  Q                  |  V         |          |
13+ 5       0.0888      0.22  Q                  |   V        |          |
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13+10	0.0905	0.24	Q	|	|	V |	|	|
13+15	0.0921	0.24	Q	|	|	V |	|	|
13+20	0.0938	0.24	Q	|	|	V |	|	|
13+25	0.0955	0.24	Q	|	|	V |	|	|
13+30	0.0971	0.24	Q	|	|	V |	|	|
13+35	0.0986	0.21	Q	|	|	V |	|	|
13+40	0.0998	0.18	Q	|	|	V |	|	|
13+45	0.1010	0.17	Q	|	|	V |	|	|
13+50	0.1021	0.17	Q	|	|	V |	|	|
13+55	0.1033	0.16	Q	|	|	V |	|	|
14+ 0	0.1044	0.16	Q	|	|	V |	|	|
14+ 5	0.1056	0.17	Q	|	|	V |	|	|
14+10	0.1069	0.19	Q	|	|	V |	|	|
14+15	0.1082	0.19	Q	|	|	V |	|	|
14+20	0.1095	0.19	Q	|	|	V |	|	|
14+25	0.1108	0.19	Q	|	|	V |	|	|
14+30	0.1121	0.19	Q	|	|	V |	|	|
14+35	0.1134	0.19	Q	|	|	V |	|	|
14+40	0.1146	0.19	Q	|	|	V |	|	|
14+45	0.1159	0.19	Q	|	|	V |	|	|
14+50	0.1172	0.18	Q	|	|	V |	|	|
14+55	0.1184	0.18	Q	|	|	V |	|	|
15+ 0	0.1197	0.18	Q	|	|	V |	|	|
15+ 5	0.1209	0.18	Q	|	|	V |	|	|
15+10	0.1221	0.17	Q	|	|	V |	|	|
15+15	0.1232	0.17	Q	|	|	V |	|	|
15+20	0.1244	0.17	Q	|	|	V |	|	|
15+25	0.1255	0.17	Q	|	|	V |	|	|
15+30	0.1267	0.16	Q	|	|	V |	|	|
15+35	0.1277	0.15	Q	|	|	V |	|	|
15+40	0.1287	0.14	Q	|	|	V |	|	|
15+45	0.1297	0.14	Q	|	|	V |	|	|
15+50	0.1306	0.14	Q	|	|	V |	|	|
15+55	0.1315	0.14	Q	|	|	V |	|	|
16+ 0	0.1325	0.14	Q	|	|	V |	|	|
16+ 5	0.1331	0.10	Q	|	|	V |	|	|
16+10	0.1335	0.05	Q	|	|	V |	|	|
16+15	0.1337	0.04	Q	|	|	V |	|	|
16+20	0.1339	0.03	Q	|	|	V |	|	|
16+25	0.1341	0.03	Q	|	|	V |	|	|
16+30	0.1343	0.03	Q	|	|	V |	|	|
16+35	0.1345	0.03	Q	|	|	V |	|	|
16+40	0.1347	0.02	Q	|	|	V |	|	|
16+45	0.1348	0.02	Q	|	|	V |	|	|
16+50	0.1350	0.02	Q	|	|	V |	|	|
16+55	0.1351	0.02	Q	|	|	V |	|	|
17+ 0	0.1353	0.02	Q	|	|	V |	|	|
17+ 5	0.1354	0.03	Q	|	|	V |	|	|
17+10	0.1357	0.03	Q	|	|	V |	|	|
17+15	0.1359	0.03	Q	|	|	V |	|	|
17+20	0.1362	0.04	Q	|	|	V |	|	|
17+25	0.1364	0.04	Q	|	|	V |	|	|
17+30	0.1366	0.04	Q	|	|	V |	|	|
17+35	0.1369	0.04	Q	|	|	V |	|	|
17+40	0.1371	0.04	Q	|	|	V |	|	|
17+45	0.1374	0.04	Q	|	|	V |	|	|
17+50	0.1376	0.03	Q	|	|	V |	|	|
17+55	0.1378	0.03	Q	|	|	V |	|	|
18+ 0	0.1380	0.03	Q	|	|	V |	|	|
18+ 5	0.1382	0.03	Q	|	|	V |	|	|
18+10	0.1384	0.03	Q	|	|	V |	|	|
18+15	0.1386	0.03	Q	|	|	V |	|	|
18+20	0.1388	0.03	Q	|	|	V |	|	|
18+25	0.1390	0.03	Q	|	|	V |	|	|
18+30	0.1392	0.03	Q	|	|	V |	|	|
18+35	0.1394	0.03	Q	|	|	V |	|	|
18+40	0.1395	0.02	Q	|	|	V |	|	|
18+45	0.1397	0.02	Q	|	|	V |	|	|
18+50	0.1398	0.02	Q	|	|	V |	|	|
18+55	0.1399	0.02	Q	|	|	V |	|	|
19+ 0	0.1400	0.01	Q	|	|	V |	|	|
19+ 5	0.1401	0.02	Q	|	|	V |	|	|
19+10	0.1403	0.02	Q	|	|	V |	|	|
19+15	0.1404	0.02	Q	|	|	V |	|	|
19+20	0.1406	0.02	Q	|	|	V |	|	|
19+25	0.1408	0.03	Q	|	|	V |	|	|
19+30	0.1410	0.03	Q	|	|	V |	|	|
19+35	0.1412	0.03	Q	|	|	V |	|	|
19+40	0.1413	0.02	Q	|	|	V |	|	|
19+45	0.1415	0.02	Q	|	|	V |	|	|
19+50	0.1416	0.02	Q	|	|	V |	|	|

19+55	0.1417	0.02	Q	|	|	|	V |
20+ 0	0.1418	0.01	Q	|	|	|	V |
20+ 5	0.1419	0.02	Q	|	|	|	V |
20+10	0.1421	0.02	Q	|	|	|	V |
20+15	0.1422	0.02	Q	|	|	|	V |
20+20	0.1423	0.02	Q	|	|	|	V |
20+25	0.1425	0.02	Q	|	|	|	V |
20+30	0.1426	0.02	Q	|	|	|	V |
20+35	0.1428	0.02	Q	|	|	|	V |
20+40	0.1429	0.02	Q	|	|	|	V |
20+45	0.1431	0.02	Q	|	|	|	V |
20+50	0.1432	0.02	Q	|	|	|	V |
20+55	0.1433	0.02	Q	|	|	|	V |
21+ 0	0.1434	0.01	Q	|	|	|	V |
21+ 5	0.1435	0.02	Q	|	|	|	V |
21+10	0.1437	0.02	Q	|	|	|	V |
21+15	0.1438	0.02	Q	|	|	|	V|
21+20	0.1440	0.02	Q	|	|	|	V|
21+25	0.1441	0.02	Q	|	|	|	V|
21+30	0.1442	0.01	Q	|	|	|	V|
21+35	0.1443	0.02	Q	|	|	|	V|
21+40	0.1444	0.02	Q	|	|	|	V|
21+45	0.1446	0.02	Q	|	|	|	V|
21+50	0.1447	0.02	Q	|	|	|	V|
21+55	0.1448	0.02	Q	|	|	|	V|
22+ 0	0.1449	0.01	Q	|	|	|	V|
22+ 5	0.1450	0.02	Q	|	|	|	V|
22+10	0.1452	0.02	Q	|	|	|	V|
22+15	0.1453	0.02	Q	|	|	|	V|
22+20	0.1454	0.02	Q	|	|	|	V|
22+25	0.1455	0.02	Q	|	|	|	V|
22+30	0.1456	0.01	Q	|	|	|	V|
22+35	0.1457	0.01	Q	|	|	|	V|
22+40	0.1458	0.01	Q	|	|	|	V|
22+45	0.1459	0.01	Q	|	|	|	V|
22+50	0.1460	0.01	Q	|	|	|	V|
22+55	0.1461	0.01	Q	|	|	|	V|
23+ 0	0.1462	0.01	Q	|	|	|	V|
23+ 5	0.1463	0.01	Q	|	|	|	V|
23+10	0.1464	0.01	Q	|	|	|	V|
23+15	0.1465	0.01	Q	|	|	|	V|
23+20	0.1466	0.01	Q	|	|	|	V|
23+25	0.1467	0.01	Q	|	|	|	V|
23+30	0.1468	0.01	Q	|	|	|	V|
23+35	0.1469	0.01	Q	|	|	|	V|
23+40	0.1470	0.01	Q	|	|	|	V|
23+45	0.1471	0.01	Q	|	|	|	V|
23+50	0.1472	0.01	Q	|	|	|	V|
23+55	0.1473	0.01	Q	|	|	|	V|
24+ 0	0.1474	0.01	Q	|	|	|	V|
24+ 5	0.1475	0.01	Q	|	|	|	V|
24+10	0.1475	0.00	Q	|	|	|	V|
24+15	0.1475	0.00	Q	|	|	|	V|
24+20	0.1475	0.00	Q	|	|	|	V|

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	168.776	37.430	3.338
2	0.167	337.552	45.607	4.068
3	0.250	506.328	10.199	0.910
4	0.333	675.104	4.300	0.383
5	0.417	843.880	2.464	0.220
			Sum = 100.000	Sum= 8.919

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.016	(0.484)	0.011	0.005
2	0.17	0.07	0.016	(0.482)	0.011	0.005
3	0.25	0.07	0.016	(0.481)	0.011	0.005
4	0.33	0.10	0.024	(0.479)	0.017	0.007
5	0.42	0.10	0.024	(0.477)	0.017	0.007
6	0.50	0.10	0.024	(0.475)	0.017	0.007
7	0.58	0.10	0.024	(0.473)	0.017	0.007
8	0.67	0.10	0.024	(0.471)	0.017	0.007
9	0.75	0.10	0.024	(0.469)	0.017	0.007
10	0.83	0.13	0.032	(0.468)	0.022	0.010
11	0.92	0.13	0.032	(0.466)	0.022	0.010
12	1.00	0.13	0.032	(0.464)	0.022	0.010
13	1.08	0.10	0.024	(0.462)	0.017	0.007
14	1.17	0.10	0.024	(0.460)	0.017	0.007
15	1.25	0.10	0.024	(0.458)	0.017	0.007
16	1.33	0.10	0.024	(0.457)	0.017	0.007
17	1.42	0.10	0.024	(0.455)	0.017	0.007
18	1.50	0.10	0.024	(0.453)	0.017	0.007
19	1.58	0.10	0.024	(0.451)	0.017	0.007
20	1.67	0.10	0.024	(0.449)	0.017	0.007
21	1.75	0.10	0.024	(0.448)	0.017	0.007
22	1.83	0.13	0.032	(0.446)	0.022	0.010
23	1.92	0.13	0.032	(0.444)	0.022	0.010
24	2.00	0.13	0.032	(0.442)	0.022	0.010
25	2.08	0.13	0.032	(0.440)	0.022	0.010
26	2.17	0.13	0.032	(0.439)	0.022	0.010
27	2.25	0.13	0.032	(0.437)	0.022	0.010
28	2.33	0.13	0.032	(0.435)	0.022	0.010
29	2.42	0.13	0.032	(0.433)	0.022	0.010
30	2.50	0.13	0.032	(0.432)	0.022	0.010
31	2.58	0.17	0.040	(0.430)	0.028	0.012
32	2.67	0.17	0.040	(0.428)	0.028	0.012
33	2.75	0.17	0.040	(0.426)	0.028	0.012
34	2.83	0.17	0.040	(0.424)	0.028	0.012
35	2.92	0.17	0.040	(0.423)	0.028	0.012
36	3.00	0.17	0.040	(0.421)	0.028	0.012
37	3.08	0.17	0.040	(0.419)	0.028	0.012
38	3.17	0.17	0.040	(0.418)	0.028	0.012
39	3.25	0.17	0.040	(0.416)	0.028	0.012
40	3.33	0.17	0.040	(0.414)	0.028	0.012
41	3.42	0.17	0.040	(0.412)	0.028	0.012
42	3.50	0.17	0.040	(0.411)	0.028	0.012
43	3.58	0.17	0.040	(0.409)	0.028	0.012
44	3.67	0.17	0.040	(0.407)	0.028	0.012
45	3.75	0.17	0.040	(0.405)	0.028	0.012
46	3.83	0.20	0.048	(0.404)	0.034	0.014
47	3.92	0.20	0.048	(0.402)	0.034	0.014
48	4.00	0.20	0.048	(0.400)	0.034	0.014
49	4.08	0.20	0.048	(0.399)	0.034	0.014
50	4.17	0.20	0.048	(0.397)	0.034	0.014
51	4.25	0.20	0.048	(0.395)	0.034	0.014
52	4.33	0.23	0.056	(0.394)	0.039	0.017
53	4.42	0.23	0.056	(0.392)	0.039	0.017
54	4.50	0.23	0.056	(0.390)	0.039	0.017
55	4.58	0.23	0.056	(0.389)	0.039	0.017
56	4.67	0.23	0.056	(0.387)	0.039	0.017
57	4.75	0.23	0.056	(0.385)	0.039	0.017
58	4.83	0.27	0.064	(0.384)	0.045	0.019
59	4.92	0.27	0.064	(0.382)	0.045	0.019
60	5.00	0.27	0.064	(0.380)	0.045	0.019
61	5.08	0.20	0.048	(0.379)	0.034	0.014

62	5.17	0.20	0.048	(0.377)	0.034	0.014
63	5.25	0.20	0.048	(0.375)	0.034	0.014
64	5.33	0.23	0.056	(0.374)	0.039	0.017
65	5.42	0.23	0.056	(0.372)	0.039	0.017
66	5.50	0.23	0.056	(0.370)	0.039	0.017
67	5.58	0.27	0.064	(0.369)	0.045	0.019
68	5.67	0.27	0.064	(0.367)	0.045	0.019
69	5.75	0.27	0.064	(0.365)	0.045	0.019
70	5.83	0.27	0.064	(0.364)	0.045	0.019
71	5.92	0.27	0.064	(0.362)	0.045	0.019
72	6.00	0.27	0.064	(0.361)	0.045	0.019
73	6.08	0.30	0.072	(0.359)	0.050	0.022
74	6.17	0.30	0.072	(0.357)	0.050	0.022
75	6.25	0.30	0.072	(0.356)	0.050	0.022
76	6.33	0.30	0.072	(0.354)	0.050	0.022
77	6.42	0.30	0.072	(0.353)	0.050	0.022
78	6.50	0.30	0.072	(0.351)	0.050	0.022
79	6.58	0.33	0.080	(0.350)	0.056	0.024
80	6.67	0.33	0.080	(0.348)	0.056	0.024
81	6.75	0.33	0.080	(0.346)	0.056	0.024
82	6.83	0.33	0.080	(0.345)	0.056	0.024
83	6.92	0.33	0.080	(0.343)	0.056	0.024
84	7.00	0.33	0.080	(0.342)	0.056	0.024
85	7.08	0.33	0.080	(0.340)	0.056	0.024
86	7.17	0.33	0.080	(0.339)	0.056	0.024
87	7.25	0.33	0.080	(0.337)	0.056	0.024
88	7.33	0.37	0.088	(0.336)	0.062	0.026
89	7.42	0.37	0.088	(0.334)	0.062	0.026
90	7.50	0.37	0.088	(0.332)	0.062	0.026
91	7.58	0.40	0.096	(0.331)	0.067	0.029
92	7.67	0.40	0.096	(0.329)	0.067	0.029
93	7.75	0.40	0.096	(0.328)	0.067	0.029
94	7.83	0.43	0.104	(0.326)	0.073	0.031
95	7.92	0.43	0.104	(0.325)	0.073	0.031
96	8.00	0.43	0.104	(0.323)	0.073	0.031
97	8.08	0.50	0.120	(0.322)	0.084	0.036
98	8.17	0.50	0.120	(0.320)	0.084	0.036
99	8.25	0.50	0.120	(0.319)	0.084	0.036
100	8.33	0.50	0.120	(0.317)	0.084	0.036
101	8.42	0.50	0.120	(0.316)	0.084	0.036
102	8.50	0.50	0.120	(0.314)	0.084	0.036
103	8.58	0.53	0.128	(0.313)	0.090	0.038
104	8.67	0.53	0.128	(0.311)	0.090	0.038
105	8.75	0.53	0.128	(0.310)	0.090	0.038
106	8.83	0.57	0.136	(0.309)	0.095	0.041
107	8.92	0.57	0.136	(0.307)	0.095	0.041
108	9.00	0.57	0.136	(0.306)	0.095	0.041
109	9.08	0.63	0.152	(0.304)	0.106	0.046
110	9.17	0.63	0.152	(0.303)	0.106	0.046
111	9.25	0.63	0.152	(0.301)	0.106	0.046
112	9.33	0.67	0.160	(0.300)	0.112	0.048
113	9.42	0.67	0.160	(0.298)	0.112	0.048
114	9.50	0.67	0.160	(0.297)	0.112	0.048
115	9.58	0.70	0.168	(0.296)	0.118	0.050
116	9.67	0.70	0.168	(0.294)	0.118	0.050
117	9.75	0.70	0.168	(0.293)	0.118	0.050
118	9.83	0.73	0.176	(0.291)	0.123	0.053
119	9.92	0.73	0.176	(0.290)	0.123	0.053
120	10.00	0.73	0.176	(0.289)	0.123	0.053
121	10.08	0.50	0.120	(0.287)	0.084	0.036
122	10.17	0.50	0.120	(0.286)	0.084	0.036
123	10.25	0.50	0.120	(0.284)	0.084	0.036
124	10.33	0.50	0.120	(0.283)	0.084	0.036
125	10.42	0.50	0.120	(0.282)	0.084	0.036
126	10.50	0.50	0.120	(0.280)	0.084	0.036
127	10.58	0.67	0.160	(0.279)	0.112	0.048
128	10.67	0.67	0.160	(0.278)	0.112	0.048
129	10.75	0.67	0.160	(0.276)	0.112	0.048
130	10.83	0.67	0.160	(0.275)	0.112	0.048
131	10.92	0.67	0.160	(0.273)	0.112	0.048
132	11.00	0.67	0.160	(0.272)	0.112	0.048
133	11.08	0.63	0.152	(0.271)	0.106	0.046
134	11.17	0.63	0.152	(0.269)	0.106	0.046
135	11.25	0.63	0.152	(0.268)	0.106	0.046
136	11.33	0.63	0.152	(0.267)	0.106	0.046
137	11.42	0.63	0.152	(0.265)	0.106	0.046
138	11.50	0.63	0.152	(0.264)	0.106	0.046
139	11.58	0.57	0.136	(0.263)	0.095	0.041
140	11.67	0.57	0.136	(0.262)	0.095	0.041
141	11.75	0.57	0.136	(0.260)	0.095	0.041
142	11.83	0.60	0.144	(0.259)	0.101	0.043

143	11.92	0.60	0.144	(0.258)	0.101	0.043
144	12.00	0.60	0.144	(0.256)	0.101	0.043
145	12.08	0.83	0.200	(0.255)	0.140	0.060
146	12.17	0.83	0.200	(0.254)	0.140	0.060
147	12.25	0.83	0.200	(0.253)	0.140	0.060
148	12.33	0.87	0.208	(0.251)	0.146	0.062
149	12.42	0.87	0.208	(0.250)	0.146	0.062
150	12.50	0.87	0.208	(0.249)	0.146	0.062
151	12.58	0.93	0.224	(0.247)	0.157	0.067
152	12.67	0.93	0.224	(0.246)	0.157	0.067
153	12.75	0.93	0.224	(0.245)	0.157	0.067
154	12.83	0.97	0.232	(0.244)	0.162	0.070
155	12.92	0.97	0.232	(0.243)	0.162	0.070
156	13.00	0.97	0.232	(0.241)	0.162	0.070
157	13.08	1.13	0.272	(0.240)	0.190	0.082
158	13.17	1.13	0.272	(0.239)	0.190	0.082
159	13.25	1.13	0.272	(0.238)	0.190	0.082
160	13.33	1.13	0.272	(0.236)	0.190	0.082
161	13.42	1.13	0.272	(0.235)	0.190	0.082
162	13.50	1.13	0.272	(0.234)	0.190	0.082
163	13.58	0.77	0.184	(0.233)	0.129	0.055
164	13.67	0.77	0.184	(0.232)	0.129	0.055
165	13.75	0.77	0.184	(0.230)	0.129	0.055
166	13.83	0.77	0.184	(0.229)	0.129	0.055
167	13.92	0.77	0.184	(0.228)	0.129	0.055
168	14.00	0.77	0.184	(0.227)	0.129	0.055
169	14.08	0.90	0.216	(0.226)	0.151	0.065
170	14.17	0.90	0.216	(0.225)	0.151	0.065
171	14.25	0.90	0.216	(0.224)	0.151	0.065
172	14.33	0.87	0.208	(0.222)	0.146	0.062
173	14.42	0.87	0.208	(0.221)	0.146	0.062
174	14.50	0.87	0.208	(0.220)	0.146	0.062
175	14.58	0.87	0.208	(0.219)	0.146	0.062
176	14.67	0.87	0.208	(0.218)	0.146	0.062
177	14.75	0.87	0.208	(0.217)	0.146	0.062
178	14.83	0.83	0.200	(0.216)	0.140	0.060
179	14.92	0.83	0.200	(0.215)	0.140	0.060
180	15.00	0.83	0.200	(0.213)	0.140	0.060
181	15.08	0.80	0.192	(0.212)	0.134	0.058
182	15.17	0.80	0.192	(0.211)	0.134	0.058
183	15.25	0.80	0.192	(0.210)	0.134	0.058
184	15.33	0.77	0.184	(0.209)	0.129	0.055
185	15.42	0.77	0.184	(0.208)	0.129	0.055
186	15.50	0.77	0.184	(0.207)	0.129	0.055
187	15.58	0.63	0.152	(0.206)	0.106	0.046
188	15.67	0.63	0.152	(0.205)	0.106	0.046
189	15.75	0.63	0.152	(0.204)	0.106	0.046
190	15.83	0.63	0.152	(0.203)	0.106	0.046
191	15.92	0.63	0.152	(0.202)	0.106	0.046
192	16.00	0.63	0.152	(0.201)	0.106	0.046
193	16.08	0.13	0.032	(0.200)	0.022	0.010
194	16.17	0.13	0.032	(0.199)	0.022	0.010
195	16.25	0.13	0.032	(0.198)	0.022	0.010
196	16.33	0.13	0.032	(0.197)	0.022	0.010
197	16.42	0.13	0.032	(0.196)	0.022	0.010
198	16.50	0.13	0.032	(0.195)	0.022	0.010
199	16.58	0.10	0.024	(0.194)	0.017	0.007
200	16.67	0.10	0.024	(0.193)	0.017	0.007
201	16.75	0.10	0.024	(0.192)	0.017	0.007
202	16.83	0.10	0.024	(0.191)	0.017	0.007
203	16.92	0.10	0.024	(0.190)	0.017	0.007
204	17.00	0.10	0.024	(0.189)	0.017	0.007
205	17.08	0.17	0.040	(0.188)	0.028	0.012
206	17.17	0.17	0.040	(0.187)	0.028	0.012
207	17.25	0.17	0.040	(0.186)	0.028	0.012
208	17.33	0.17	0.040	(0.185)	0.028	0.012
209	17.42	0.17	0.040	(0.184)	0.028	0.012
210	17.50	0.17	0.040	(0.183)	0.028	0.012
211	17.58	0.17	0.040	(0.182)	0.028	0.012
212	17.67	0.17	0.040	(0.181)	0.028	0.012
213	17.75	0.17	0.040	(0.180)	0.028	0.012
214	17.83	0.13	0.032	(0.179)	0.022	0.010
215	17.92	0.13	0.032	(0.179)	0.022	0.010
216	18.00	0.13	0.032	(0.178)	0.022	0.010
217	18.08	0.13	0.032	(0.177)	0.022	0.010
218	18.17	0.13	0.032	(0.176)	0.022	0.010
219	18.25	0.13	0.032	(0.175)	0.022	0.010
220	18.33	0.13	0.032	(0.174)	0.022	0.010
221	18.42	0.13	0.032	(0.173)	0.022	0.010
222	18.50	0.13	0.032	(0.173)	0.022	0.010
223	18.58	0.10	0.024	(0.172)	0.017	0.007

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224  18.67     0.10      0.024       (  0.171)       0.017        0.007
225  18.75     0.10      0.024       (  0.170)       0.017        0.007
226  18.83     0.07      0.016       (  0.169)       0.011        0.005
227  18.92     0.07      0.016       (  0.168)       0.011        0.005
228  19.00     0.07      0.016       (  0.168)       0.011        0.005
229  19.08     0.10      0.024       (  0.167)       0.017        0.007
230  19.17     0.10      0.024       (  0.166)       0.017        0.007
231  19.25     0.10      0.024       (  0.165)       0.017        0.007
232  19.33     0.13      0.032       (  0.165)       0.022        0.010
233  19.42     0.13      0.032       (  0.164)       0.022        0.010
234  19.50     0.13      0.032       (  0.163)       0.022        0.010
235  19.58     0.10      0.024       (  0.162)       0.017        0.007
236  19.67     0.10      0.024       (  0.162)       0.017        0.007
237  19.75     0.10      0.024       (  0.161)       0.017        0.007
238  19.83     0.07      0.016       (  0.160)       0.011        0.005
239  19.92     0.07      0.016       (  0.159)       0.011        0.005
240  20.00     0.07      0.016       (  0.159)       0.011        0.005
241  20.08     0.10      0.024       (  0.158)       0.017        0.007
242  20.17     0.10      0.024       (  0.157)       0.017        0.007
243  20.25     0.10      0.024       (  0.157)       0.017        0.007
244  20.33     0.10      0.024       (  0.156)       0.017        0.007
245  20.42     0.10      0.024       (  0.155)       0.017        0.007
246  20.50     0.10      0.024       (  0.155)       0.017        0.007
247  20.58     0.10      0.024       (  0.154)       0.017        0.007
248  20.67     0.10      0.024       (  0.153)       0.017        0.007
249  20.75     0.10      0.024       (  0.153)       0.017        0.007
250  20.83     0.07      0.016       (  0.152)       0.011        0.005
251  20.92     0.07      0.016       (  0.151)       0.011        0.005
252  21.00     0.07      0.016       (  0.151)       0.011        0.005
253  21.08     0.10      0.024       (  0.150)       0.017        0.007
254  21.17     0.10      0.024       (  0.150)       0.017        0.007
255  21.25     0.10      0.024       (  0.149)       0.017        0.007
256  21.33     0.07      0.016       (  0.148)       0.011        0.005
257  21.42     0.07      0.016       (  0.148)       0.011        0.005
258  21.50     0.07      0.016       (  0.147)       0.011        0.005
259  21.58     0.10      0.024       (  0.147)       0.017        0.007
260  21.67     0.10      0.024       (  0.146)       0.017        0.007
261  21.75     0.10      0.024       (  0.146)       0.017        0.007
262  21.83     0.07      0.016       (  0.145)       0.011        0.005
263  21.92     0.07      0.016       (  0.145)       0.011        0.005
264  22.00     0.07      0.016       (  0.144)       0.011        0.005
265  22.08     0.10      0.024       (  0.144)       0.017        0.007
266  22.17     0.10      0.024       (  0.143)       0.017        0.007
267  22.25     0.10      0.024       (  0.143)       0.017        0.007
268  22.33     0.07      0.016       (  0.142)       0.011        0.005
269  22.42     0.07      0.016       (  0.142)       0.011        0.005
270  22.50     0.07      0.016       (  0.142)       0.011        0.005
271  22.58     0.07      0.016       (  0.141)       0.011        0.005
272  22.67     0.07      0.016       (  0.141)       0.011        0.005
273  22.75     0.07      0.016       (  0.140)       0.011        0.005
274  22.83     0.07      0.016       (  0.140)       0.011        0.005
275  22.92     0.07      0.016       (  0.140)       0.011        0.005
276  23.00     0.07      0.016       (  0.139)       0.011        0.005
277  23.08     0.07      0.016       (  0.139)       0.011        0.005
278  23.17     0.07      0.016       (  0.139)       0.011        0.005
279  23.25     0.07      0.016       (  0.138)       0.011        0.005
280  23.33     0.07      0.016       (  0.138)       0.011        0.005
281  23.42     0.07      0.016       (  0.138)       0.011        0.005
282  23.50     0.07      0.016       (  0.138)       0.011        0.005
283  23.58     0.07      0.016       (  0.137)       0.011        0.005
284  23.67     0.07      0.016       (  0.137)       0.011        0.005
285  23.75     0.07      0.016       (  0.137)       0.011        0.005
286  23.83     0.07      0.016       (  0.137)       0.011        0.005
287  23.92     0.07      0.016       (  0.137)       0.011        0.005
288  24.00     0.07      0.016       (  0.137)       0.011        0.005
               (Loss Rate Not Used)
    Sum =     100.0                                  Sum =     7.2
      Flood volume = Effective rainfall      0.60(In)
       times area       8.8(Ac.)/[(In)/(Ft.)] =       0.4(Ac.Ft)
      Total soil loss =      1.40(In)
      Total soil loss =     1.032(Ac.Ft)
      Total rainfall =      2.00(In)
      Flood volume =       19275.0 Cubic Feet
      Total soil loss =       44974.9 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      0.728(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
      ---------------------------------------------------------------------
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Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0001	0.02	Q				
0+10	0.0004	0.04	Q				
0+15	0.0006	0.04	Q				
0+20	0.0010	0.05	Q				
0+25	0.0014	0.06	Q				
0+30	0.0018	0.06	Q				
0+35	0.0023	0.06	Q				
0+40	0.0027	0.06	Q				
0+45	0.0031	0.06	Q				
0+50	0.0036	0.07	Q				
0+55	0.0042	0.08	Q				
1+ 0	0.0048	0.08	Q				
1+ 5	0.0053	0.08	Q				
1+10	0.0058	0.07	Q				
1+15	0.0062	0.07	Q				
1+20	0.0067	0.06	Q				
1+25	0.0071	0.06	Q				
1+30	0.0076	0.06	Q				
1+35	0.0080	0.06	Q				
1+40	0.0085	0.06	Q				
1+45	0.0089	0.06	Q				
1+50	0.0094	0.07	Q				
1+55	0.0100	0.08	Q				
2+ 0	0.0105	0.08	Q				
2+ 5	0.0111	0.09	QV				
2+10	0.0117	0.09	QV				
2+15	0.0123	0.09	QV				
2+20	0.0129	0.09	QV				
2+25	0.0135	0.09	QV				
2+30	0.0141	0.09	QV				
2+35	0.0147	0.09	QV				
2+40	0.0154	0.10	QV				
2+45	0.0162	0.11	QV				
2+50	0.0169	0.11	QV				
2+55	0.0176	0.11	QV				
3+ 0	0.0184	0.11	QV				
3+ 5	0.0191	0.11	QV				
3+10	0.0198	0.11	QV				
3+15	0.0206	0.11	QV				
3+20	0.0213	0.11	QV				
3+25	0.0221	0.11	QV				
3+30	0.0228	0.11	Q V				
3+35	0.0235	0.11	Q V				
3+40	0.0243	0.11	Q V				
3+45	0.0250	0.11	Q V				
3+50	0.0258	0.12	Q V				
3+55	0.0267	0.12	Q V				
4+ 0	0.0275	0.13	Q V				
4+ 5	0.0284	0.13	Q V				
4+10	0.0293	0.13	Q V				
4+15	0.0302	0.13	Q V				
4+20	0.0311	0.14	Q V				
4+25	0.0321	0.15	Q V				
4+30	0.0332	0.15	Q V				
4+35	0.0342	0.15	Q V				
4+40	0.0352	0.15	Q V				
4+45	0.0363	0.15	Q V				
4+50	0.0373	0.16	Q V				
4+55	0.0385	0.17	Q V				
5+ 0	0.0397	0.17	Q V				
5+ 5	0.0407	0.15	Q V				
5+10	0.0417	0.14	Q V				
5+15	0.0426	0.13	Q V				
5+20	0.0435	0.14	Q V				
5+25	0.0445	0.15	Q V				
5+30	0.0455	0.15	Q V				
5+35	0.0466	0.16	Q V				
5+40	0.0478	0.17	Q V				
5+45	0.0490	0.17	Q V				
5+50	0.0501	0.17	Q V				
5+55	0.0513	0.17	Q V				
6+ 0	0.0525	0.17	Q V				
6+ 5	0.0537	0.18	Q V				
6+10	0.0550	0.19	Q V				
6+15	0.0563	0.19	Q V				
6+20	0.0577	0.19	Q V				

```
  6+25       0.0590      0.19  Q    V    |          |          |          |
  6+30       0.0603      0.19  Q    V    |          |          |          |
  6+35       0.0617      0.20  Q    V    |          |          |          |
  6+40       0.0632      0.21  Q    V    |          |          |          |
  6+45       0.0646      0.21  Q    V    |          |          |          |
  6+50       0.0661      0.21  Q    V    |          |          |          |
  6+55       0.0676      0.21  Q     V   |          |          |          |
  7+ 0       0.0690      0.21  Q     V   |          |          |          |
  7+ 5       0.0705      0.21  Q     V   |          |          |          |
  7+10       0.0720      0.21  Q     V   |          |          |          |
  7+15       0.0735      0.21  Q     V   |          |          |          |
  7+20       0.0750      0.22  Q     V   |          |          |          |
  7+25       0.0766      0.23  Q     V   |          |          |          |
  7+30       0.0782      0.23  Q      V  |          |          |          |
  7+35       0.0799      0.24  Q      V  |          |          |          |
  7+40       0.0816      0.25  |Q     V  |          |          |          |
  7+45       0.0834      0.26  |Q     V  |          |          |          |
  7+50       0.0852      0.26  |Q     V  |          |          |          |
  7+55       0.0871      0.27  |Q     V  |          |          |          |
  8+ 0       0.0890      0.28  |Q      V |          |          |          |
  8+ 5       0.0910      0.29  |Q      V |          |          |          |
  8+10       0.0932      0.31  |Q      V |          |          |          |
  8+15       0.0954      0.32  |Q      V |          |          |          |
  8+20       0.0976      0.32  |Q      V |          |          |          |
  8+25       0.0998      0.32  |Q       V|          |          |          |
  8+30       0.1020      0.32  |Q       V|          |          |          |
  8+35       0.1043      0.33  |Q       V|          |          |          |
  8+40       0.1066      0.34  |Q       V|          |          |          |
  8+45       0.1090      0.34  |Q       V|          |          |          |
  8+50       0.1114      0.35  |Q        V          |          |          |
  8+55       0.1139      0.36  |Q        V          |          |          |
  9+ 0       0.1164      0.36  |Q        V          |          |          |
  9+ 5       0.1190      0.38  |Q        V          |          |          |
  9+10       0.1217      0.40  |Q        |V         |          |          |
  9+15       0.1245      0.40  |Q        |V         |          |          |
  9+20       0.1274      0.41  |Q        |V         |          |          |
  9+25       0.1303      0.42  |Q        |V         |          |          |
  9+30       0.1332      0.43  |Q        | V        |          |          |
  9+35       0.1362      0.44  |Q        | V        |          |          |
  9+40       0.1393      0.45  |Q        | V        |          |          |
  9+45       0.1424      0.45  |Q        | V        |          |          |
  9+50       0.1455      0.46  |Q        |  V       |          |          |
  9+55       0.1488      0.47  |Q        |  V       |          |          |
 10+ 0       0.1520      0.47  |Q        |  V       |          |          |
 10+ 5       0.1549      0.41  |Q        |  V       |          |          |
 10+10       0.1572      0.35  |Q        |   V      |          |          |
 10+15       0.1595      0.33  |Q        |   V      |          |          |
 10+20       0.1618      0.32  |Q        |   V      |          |          |
 10+25       0.1640      0.32  |Q        |   V      |          |          |
 10+30       0.1662      0.32  |Q        |    V     |          |          |
 10+35       0.1687      0.36  |Q        |    V     |          |          |
 10+40       0.1715      0.41  |Q        |    V     |          |          |
 10+45       0.1744      0.42  |Q        |    V     |          |          |
 10+50       0.1773      0.43  |Q        |     V    |          |          |
 10+55       0.1803      0.43  |Q        |     V    |          |          |
 11+ 0       0.1832      0.43  |Q        |     V    |          |          |
 11+ 5       0.1861      0.42  |Q        |     V    |          |          |
 11+10       0.1890      0.41  |Q        |      V   |          |          |
 11+15       0.1918      0.41  |Q        |      V   |          |          |
 11+20       0.1946      0.41  |Q        |      V   |          |          |
 11+25       0.1974      0.41  |Q        |      V   |          |          |
 11+30       0.2002      0.41  |Q        |       V  |          |          |
 11+35       0.2029      0.39  |Q        |       V  |          |          |
 11+40       0.2054      0.37  |Q        |       V  |          |          |
 11+45       0.2080      0.37  |Q        |       V  |          |          |
 11+50       0.2105      0.37  |Q        |        V |          |          |
 11+55       0.2132      0.38  |Q        |        V |          |          |
 12+ 0       0.2158      0.38  |Q        |        V |          |          |
 12+ 5       0.2188      0.44  |Q        |        V |          |          |
 12+10       0.2223      0.51  | Q       |         V          |          |
 12+15       0.2260      0.53  | Q       |         V          |          |
 12+20       0.2297      0.54  | Q       |         V          |          |
 12+25       0.2335      0.55  | Q       |         |V         |          |
 12+30       0.2373      0.56  | Q       |         |V         |          |
 12+35       0.2413      0.57  | Q       |         |V         |          |
 12+40       0.2453      0.59  | Q       |         | V        |          |
 12+45       0.2494      0.60  | Q       |         | V        |          |
 12+50       0.2536      0.61  | Q       |         | V        |          |
 12+55       0.2579      0.62  | Q       |         |  V       |          |
 13+ 0       0.2621      0.62  | Q       |         |  V       |          |
 13+ 5       0.2667      0.66  | Q       |         |   V      |          |
```

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13+10       0.2716      0.71  | Q       |          |   V     |          |
13+15       0.2765      0.72  | Q       |          |   V     |          |
13+20       0.2815      0.73  | Q       |          |    V    |          |
13+25       0.2866      0.73  | Q       |          |    V    |          |
13+30       0.2916      0.73  | Q       |          |     V   |          |
13+35       0.2960      0.64  | Q       |          |     V   |          |
13+40       0.2997      0.53  | Q       |          |      V  |          |
13+45       0.3032      0.51  | Q       |          |      V  |          |
13+50       0.3066      0.50  |Q        |          |      V  |          |
13+55       0.3100      0.49  |Q        |          |       V |          |
14+ 0       0.3134      0.49  |Q        |          |       V |          |
14+ 5       0.3170      0.52  | Q       |          |       V |          |
14+10       0.3209      0.56  | Q       |          |        V|          |
14+15       0.3248      0.57  | Q       |          |        V|          |
14+20       0.3287      0.57  | Q       |          |        V|          |
14+25       0.3326      0.56  | Q       |          |         V          |
14+30       0.3364      0.56  | Q       |          |         V          |
14+35       0.3403      0.56  | Q       |          |         V          |
14+40       0.3441      0.56  | Q       |          |          V         |
14+45       0.3479      0.56  | Q       |          |          V         |
14+50       0.3517      0.55  | Q       |          |          V         |
14+55       0.3554      0.54  | Q       |          |           V        |
15+ 0       0.3591      0.54  | Q       |          |           V        |
15+ 5       0.3628      0.53  | Q       |          |           V        |
15+10       0.3663      0.52  | Q       |          |            V       |
15+15       0.3699      0.52  | Q       |          |            V       |
15+20       0.3734      0.51  | Q       |          |            V       |
15+25       0.3768      0.50  |Q        |          |             V      |
15+30       0.3802      0.49  |Q        |          |             V      |
15+35       0.3834      0.46  |Q        |          |             V      |
15+40       0.3863      0.42  |Q        |          |             V      |
15+45       0.3891      0.41  |Q        |          |              V     |
15+50       0.3919      0.41  |Q        |          |              V     |
15+55       0.3947      0.41  |Q        |          |              V     |
16+ 0       0.3975      0.41  |Q        |          |              V     |
16+ 5       0.3995      0.29  |Q        |          |               V    |
16+10       0.4005      0.14  Q         |          |               V    |
16+15       0.4012      0.11  Q         |          |               V    |
16+20       0.4018      0.09  Q         |          |               V    |
16+25       0.4024      0.09  Q         |          |               V    |
16+30       0.4030      0.09  Q         |          |               V    |
16+35       0.4036      0.08  Q         |          |               V    |
16+40       0.4040      0.07  Q         |          |               V    |
16+45       0.4045      0.07  Q         |          |               V    |
16+50       0.4049      0.06  Q         |          |               V    |
16+55       0.4054      0.06  Q         |          |               V    |
17+ 0       0.4058      0.06  Q         |          |               V    |
17+ 5       0.4064      0.08  Q         |          |               V    |
17+10       0.4071      0.10  Q         |          |               V    |
17+15       0.4078      0.10  Q         |          |               V    |
17+20       0.4085      0.11  Q         |          |               V    |
17+25       0.4092      0.11  Q         |          |               V    |
17+30       0.4100      0.11  Q         |          |                V   |
17+35       0.4107      0.11  Q         |          |                V   |
17+40       0.4115      0.11  Q         |          |                V   |
17+45       0.4122      0.11  Q         |          |                V   |
17+50       0.4129      0.10  Q         |          |                V   |
17+55       0.4135      0.09  Q         |          |                V   |
18+ 0       0.4141      0.09  Q         |          |                V   |
18+ 5       0.4147      0.09  Q         |          |                V   |
18+10       0.4153      0.09  Q         |          |                V   |
18+15       0.4159      0.09  Q         |          |                V   |
18+20       0.4165      0.09  Q         |          |                V   |
18+25       0.4170      0.09  Q         |          |                V   |
18+30       0.4176      0.09  Q         |          |                V   |
18+35       0.4182      0.08  Q         |          |                V   |
18+40       0.4186      0.07  Q         |          |                V   |
18+45       0.4191      0.07  Q         |          |                V   |
18+50       0.4195      0.06  Q         |          |                V   |
18+55       0.4198      0.05  Q         |          |                V   |
19+ 0       0.4201      0.04  Q         |          |                V   |
19+ 5       0.4205      0.05  Q         |          |                 V  |
19+10       0.4209      0.06  Q         |          |                 V  |
19+15       0.4213      0.06  Q         |          |                 V  |
19+20       0.4218      0.07  Q         |          |                 V  |
19+25       0.4224      0.08  Q         |          |                 V  |
19+30       0.4229      0.08  Q         |          |                 V  |
19+35       0.4235      0.08  Q         |          |                 V  |
19+40       0.4239      0.07  Q         |          |                 V  |
19+45       0.4244      0.07  Q         |          |                 V  |
19+50       0.4248      0.06  Q         |          |                 V  |
```

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   19+55       0.4251      0.05  Q          |          |          |         V |
   20+ 0       0.4254      0.04  Q          |          |          |         V |
   20+ 5       0.4258      0.05  Q          |          |          |         V |
   20+10       0.4262      0.06  Q          |          |          |         V |
   20+15       0.4266      0.06  Q          |          |          |         V |
   20+20       0.4271      0.06  Q          |          |          |         V |
   20+25       0.4275      0.06  Q          |          |          |         V |
   20+30       0.4279      0.06  Q          |          |          |         V |
   20+35       0.4284      0.06  Q          |          |          |         V |
   20+40       0.4288      0.06  Q          |          |          |         V |
   20+45       0.4293      0.06  Q          |          |          |         V |
   20+50       0.4297      0.06  Q          |          |          |         V |
   20+55       0.4300      0.05  Q          |          |          |         V |
   21+ 0       0.4303      0.04  Q          |          |          |         V |
   21+ 5       0.4306      0.05  Q          |          |          |         V |
   21+10       0.4311      0.06  Q          |          |          |         V |
   21+15       0.4315      0.06  Q          |          |          |          V|
   21+20       0.4319      0.06  Q          |          |          |          V|
   21+25       0.4322      0.05  Q          |          |          |          V|
   21+30       0.4325      0.04  Q          |          |          |          V|
   21+35       0.4328      0.05  Q          |          |          |          V|
   21+40       0.4333      0.06  Q          |          |          |          V|
   21+45       0.4337      0.06  Q          |          |          |          V|
   21+50       0.4341      0.06  Q          |          |          |          V|
   21+55       0.4344      0.05  Q          |          |          |          V|
   22+ 0       0.4347      0.04  Q          |          |          |          V|
   22+ 5       0.4351      0.05  Q          |          |          |          V|
   22+10       0.4355      0.06  Q          |          |          |          V|
   22+15       0.4359      0.06  Q          |          |          |          V|
   22+20       0.4363      0.06  Q          |          |          |          V|
   22+25       0.4366      0.05  Q          |          |          |          V|
   22+30       0.4369      0.04  Q          |          |          |          V|
   22+35       0.4372      0.04  Q          |          |          |          V|
   22+40       0.4375      0.04  Q          |          |          |          V|
   22+45       0.4378      0.04  Q          |          |          |          V|
   22+50       0.4381      0.04  Q          |          |          |          V|
   22+55       0.4384      0.04  Q          |          |          |          V|
   23+ 0       0.4387      0.04  Q          |          |          |          V|
   23+ 5       0.4390      0.04  Q          |          |          |          V|
   23+10       0.4393      0.04  Q          |          |          |          V|
   23+15       0.4396      0.04  Q          |          |          |          V|
   23+20       0.4399      0.04  Q          |          |          |          V|
   23+25       0.4402      0.04  Q          |          |          |          V|
   23+30       0.4405      0.04  Q          |          |          |          V|
   23+35       0.4408      0.04  Q          |          |          |          V|
   23+40       0.4411      0.04  Q          |          |          |          V|
   23+45       0.4413      0.04  Q          |          |          |          V|
   23+50       0.4416      0.04  Q          |          |          |          V|
   23+55       0.4419      0.04  Q          |          |          |          V|
   24+ 0       0.4422      0.04  Q          |          |          |          V|
   24+ 5       0.4424      0.03  Q          |          |          |          V|
   24+10       0.4425      0.01  Q          |          |          |          V|
   24+15       0.4425      0.00  Q          |          |          |          V|
   24+20       0.4425      0.00  Q          |          |          |           V
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U n i t H y d r o g r a p h A n a l y s i s

Study date 10/26/20 File: PRO22242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

Drainage Area = 8.85(Ac.) = 0.014 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 8.85(Ac.) = 0.014 Sq. Mi.
Length along longest watercourse = 975.00(Ft.)
Length along longest watercourse measured to centroid = 488.00(Ft.)
Length along longest watercourse = 0.185 Mi.
Length along longest watercourse measured to centroid = 0.092 Mi.
Difference in elevation = 27.50(Ft.)
Slope along watercourse = 148.9231 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time = 0.049 Hr.
Lag time = 2.96 Min.
25% of lag time = 0.74 Min.
40% of lag time = 1.19 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
8.85	2.00	17.70

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
8.85	6.00	53.10

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 2.000(In)
Area Averaged 100-Year Rainfall = 6.000(In)

Point rain (area averaged) = 2.000(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.000(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
8.850	85.50	0.250

Total Area Entered = 8.85(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
85.5	70.8	0.353	0.250	0.273	1.000	0.273
					Sum (F) =	0.273

Area averaged mean soil loss (F) (In/Hr) = 0.273
Minimum soil loss rate ((In/Hr)) = 0.137
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.700

U n i t H y d r o g r a p h
VALLEY S-Curve

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section G of the WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table G.1on page 23 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ A. **On-site storm drain inlets**	☒ **Locations of inlets.**	☒ **Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.**	☒ **Maintain and periodically repaint or replace inlet markings.** ☒ **Provide stormwater pollution prevention information to new site owners, lessees, or operators.** ☒ **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** ☒ **Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."**
☐ B. **Interior floor drains and elevator shaft sump pumps**		☐ **State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.**	☐ **Inspect and maintain drains to prevent blockages and overflow.**
☐ C. **Interior parking garages**		☐ **State that parking garage floor drains will be plumbed to the sanitary sewer.**	☐ **Inspect and maintain drains to prevent blockages and overflow.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ D1. **Need for future indoor & structural pest control**		☐ **Note building design features that discourage entry of pests.**	☐ **Provide Integrated Pest Management information to owners, lessees, and operators.**
☒ D2. **Landscape/ Outdoor Pesticide Use**	☐ **Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.** ☒ **Show self-retaining landscape areas, if any.** ☒ **Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)**	**State that final landscape plans will accomplish all of the following.** ☐ **Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.** ☒ **Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.** ☒ **Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.** ☒ **Consider using pest-resistant plants, especially adjacent to hardscape.** **To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.**	☒ **Maintain landscaping using minimum or no pesticides.** ☒ **See applicable operational BMPs in "What you should know for…..Landscape and Gardening"** at http://rcflood.org/stormwater/**Error! Hyperlink reference not valid.** ☒ **Provide IPM information to new owners, lessees and operators.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ E. **Pools, spas, ponds, decorative fountains, and other water features.**	☒ **Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)**	**If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.**	☒ **See applicable operational BMPs in** "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater/
☐ F. **Food service**	☐ **For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.** ☐ **On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.**	☐ **Describe the location and features of the designated cleaning area.** ☐ **Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.**	☐ **See the brochure, "**The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/ **Provide this brochure to new site owners, lessees, and operators.**
☐ G. **Refuse areas**	☐ **Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.** ☐ **If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area.** ☐ **Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.**	☐ **State how site refuse will be handled and provide supporting detail to what is shown on plans.** ☐ **State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.**	☐ **State how the following will be implemented:** **Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ H. **Industrial processes.**	❑ **Show process area.**	❑ **If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."**	❑ **See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ I. **Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)**	❑ **Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area.** ❑ **Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.** ❑ **Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.**	**Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.** **Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:** ▪ **Hazardous Waste Generation** ▪ **Hazardous Materials Release Response and Inventory** ▪ **California Accidental Release (CalARP)** ▪ **Aboveground Storage Tank** ▪ **Uniform Fire Code Article 80 Section 103(b) & (c) 1991** ▪ **Underground Storage Tank** **www.cchealth.org/groups/hazmat/**	❑ **See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ J. **Vehicle and Equipment Cleaning**	❑ **Show on drawings as appropriate:** **(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.** **(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).** **(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.** **(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.**	❑ **If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.**	**Describe operational measures to implement the following (if applicable):** ❑ **Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system.** Refer to "Outdoor Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/ ❑**Car dealerships and similar may rinse cars with water only.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ K. **Vehicle/Equipment Repair and Maintenance**	❑ **Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.** ❑ **Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.** ❑ **Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.**	❑ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ❑ **State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.** ❑ **State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.**	**In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:** ❑ **No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.** ❑ **No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.** ❑ **No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.** Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://rcflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ L. **Fuel Dispensing Areas**	❑ **Fueling areas[6] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.** ❑ **Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.**		❑ **The property owner shall dry sweep the fueling area routinely.** ❑ **See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

[6] **The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ M. **Loading Docks**	❑ **Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.** ❑ **Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		❑ **Move loaded and unloaded items indoors as soon as possible.** ❑ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ N. **Fire Sprinkler Test Water**		☒ **Provide a means to drain fire sprinkler test water to the sanitary sewer.**	☒ **See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
O. **Miscellaneous Drain or Wash Water or Other Sources** ❑ **Boiler drain lines** ☒ **Condensate drain lines** ❑ **Rooftop equipment** ❑ **Drainage sumps** ☒ **Roofing, gutters, and trim.** ❑ **Other sources**		❑ **Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.** ☒ **Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system.** ☒ **Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment.** ❑ **Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.** ☒ **Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.** ❑ **Include controls for other sources as specified by local reviewer.**	

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ P. **Plazas, sidewalks, and parking lots.**			☒ **Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.**

Appendix 9: O&M

Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms

Operations & Maintenance Responsibility for Treatment Control BMP's

BMP Required Maintenance	Frequency	Maintenance Requirements	Responsibility
Trash	Weekly	Empty Dumpsters	City
Bioretention Basins	On-Going	• Keep Adjacent landscape areas maintained. Remove clippings from landscape maintenance activities. • Remove trash and debris • Replace damaged grass and/or plants • Replace surface mulch layer as needed to maintain a 2-3 inch soil cover.	City
	After Storm Events	Inspect areas for ponding	
	Annually	Inspect/clean inlets and outlets	
Landscape Areas	Bi-Weekly	Mow, weed, trim and remove accumulation of trash debris and/or sediment. Retaining areas should be mowed at 4-6 inches in height if grass is proposed.	City

BMP's should start and be inspected prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

Funding

Owner:

Sycamore Creek Holdings, LLC

2151 Michelson Drive, Suite 250

Irvine, CA 92612

(949) 748-6714

I. Inspection and Maintenance Log

Inspection and Maintenance Log is found within Appendix 9 hereon

II. Updates, Revisions and Errata
Will be logged Separately

III. Introduction

i. The project consists of an active sports park. While many natural features of the site would be retained, park development would include the introduction of hardscape and impermeable surfaces as well as turfed and landscaped areas. The park plan includes a multi-use field, child play area, toddler play area, adventure play area, restrooms, picnic shelters, hardscape, parking lots, bridges, trails, a basketball court, BMX course improvements, art rocks, a splash pad, a skating area, and a zip line. Additionally, the Project would retain and incorporate some of the existing site features, such as Owl Rock, and formalize the unofficial BMX course that exists on the site. Responsibility for Maintenance

ii. General

a. Name/Contact Info: ***City of Perris, 101 N. D Street, Perris, CA 92570***

b. Organizational chart for maintenance function

1. ***City of Perris***

c. ***Operation and Maintenance Agreement is found in Appendix 9 hereon.***

d. Maintenance Funding: ***Source of Maintenance funds is the City of Perris.***

IV. Summary of Drainage Management Areas and Stormwater BMP's

a. Drainage Areas: ***See Attachments Hereon***
b. Structural Post-Construction BMP's: ***See Attachments Hereon***
c. Self-Retaining Areas or Other: ***N/A To This Project***

V. Stormwater BMP Design Documentation

a. As-built drawings of each BMP: ***Will provide post construction and inserted herein.***
b. ***Manufacture's data manuals are found in Appendix 9 herein***

VI. Maintenance Schedule

a. ***Maintenance Schedules and plans are found in Appendix 9 herein.***

Basin Site Maintenance Summary Form

Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
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Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		

Basin Site Maintenance Summary Form

Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
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Basin Site Maintenance Summary Form

Date:	**Inspector Name:**	**Basin:**
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Maintenance Performed:		

Appendix 10: Educational Materials

BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information

SITE DESIGN BMPs

SD-10 Site Design & Landscape Planning
SD-12 Efficient Irrigation
SD-13 Storm Drain Signage

SOURCE CONTROL BMPs

SC-11 Spill Prevention, Control and Cleanup
SC-41 Building and Grounds Maintenance

TREATMENT CONTROL BMPs

TC-32 Bioretention

Site Design & Landscape Planning SD-10

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “ redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include “NO DUMPING

– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Bioretention TC-32

Design Considerations

- Soil for Infiltration
- Tributary Area
- Slope
- Aesthetics
- Environmental Side-effects

Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

Targeted Constituents

☑	Sediment	■
☑	Nutrients	▲
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

None documented. Bioretention has been used as a stormwater BMP since 1992. In addition to Prince George's County, MD and Alexandria, VA, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

Advantages

- Bioretention provides stormwater treatment that enhances the quality of downstream water bodies by temporarily storing runoff in the BMP and releasing it over a period of four days to the receiving water (EPA, 1999).
- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape.

Limitations

- The bioretention BMP is not recommended for areas with slopes greater than 20% or where mature tree removal would

be required since clogging may result, particularly if the BMP receives runoff with high sediment loads (EPA, 1999).

- Bioretention is not a suitable BMP at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
- By design, bioretention BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water.
- In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

Design and Sizing Guidelines

- The bioretention area should be sized to capture the design storm runoff.
- In areas where the native soil permeability is less than 0.5 in/hr an underdrain should be provided.
- Recommended minimum dimensions are 15 feet by 40 feet, although the preferred width is 25 feet. Excavated depth should be 4 feet.
- Area should drain completely within 72 hours.
- Approximately 1 tree or shrub per 50 ft^2 of bioretention area should be included.
- Cover area with about 3 inches of mulch.

Construction/Inspection Considerations

Bioretention area should not be established until contributing watershed is stabilized.

Performance

Bioretention removes stormwater pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization (EPA, 1999). Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover, and planting soil.

Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter. Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately

aerated. Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic stormwater runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals and nutrients are shown in Table 1.

Table 1 Laboratory and Estimated Bioretention Davis et al. (1998); PGDER (1993)

Pollutant	Removal Rate
Total Phosphorus	70-83%
Metals (Cu, Zn, Pb)	93-98%
TKN	68-80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

Results for both the laboratory and field experiments were similar for each of the pollutants analyzed. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants concentrations (Davis et al, 1998).

The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

Siting Criteria

Bioretention BMPs are generally used to treat stormwater from impervious surfaces at commercial, residential, and industrial areas (EPA, 1999). Implementation of bioretention for stormwater management is ideal for median strips, parking lot islands, and swales. Moreover, the runoff in these areas can be designed to either divert directly into the bioretention area or convey into the bioretention area by a curb and gutter collection system.

The best location for bioretention areas is upland from inlets that receive sheet flow from graded areas and at areas that will be excavated (EPA, 1999). In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized drainage areas.

Additional Design Guidelines

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered (EPA, 1999). Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.

The use of bioretention may not be feasible given an unstable surrounding soil stratum, soils with clay content greater than 25 percent, a site with slopes greater than 20 percent, and/or a site with mature trees that would be removed during construction of the BMP.

Bioretention can be designed to be off-line or on-line of the existing drainage system (EPA, 1999). The drainage area for a bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Larger drainage areas may require multiple bioretention areas. Furthermore, the maximum drainage area for a bioretention area is determined by the expected rainfall intensity and runoff rate. Stabilized areas may erode when velocities are greater than 5 feet per second (1.5 meter per second). The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area, which is a function of the drainage area and the runoff generated from the area is sized to capture the water quality volume.

The recommended minimum dimensions of the bioretention area are 15 feet (4.6 meters) wide by 40 feet (12.2 meters) long, where the minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established. Thus replicating a natural forest and creating a microclimate, thereby enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 25 feet (7.6 meters), with a length of twice the width. Essentially, any facilities wider than 20 feet (6.1 meters) should be twice as long as they are wide, which promotes the distribution of flow and decreases the chances of concentrated flow.

In order to provide adequate storage and prevent water from standing for excessive periods of time the ponding depth of the bioretention area should not exceed 6 inches (15 centimeters). Water should not be left to stand for more than 72 hours. A restriction on the type of plants that can be used may be necessary due to some plants' water intolerance. Furthermore, if water is left standing for longer than 72 hours mosquitoes and other insects may start to breed.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent.

Generally the soil should have infiltration rates greater than 0.5 inches (1.25 centimeters) per hour, which is typical of sandy loams, loamy sands, or loams. The pH of the soil should range between 5.5 and 6.5, where pollutants such as organic nitrogen and phosphorus can be adsorbed by the soil and microbial activity can flourish. Additional requirements for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.

Soil tests should be performed for every 500 cubic yards (382 cubic meters) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area (EPA, 1999). Planting soil should be 4 inches (10.1 centimeters) deeper than the bottom of the largest root ball and 4 feet (1.2 meters) altogether. This depth will provide adequate soil for the plants' root systems to become established, prevent plant damage due to severe wind, and provide adequate moisture capacity. Most sites will require excavation in order to obtain the recommended depth.

Planting soil depths of greater than 4 feet (1.2 meters) may require additional construction practices such as shoring measures (EPA, 1999). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1.

Trees and shrubs should be planted when conditions are favorable. Vegetation should be watered at the end of each day for fourteen days following its planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area.

The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities. The designers should evaluate the best placement of vegetation within the bioretention area. Plants should be placed at irregular intervals to replicate a natural forest. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site.

Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

Maintenance

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aide in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural

soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance.

Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation (EPA, 1999). Diseased vegetation should be treated as needed using preventative and low-toxic measures to the extent possible. BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention BMPs are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained.

In order to maintain the treatment area's appearance it may be necessary to prune and weed. Furthermore, mulch replacement is suggested when erosion is evident or when the site begins to look unattractive. Specifically, the entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas. Mulch replacement should be done prior to the start of the wet season.

New Jersey's Department of Environmental Protection states in their bioretention systems standards that accumulated sediment and debris removal (especially at the inflow point) will normally be the primary maintenance function. Other potential tasks include replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures. There is also the possibility that the cation exchange capacity of the soils in the cell will be significantly reduced over time. Depending on pollutant loads, soils may need to be replaced within 5-10 years of construction (LID, 2000).

Cost

Construction Cost

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999). A general rule of thumb (Coffman, 1999) is that residential bioretention areas average about $3 to $4 per square foot, depending on soil conditions and the density and types of plants used. Commercial, industrial and institutional site costs can range between $10 to $40 per square foot, based on the need for control structures, curbing, storm drains and underdrains.

Retrofitting a site typically costs more, averaging $6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland, Kettering Development, with 15 bioretention areas were estimated at $111,600.

In any bioretention area design, the cost of plants varies substantially and can account for a significant portion of the expenditures. While these cost estimates are slightly greater than those of typical landscaping treatment (due to the increased number of plantings, additional soil excavation, backfill material, use of underdrains etc.), those landscaping expenses that would be required regardless of the bioretention installation should be subtracted when determining the net cost.

Perhaps of most importance, however, the cost savings compared to the use of traditional structural stormwater conveyance systems makes bioretention areas quite attractive financially. For example, the use of bioretention can decrease the cost required for constructing stormwater conveyance systems at a site. A medical office building in Maryland was able to reduce the amount of storm drain pipe that was needed from 800 to 230 feet - a cost savings of $24,000 (PGDER, 1993). And a new residential development spent a total of approximately $100,000 using bioretention cells on each lot instead of nearly $400,000 for the traditional stormwater ponds that were originally planned (Rappahanock,). Also, in residential areas, stormwater management controls become a part of each property owner's landscape, reducing the public burden to maintain large centralized facilities.

Maintenance Cost

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

References and Sources of Additional Information

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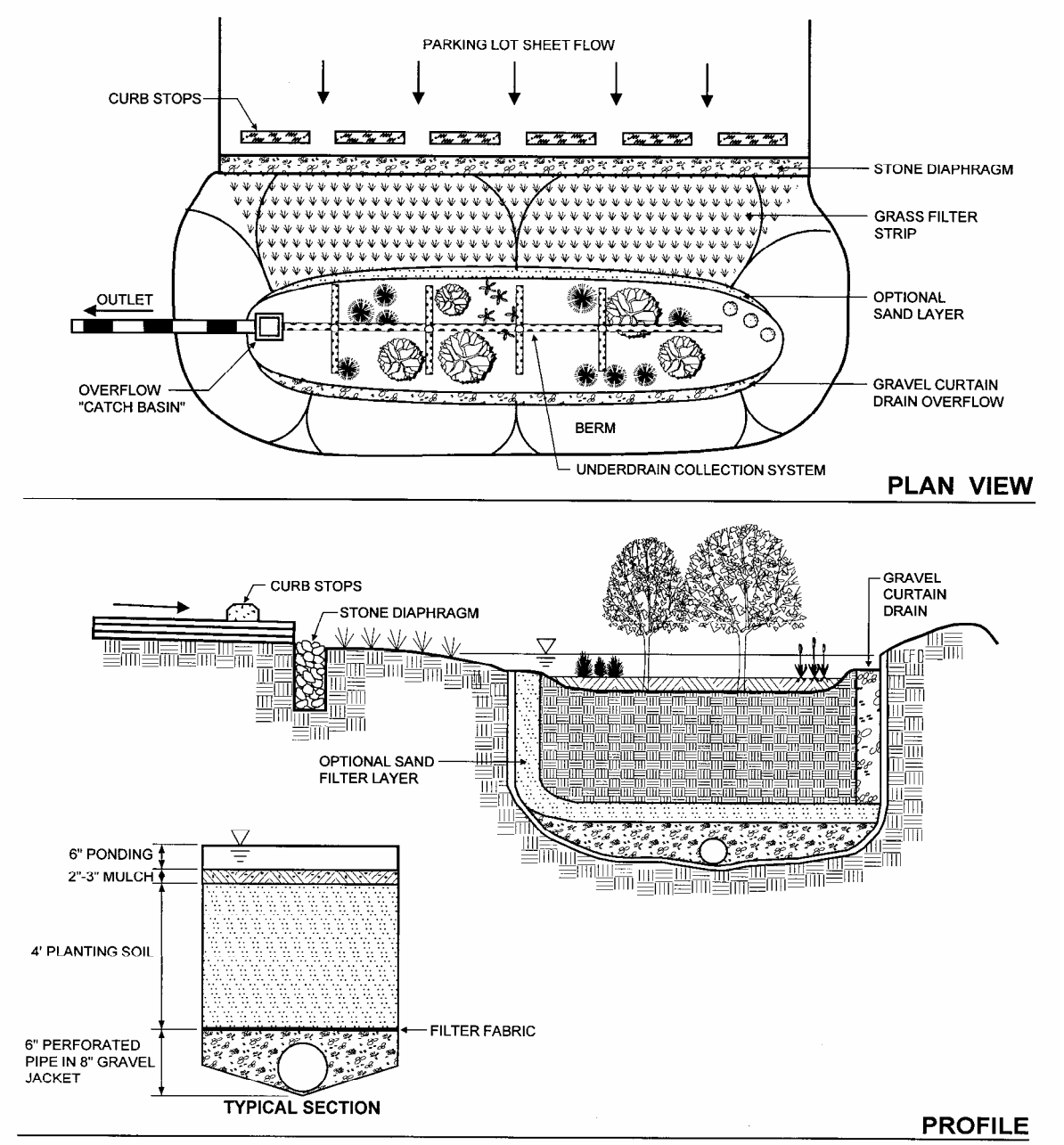

Schematic of a Bioretention Facility (MDE, 2000)