BLACKHAWK LOGISTICS, LLC

GRANT FOR LCNG FUELING FACILITY BLYTHE, CALIFORNIA

INITIAL STUDY AND MITIGATED NEGATIVE DECLARATION RECOMMENDATION

CALIFORNIA ENERGY COMMISSION

1516 NINTH STREET
SACRAMENTO, CALIFORNIA 95814

OCTOBER 2012

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INITIAL STUDY AND PROPOSED MITIGATED NEGATIVE DECLARATION

PROJECT: Blackhawk Logistics LCNG Fueling Facility
Blythe, California

LEAD AGENCY:

California Energy Commission,
1516 9th Street, Sacramento, California 95814

BRIEF PROJECT DESCRIPTION:

The project applicant, Blackhawk Logistics, LLC, a jointly held company of HayDay Farms, Inc. and Border Valley Trading, Ltd., is proposing to construct a Liquefied and Compressed Natural Gas (LCNG) fueling station in the City of Blythe, California. The fueling station would serve HayDay Farms' expanding fleet of natural gas powered trucks, and those of a short list of private operators with service agreements with Blackhawk Logistics. The station would also be available for use by the general public. The project would be constructed in two to three phases with the first phase consisting of the installation of LNG fueling facilities. The CNG fueling facilities would be added during the second and third phases of the project, which will be dictated by market demand.

EXECUTIVE SUMMARY

The proposed project involves the multi-phase development of a publicly accessible LCNG fueling station on a 1.73-acre site located on the east side of S. Willow Street between W. Wells Street and W. 14th Avenue in the Blythe, California. The property address is 450 S. Willow Street and the applicable Riverside County Assessor's Parcel Numbers are 848-110-010 and 848-110-011.

The existing land uses and General Plan/Zoning designations are shown on the following table.

Table ES-1
Existing Use, General Plan, and Zoning Designations

Location	Existing Use	General Plan Designation	Zoning Designation
Site	Vacant	General Commercial	CG
North	Truck/recreational vehicle parking area for a Super 8 Motel	General Commercial	CG
South	Vacant	General Commercial	CG
East	Public utility (SCE) service center	Public/Quasi-Public	P/Q-P
West	Vacant	General Commercial	CG

The project site is undeveloped, but has been entirely disturbed by prior human activity (i.e., graded/disked). The site is devoid of any significant types of vegetation. The sparse vegetative cover on the site is limited to common ruderal grasses and low growing scrub vegetation. The property does not contain any wetland or riparian features that would fall under the jurisdiction of the U.S. Army Corps of Engineers, the California Department of Fish and Game, or the Regional Water Quality Control Board.

The current General Plan and Zoning designations for the property are General Commercial (CG). The project site consists of two parcels that will be merged prior to the issuance of building/public improvement permits by the City of Blythe. The applicant, Blackhawk Logistics, LLC, proposes to construct an LCNG fueling station on the property in two to three phases with the first phase consisting of the installation of LNG fueling facilities. It is anticipated that the CNG fueling facilities would be added during the subsequent phases of development, which will be dictated by market conditions and demand. However, the site planning and engineering for the project provides for the accommodation of CNG fueling facilities during the initial phase of development, if the market conditions so warrant. The proposed station will close an existing "gap" in the regional clean fuel infrastructure and assist in reducing greenhouse

gas (GHG) emissions from currently diesel powered trucks transporting goods from the Ports of Long Beach and Los Angeles to Arizona, consistent with the goals of AB 32.

This Initial Study serves as the environmental review of the proposed project, as required by the California Environmental Quality Act (CEQA), Public Resources Code Section 21000 et seq., and the State CEQA Guidelines. Although the City of Blythe has exempted the project as "ministerial," the California Energy Commission cannot similarly make this determination, since its decision to approve $600,000 in grant funding being requested by the project sponsor is wholly discretionary. Hence, the Energy Commission's consideration of awarding grant funding to construct the proposed LCNG facility is not exempt from CEQA. As the only public agency having discretionary approval over the project, the Energy Commission is, by default, the "lead agency" for the purposes of CEQA and is responsible for preparing the appropriate environmental documents for the proposed project. As on-call planning staff to the City of Blythe, Willdan Engineering, in turn, was authorized by the City to assist the Energy Commission in determining the appropriate environmental documentation to be prepared for the project pursuant to CEQA, beginning with an Initial Study.

In accordance with Section 15063 of the State CEQA Guidelines, the Energy Commission is required to prepare an Initial Study to determine if the project may have a significant effect on the environment. This Initial Study is intended to be an informational document providing the Energy Commission, other public agencies, and the general public with an objective assessment of the potential environmental impacts that could result from implementation of the project. The results of the Initial Study show that there are potentially significant impacts to Cultural Resources (archaeological resources), Geology and Soils (liquefaction and soil corrosivity), Hydrology and Water Quality (possible construction dewatering), and Noise (construction), but that these potential impacts can be reduced to less than significant levels through the imposition of proposed mitigation measures.

Impacts to other environmental factors - Aesthetics, Agriculture and Forestry Resources, Air Quality, Biological Resources, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Land Use and Planning, Mineral Resources, Population and Housing, Public Services, Recreation, Transportation/Traffic, and Utilities and Service Systems - are considered as having a less than significant impact or no impact on the environment.

1. INTRODUCTION

Blackhawk Logistics, LLC, a jointly held company of HayDay Farms, Inc. and Border Valley Trading, Ltd., proposes to construct a publicly accessible Liquefied and Compressed Natural Gas (LCNG) dispensing facility on vacant property located at 450 S. Willow Street in Blythe, California. Blackhawk Logistics applied for a grant award of $600,000 from the California Energy Commission (Energy Commission) to financially assist with the construction of the facility and was proposed for an award on April 24, 2012.

The project is a principally permitted use (i.e., a use allowed by right) in the General Commercial (C-G) zoning district in which it is proposed to be constructed. The project will only require a parcel merger prior to the issuance of required building/public improvement permits by the City of Blythe, which are "ministerial" actions under the California Environmental Quality Act (CEQA). Since no discretionary actions are required on the part of the City of Blythe in order to allow the project to proceed, the City determined that the project was exempt from further CEQA review.

Under CEQA, "project" means "the whole of an action, which has the potential for resulting in either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment," and that is "an activity undertaken by a person which is supported in whole or in part through public agency contracts, grants, subsidies, loans, or other forms of assistance from one or more public agencies." The proposed LCNG facility is an activity that has the potential to result in a direct physical change to the environment. Additionally, the project is proposed to be partially supported by a discretionary grant from the Energy Commission, which it could decide to approve or not to approve at a future business meeting. Therefore, the Energy Commission's consideration of discretionary grant funding for the proposed Blackhawk Logistics LCNG facility is a "project" under CEQA.

Although the City of Blythe has exempted the project as "ministerial," the Energy Commission cannot similarly make this determination, since its decision to approve the requested grant funding is wholly discretionary. Hence, the Energy Commission's consideration of awarding grant funding to construct the proposed LCNG facility is not exempt from CEQA. As the only public agency having discretionary approval over the project, the Energy Commission is, by default, the "lead agency" for the purposes of CEQA and is responsible for preparing the appropriate environmental documents for the proposed project. As on-call planning staff to the City of Blythe, Willdan Engineering, in turn, was authorized by the City to assist the Energy Commission in determining the appropriate environmental documentation to be prepared for the project pursuant to CEQA, beginning with an Initial Study.

2. PROJECT DESCRIPTION

The project applicant, Blackhawk Logistics, LLC, a jointly held company of HayDay Farms, Inc. and Border Valley Trading, Ltd., is proposing to construct an LCNG fueling station in the City of Blythe, California. The fueling station would serve HayDay Farms' expanding fleet of natural gas powered trucks, and those of a short list of private operators with service agreements with Blackhawk Logistics. The station would also be available for use by the general public. The project would be constructed in two to three phases with the first phase consisting of the installation of LNG fueling facilities. It is anticipated that the CNG fueling facilities would be added during the subsequent phases of the project, which will be dictated by market demand. However, the site planning and engineering for the project provides for the accommodation of CNG fueling facilities during the initial phase of development, if the market conditions so warrant.

2.1 PROJECT LOCATION

The project is located in the City of Blythe, in the easternmost portion of Riverside County, California. The project site lies in the southwest portion of the City, south of Interstate 10 (I-10) and the City's downtown area (Figure 1). More specifically, the project site consists of two parcels located on the east side of S. Willow Street between W. Wells Street and W. 14th Avenue (Figure 2).

2.2 BACKGROUND AND PURPOSE

Blackhawk Logistics, LLC, a jointly held company of HayDay Farms, Inc. and Border Valley Trading Ltd., has requested grant funding support from the California Energy Commission in the amount of $600,000 to develop a publicly accessible LNG station in Blythe, California to fuel HayDay Farms' expanding fleet of natural gas powered trucks. In conjunction with this Energy Commission supported LNG station project, HayDay Farms and Border Valley Trading plan to include LCNG fueling capacity at this facility.

The initial LNG station project will provide alternative fueling options for LNG and CNG vehicle users with routes along I-10 and that operate in the Imperial Valley. The primary objective of this project is to establish the LNG fueling infrastructure to support HayDay Farms' fleet and others operating along one of the busiest stretches of highway in the nation. This project will make natural gas fuel accessible to the HayDay Farms' fleet and the general retail market, predominantly goods movement trucks operating along the I-10 between Arizona and California, including Swift, Western Milling, Apex Bulk Commodities, and other retail users.

This project also will help regional goods movement and public agency fleets transition to clean natural gas, including Mallet and Sons, Coachella Valley Ice Company, the Palo Verde Irrigation District, and the City of Blythe. These entities are specifically examining natural gas fuel and are interested in using the Blythe station as they adopt LNG and CNG usage. This project will therefore assist the Energy Commission in reducing petroleum use and greenhouse gas emissions from the existing HayDay Farms LNG fleet, as well as numerous heavy-duty diesel trucks operated locally or traveling on I-10 between Los Angeles and Phoenix.

HayDay Farms and its partner, Border Valley Trading, are existing natural gas fleet users with an extremely high fuel demand from 40 LNG trucks (20 trucks per fleet). Both fleets transitioned to LNG in 2008 in response to the San Pedro Bay Ports Clean Air Action Plan and used the Sunline LNG station in Thousand Palms for refueling, until it went offline in late 2008. HayDay Farms and Border

Blythe LCNG Facility	Project Location	Figure 1

Blythe LCNG Facility	Project Site	Figure 2

Valley Trading remained committed to LNG fueling and have been working together to construct public-access stations for both their operations, plus other regional fleets. This partnership was formalized with the creation of Blackhawk Logistics, LLC, and led to an Energy Commission supported LNG/LCNG station in Palm Springs. Blackhawk Logistics is now seeking Energy Commission funding for this LNG station in Blythe to support HayDay Farms' LNG operations, although the fleet will continue to use the Palm Springs station for fueling redundancy and en-route fueling.

Once established, the Blythe station will close an existing "gap" in clean fuel infrastructure in this region. The closest public access fueling stations to Blythe are currently 100 miles away in El Centro, and 120 miles away in Palm Springs. Therefore, this public-access station will fill an important gap in natural gas availability for natural gas vehicle users looking to travel lengthy distances along the I-10 and or through the Imperial Valley. In addition to HayDay Farms's own fleet of vehicles, several regional heavy-duty fleet operators are also expected to utilize this planned facility as previously stated.

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The proposed Blythe station will serve an important economic function for a region that has been negatively impacted by the recession by providing a more economical fueling option for local fleets. This station will also reduce greenhouse gas and criteria pollutant emissions in an area that is heavily impacted by emissions, geography and weather patterns. Lastly, this station will support businesses located in hard-hit communities, helping them to save money, displace large quantities of petroleum, and use entirely low-carbon fueling operations. This station will also enable goods movement fleets to reliably reach the Southern California ports and create the last needed link into LNG fueling markets 150 miles away in Phoenix, Arizona. This Blythe station will also connect with public retail stations in Palm Springs and in Ontario, creating a true interstate regional clean fuel corridor that will enable Inland Empire and Arizona goods movement fleets to fuel with LNG and CNG across the states of California and Arizona.

Hayday Farms and Border Valley Trading will jointly own the land. They have already contracted with GreenFIX to oversee project implementation, and are in the process of vendor selection for the station development. Permitting, site design, and vendor research is all currently underway in preparation for potential Energy Commission funding. Led by a prepared and seasoned team with a seasoned understanding of the technology, Hayday Farms, Border Valley Trading, and GreenFIX are fully prepared to immediately implement this highly beneficial project. The full cost of the proposed fueling station will be $1,725,000, with Blackhawk Logistics requesting $600,000 in Energy Commission funding to support a project that will achieve the following goals:

- Support and bolster the regional refueling infrastructure strategy being developed in Southern California and Arizona through the development of a new publicly accessible station along a key goods movement corridor;
- Promote regional growth in alternative fuel vehicle deployments and the replacement of heavy-duty diesel trucks;
- Provide natural gas refueling for HayDay Farms and other retail fleets;
- Eliminating 212,500 gallons of diesel usage by HayDay Farms in 2013;
- Replacing 758,275 gallons of annual diesel use with LNG from conservative estimates of HayDay Farms and other retail use in 2015;
- Reducing annual greenhouse gas (GHG) emissions by 638 metric tons in 2013;
- Further reducing annual GHG emissions by 2,486 metric tons in 2015;
- Reducing annual GHG emissions by 4,798 metric tons from 2013-2015;
- Achieving these goals at a cost-effectiveness as low as $0.40 per gallon of diesel fuel use eliminated and $125.00 per metric ton of GHGs reduced from 2013-2015.

3. ENVIRONMENTAL CHECKLIST

PROJECT INFORMATION
1. Project Title: **LCNG Fueling Facility**
2. Lead Agency Name and Address: **California Energy Commission** **1516 Ninth Street** **Sacramento, CA 95814**
3. Contact Person and Phone Number: **Donald Coe, (916) 654-3941**
4. Project Location: **450 S. Willow Street, Blythe, California**
5. Project Sponsor's Name and Address: **Blackhawk Logistics, LLC, 44700 Village Court, Suite 100, Palm Desert, CA 92260**
6. General Plan Designation: **General Commercial (CG)**
7. Zoning: **General Commercial (CG)**

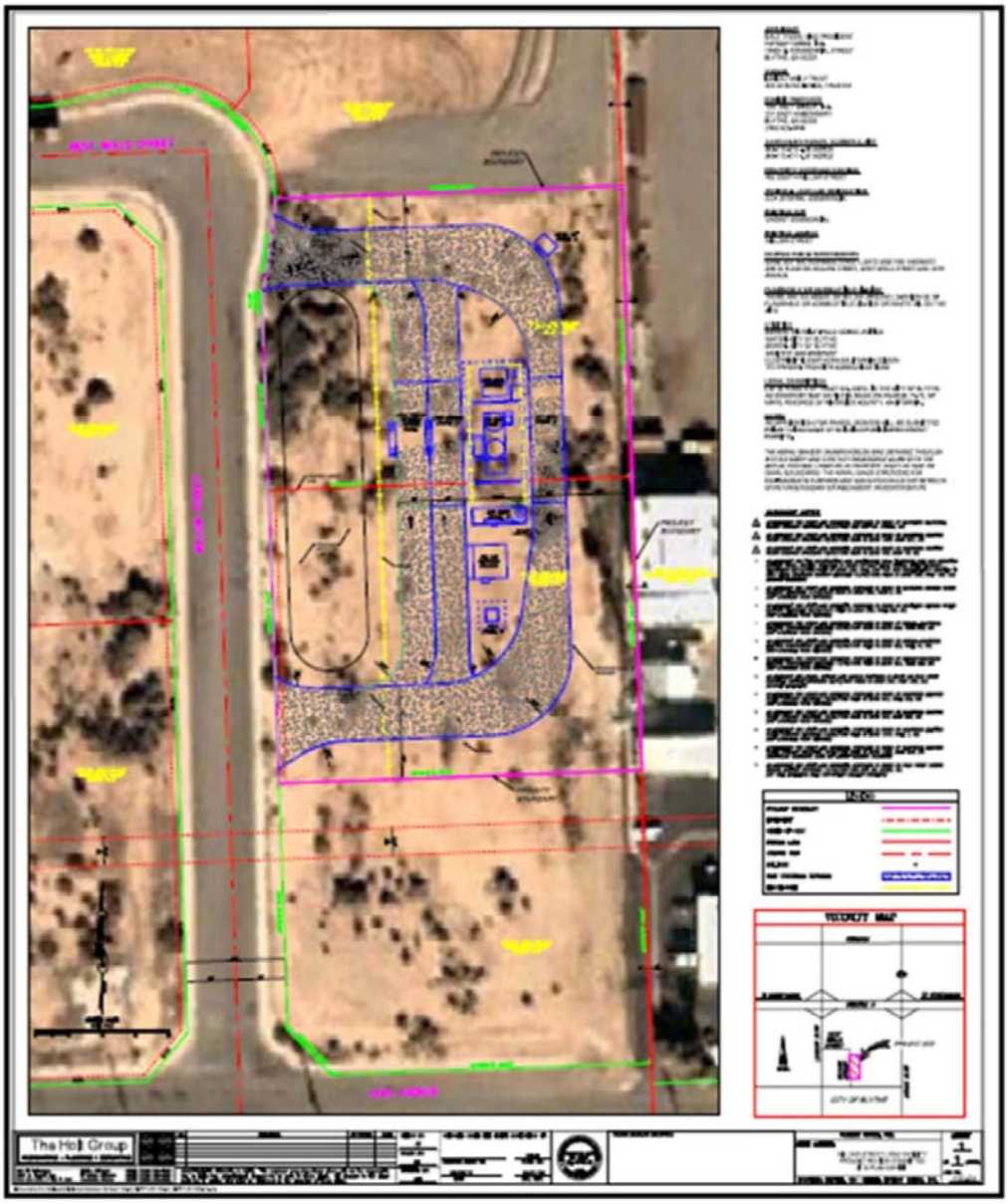
8. Description of Project (Describe the whole action involved, including but not limited to later phases of the project, and any secondary, support, or off-site features necessary for its implementation. Attach additional sheets if necessary.): **The proposed project involves the multi-phase development of a publicly accessible LCNG fueling station on a 1.73-acre site, at 450 S. Willow Street in the Blythe, California (Figure 3). The project would be constructed in two to three phases with the first phase consisting of the installation of LNG fueling facilities.**

The first phase of development will include the installation of an up to 15,000 gallon storage tank and ancillary equipment for the pumping, vaporization and dispensing of LNG fuel. Site preparation will occur during this phase to accommodate expanded LNG storage and the addition of a CNG fueling facility in the future, during subsequent phases of development, as market conditions warrant. Phase 1 of the development will also include the installation of utilities, supporting safety equipment, and a portable toilet module, as well as the construction of driveways, concrete pads, a storm water retention basin and landscaping improvements. The site will be enclosed by a 6 to 8-foot high wall along the Willow Street frontage and by chain link fencing along the remaining perimeter of the site. Two access points will be provided on Willow Street; the southern access for ingress only and the northern access for egress only.

Subsequent phases of development, which shall be dictated by market conditions and demand, may include the expansion of LNG storage to 30,000 gallons with the addition of 1 or more fueling dispensers and the addition of a CNG fueling facility with 1 or more fueling dispensers. These phases of development would also include the construction of a restroom facility with connection to the existing sewer main located in S. Willow Street.

Access to the private portion of the LNG station will be controlled by perimeter fencing with lockable, automatic rolling driveway gates. This portion of the station would be restricted to HayDay Farms and a short list of private operators with service agreements with Blackhawk Logistics. The public portion of the station will include unrestricted public access for LNG dispensing and future CNG fueling.

Gas deliveries during Phase1 will be dictated by demand but are estimated to be approximately twice each week. When fully developed and operational, it is anticipated that a maximum of 150 LNG vehicles and 40-50 CNG vehicles will use the fueling station daily. Gas deliveries to the site will increase as public/private demand for fuel increases.



Blythe LCNG Facility	Site Plan	Figure 3

All proposed facilities will comply with the National Fire Protection Association 52 (NFPA 52) Vehicular Gaseous Fuel Systems Code and with the City of Blythe and state fire protection regulations. These are applicable to all aspects of the project, including the storage tanks' structural integrity and the safety mechanisms on auxiliary attachments and supporting equipment. The facility will also be equipped with programmable security and emergency measures. Additional safety procedures will be followed by trained fuelers and by qualified routine inspection and maintenance personnel.

Assuming that the Energy Commission approves the grant award in November 2012, the final engineering, preconstruction and permitting for Phase 1 of the development would be performed between November 2012 and April 2013. The LNG equipment required for the project would also be ordered during this period. Site preparation and improvements would be completed during May and June 2013, and the installation of the LNG equipment to occur between June and August 2013. Phase 1 of the fueling station would become fully operational, following startup and commissioning, by September 2013. As previously stated, the timing of the subsequent phases of the station development will be dictated by market demand and conditions. However, the subsequent phases of development would require less time to construct than Phase 1 of the development since the site preparation and improvements needed to accommodate future expansion of the LNG fueling facilities and the possible addition of CNG fueling facilities will have been completed during Phase 1.

The project site currently consists of two parcels: APN 848-110-010, which is .86 acres in size, and APN 848-110-011, which is .87 acres in size. Therefore, a parcel merger will be required prior to the issuance of building/public improvement permits by the City of Blythe, all of which are "ministerial" actions under CEQA. There are no discretionary actions required on the part of the City of Blythe since the project is a principally permitted use (i.e., permitted by right) in the General Commercial (CG) zone in which it is proposed to be constructed.

9. Surrounding Land Uses and Setting**: The proposed project is located in the southwest portion of the City, which is an urbanized area consisting of commercial and other non-residential uses intermingled with undeveloped lots. The project site is bordered by a truck/recreational vehicle (RV) parking area for a Super 8 Motel on the north, a public utility (i.e., Southern California Edison) service center on the east, vacant land on the south, and Willow Street and vacant land beyond to the west.**

10. Other Public Agencies Whose Approval is Required (e.g., permits, financing approval, or participation agreement): **City of Blythe (ministerial approval of a parcel merger and the issuance of building and public improvement permits)**

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED					
	Aesthetics		Agriculture and Forest Resources		Air Quality
	Biological Resources		Cultural Resources		Geology and Soils
	Greenhouse Gas Emissions		Hazards and Hazardous Materials		Hydrology and Water Quality
	Land Use and Planning		Mineral Resources		Noise
	Population and Housing		Public Services		Recreation
	Transportation / Traffic		Utilities and Service Systems		Mandatory Findings of Significance

DETERMINATION (To be completed by the Lead Agency)	
On the basis of this initial evaluation:	
☐	I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.
☒	I find that although the proposed project could have a significant effect on the environment, there WILL NOT be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.
☐	I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.
☐	I find that the proposed project MAY have a “potentially significant impact” or “potentially significant unless mitigated” impact on the environment, but at least one effect (1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and (2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.
☐	I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature _____ Date _____

Printed Name _____ Title _____

Agency _____

EVALUATION OF ENVIRONMENTAL IMPACTS

1. A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).
2. All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.
3. Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.
4. "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from "Earlier Analyses," as described in (5) below, may be cross-referenced).
5. Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:
   a) Earlier Analysis Used. Identify and state where they are available for review.
   b) Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
   c) Mitigation Measures. For effects that are "Less than Significant with Mitigation Measures Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.
6. Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.

7. Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

8. This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.

9. The explanation of each issue should identify:
   a) The significance criteria or threshold, if any, used to evaluate each question; and
   b) The mitigation measure identified, if any, to reduce the impact to less than significance.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
I. Aesthetics. Would the project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☒	☐
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☒	☐

ENVIRONMENTAL SETTING

The City of Blythe is located in eastern Riverside County, along the Colorado River and immediately west of the Arizona-California border. The City of Blythe is somewhat topographically uniform and has an average elevation of 270 feet above mean sea level. The elevation ranges from 430 feet on the Palo Verde Mesa to about 255 feet south of 18th Avenue. Development is generally focused along the main north-south and east-west arterial roadways in the City and along the I-10 corridor. The primary aesthetic and scenic resources in the City and surrounding area are the Colorado River and the views to the Palo Verde Mesa to the west and north, Big Maria Mountains to the north, Dome Rock, Trigo and Chocolate Mountains across the Colorado River in Arizona, and the McCoy and Chocolate Mountains to the northwest and southwest, respectively *(Final Program EIR, City of Blythe General Plan 2025)*.

DISCUSSION

a) Have a substantial adverse effect on a scenic vista?

The project involves the construction of an LCNG fueling station in the southwestern portion of the City. The project area is urbanized and comprised of commercial and other non-residential uses interspersed with undeveloped properties. There are no scenic or aesthetic resources on or within the immediate vicinity of the project site. The project will involve the installation of up to two LNG storage tanks. The cylindrical-shaped structures will have a maximum height of 50 feet and a maximum diameter of 15 feet and will be visible from surrounding properties. However, given the location of the project and the fact that there are no scenic vistas in the immediate vicinity of the project site, the project has no potential to impact scenic vistas of the Colorado River or the surrounding mountains to the north, east, and south. Therefore, it is determined that the project will have no impact on scenic resources.

b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?

Interstate 10, which is located approximately 1,000 feet north of the site, is not listed as an "Officially Designated State Scenic Highway" or an "Eligible and Officially Designated Route" according to the California Department of Transportation's Scenic Highway Program. Therefore, the project would not substantially damage scenic resources, including but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway.

c) Substantially degrade the existing visual character or quality of the site and its surroundings?

The project site is currently undeveloped. The immediately surrounding properties are developed with a motel parking lot for trucks/recreational vehicles and a public utility service center, or are otherwise undeveloped. The proposed project will convert the existing vacant land into an LCNG fueling facility. The project area is designated General Commercial in the Blythe General Plan and the project is consistent with this designation. Although the visual character of the project site will change, it will not impair the long-term future development pattern envisioned by the General Plan. Therefore, impacts to the visual character of the area will be less than significant.

d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?

The project will include outdoor illumination for nighttime safety and security. In compliance with Section 17.28.030 of the Blythe Municipal Code, which contains performance standards and general requirements that require lighting to be arranged so as to reflect away from adjoining property and to not cause a nuisance either to highway traffic or to the living environment, the lighting will consist of downward oriented luminaries with shielding to prevent light spillage on adjacent parcels.

The project will involve the installation of up to two cylindrical-shaped LNG storage tanks, with maximum heights of 50 feet and maximum diameters of 15 feet. Though the proposed LNG tanks will be visible from S. Lovekin Boulevard, W. 14th Avenue, and other nearby roadways, they are not expected to create glare that would adversely affect the day or nighttime views in the area since they will be painted with a matt-finish, natural light color that is complementary to the desert environment. Similarly, the other facilities proposed on the site will not contain reflective surfaces. Therefore, less than significant impacts are anticipated to result from the proposed project.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The project will have a less than significant impact on the visual character of the site and surrounding area.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
II. Agriculture and Forest Resources.				
In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997, as updated) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board.				
Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use or a Williamson Act contract?	☐	☐	☐	☒
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☒
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒
e) Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of Farmland to non-agricultural use or conversion of forest land to non-forest use?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

The City of Blythe is located within the Palo Verde Valley. According to the *Final Program EIR, City of Blythe General Plan 2025,* the valley is known as one of the richest agricultural regions in California, having been created by the continuous flooding of the valley floor by the Colorado River, leaving deep, rich deposits of silt. The flat floor of the Palo Verde Valley is characterized by a constantly changing pattern of crops and

cultivation. Agricultural uses in the City include primarily alfalfa, cotton, hay, orchards, and field crops. Land to the north and south of I-10 and east of the Palo Verde Mesa are considered suitable for seasonal livestock (sheep) grazing. Prime agricultural soils are found east of the airport and used for orchards and field crops. Large areas with active Williamson Act contracts are located just north of the City boundaries between U.S. 95 and the Colorado River, and south of I-10 outside of the City boundaries. Being located in the Lower Mojave Desert region of Southern California, there is no timberland or forest land within the City or surrounding area.

DISCUSSION

a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?

The project site is shown on the maps prepared pursuant to the Farmland mapping and Monitoring Program of the California Resources Agency as "Urban and Built-Up Land."

b) Conflict with existing zoning for agricultural use or a Williamson Act contract?

The project site is currently zoned General Commercial (CG). This zoning designation is not intended to facilitate agricultural production.

The surrounding zoning designations are General Commercial (CG) to the north; Public/Quasi-Public (P/Q-P) to the east; General Commercial (CG) to the west; and General Commercial (CG) to the south. Therefore, the project would not create conflicts between agriculture zoning and non-agriculture zoning.

In addition, according to the Riverside County Land Information System, the site is not covered by a Williamson Act Contract. Therefore, there are no impacts on existing agricultural zoning or a Williamson Act Contract.

c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?

The current zoning designation on the site is General Commercial (CG). This zoning designation is not intended to accommodate forest land or timberland resources. There is no land on the site or in the vicinity of the site that is zoned as forest land or timberland. Therefore, the project would not conflict with existing zoning for forest land or timberland and it would not cause the rezoning of forest land or timberland.

d) Result in the loss of forest land or conversion of forest land to non-forest use?

There is no forest land on or in the vicinity of the project site and, therefore, the project has no potential to result in the loss of forest land or the conversion of forest land to non-forest use.

e) Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of Farmland to non-agricultural use or conversion of forest land to non-forest use?

Since there is no Farmland or forest land on or in the vicinity of the project site, the project does not involve any changes in the existing environment that could result in the conversion of Farmland to non-agricultural use or the conversion of forest land to non-forest use.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The proposed project will have no impact on agriculture or forest resources.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
III. Air Quality.				
Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make the following determinations.				
Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☐	☒
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☒	☐
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☒	☐
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☒	☐

ENVIRONMENTAL SETTING

The Mojave Desert Air Quality Management District (MDAQMD) has jurisdiction over air quality management for the project. According to the *Final Program EIR, City of Blythe General Plan 2025,* the MDAQMD has two plans in effect to address Ozone and Particulate Matter of 10 microns or less in size (PM_{10}): "MDAQMD 2004 Ozone Attainment Plan (State and Federal)" and "Final Mojave Desert Planning Area Federal Particulate Matter (PM_{10}) Attainment Plan." However, the PM_{10} attainment plan does not apply to the Eastern Riverside County portion of the Mojave Desert Air Basin, because this area is in attainment for the federal PM_{10}.

The MDAQMD's primary means of implementing the above air quality plans is by adopting and enforcing rules and regulations. Stationary sources within the jurisdiction are regulated by the District's permit authority over such sources and through its review and planning activities.

In addition to various general MDAQMD rules concerning permits and fees, the following Prohibitory Rules are specifically applicable to the long-term development included in the *City of Blythe General Plan 2025* planning area: Rule 403 Fugitive Dust, Rule 1103 Cutback and Emulsified Asphalt, and Rule 1113 Architectural Coatings (during construction). Prohibitory rules must be complied with; violations are subject to fine. (Ref. General Plan EIR Pages 3.2-6 and 3.2-7).

DISCUSSION

a) Conflict with or obstruct implementation of the applicable air quality plan?

Project-generated emissions were modeled using the California Emissions Estimator Model (CalEEMod). Project-generated emissions were modeled based on project specific information and/or default information contained in CalEEMod, if project specific information was not available. Based on the CalEEMod computer program, the project's air pollutant emissions generated during all phases of the project will not exceed construction or operational emission thresholds. (See Tables 1 through 3). Therefore, the project's emissions are in compliance with the thresholds established by the Mojave Desert Air Quality Management District.

A project is considered to be compliant with the applicable air quality plans if it is consistent with the growth forecasts in the applicable plan(s) (or is directly included in the applicable plans). Conformity with growth forecasts can be established by demonstrating that the project is consistent with the land use plan that was used to generate the growth forecast. An example of a non-conforming project would be one that increases the gross number of dwelling units, increases the number of trips, and/or increases the overall vehicle miles traveled in an affected area (relative to the applicable land use plan).

The City's General Plan was used to generate the growth forecast that is the underpinning of the applicable air quality plans. The proposed project, in turn, is consistent with the Blythe General Plan designation of the project site as General Commercial. Therefore, the project is in not in conflict with the Air Quality Plans of the Mojave Desert Air Quality Management District. Moreover, as discussed in the Background and Purpose section of this Initial Study, the project is expected to have a beneficial impact on regional air quality by providing low carbon fuels for goods movement vehicles operating between the Southern California ports and Arizona and thereby reducing annual GHG emissions from these vehicles by 4,798 metric tons from 2013-2015.

b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?

The CEQA Guidelines indicate that a significant impact would occur if the proposed project would violate any air quality standard or contribute significantly to an existing or projected air quality violation.

The applicable thresholds of significance for air emissions generated by the Project are established by the Mojave Desert Air Quality Management District (MDAQMD) and are shown Table 1.

Table 1
MDAQMD Significant Emission Thresholds

Criteria Pollutant	Daily Threshold (pounds)
Carbon Monoxide (CO)	548
Oxides of Nitrogen (NOx)	137
Reactive Organic Matter (ROG) and Volatile Organic Compounds (VOC)	137
Oxides of Sulphur (SOx)	137
Particulate Matter (PM10)	82
Particulate Matter (PM2.5)	82
Source: Mojave Desert Air Quality Management District	

Construction Emissions:

Construction emissions can be distinguished as either on-site or off-site. On-site emissions generated during construction principally consist of exhaust emissions (CO, ROG/VOC, NO_X, SO_X, PM_{10}, CO_2 and $PM_{2.5}$) from equipment use, and fugitive dust (PM_{10}, $PM_{2.5}$) from clearing/grubbing, on-site traffic, and ground disturbance. Off-site emissions during construction typically consist of exhaust emissions from truck traffic and worker commute trips; road dust associated with traffic to and from the construction site; and fugitive dust (PM_{10} and $PM_{2.5}$) from trucks hauling materials and construction debris or excavated soils to/from the site.

The air quality calculations/analysis for the proposed project, which are presented in Appendix A, assumed a schedule for construction and estimated the project completion in 128-days. Table 2 shows the project's emissions for construction.

Table 2
Construction Emissions

Pollutant	Pounds (lbs/day)	Mojave AQMD Threshold	Exceeds Threshold?
CO	25.35	548	NO
NOx	33.67	137	NO
ROG/VOC	5.97	137	NO
PM 10	8.02	82	NO
PM 2.5	4.64	82	NO
SO2	0.04	137	NO

As shown in Table 2, construction emissions would be below the Mojave AQMD's significance thresholds for CO, ROG, NOx, PM_{10}, $PM_{2.5}$ and SO2. With no emissions exceeding the significance thresholds, predicted emissions would be considered to have a less than significant adverse impact during the construction phase of the project.

Operational Emissions:

Operational emissions were modeled using the California Emissions Estimator Model (CalEEMod) and the results of the modeling are presented in Appendix A. Project-generated emissions were modeled based on project specific information and/or default information contained in CalEEMod. The operational emissions were estimated on all three (3) phases of the project described as follows:

Phase 1:

- 15,000 gallon storage tank and ancillary equipment for the pumping, vaporization and dispensing of LNG fuel.

Phases 2 - 3

- Additional 15,000 gallon LNG storage tank and ancillary equipment for the pumping, vaporization and dispensing of LNG fuel.
- CNG fueling facilities.
- Restroom facility connected to the existing sewer main located in South Willow Street.

Table 3 shows the project's emissions for operations.

Table 3
Operational Emissions

Pollutant	Pounds (lbs/day)	Mojave AQMD Threshold	Exceeds Threshold?
CO	25.35	548	NO
NOx	33.67	137	NO
ROG/VOC	4.04	137	NO
PM 10	2.07	82	NO
PM 2.5	0.51	82	NO
SO2	0.02	137	NO

Conclusion

Both construction and operation emissions are below the thresholds established by the Mojave Desert Air Quality Management District. Nevertheless, the Mojave Desert Air Quality Management District enforces a series of rules and regulations that are intended to reduce air quality impacts to the maximum extent feasible and the project will be required to comply with all applicable rules and regulations. Moreover, as indicated earlier, the project will assist in reducing annual GHG emissions from goods movement vehicles operating along the I-10 between the Southern California ports and Arizona by 4,798 metric tons from 2013-2015. Therefore, it can be concluded that the project will not violate any air quality standard or contribute substantially to an existing or projected air quality violation.

c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?

The project is located in a region that has been identified as being in Non-Attainment for Ozone and PM_{10} (State) according to the California Air Resources Board Area Designation Maps. This means that the background concentration of these pollutants have historically been over the Federal and/or State Ambient Air Quality Standards. With respect to air quality**,** no individual project would by itself result in Non-Attainment of the Federal or State Ambient Air Quality Standards. However, a project's air pollution emissions although individually limited, may be cumulatively considerable when taken in combination with past, present, and future development projects. In order to be considered significant, a project's air pollutant emissions must exceed the emission thresholds established by the regional Air Quality Management District.

The results of the CalEEMod computer model prepared for the project determined that the thresholds for the above referenced criteria pollutants would not be exceeded by the project. (See Tables 2 and 3). Therefore, impacts from the project are not cumulatively considerable when included with other past, present, and future probable projects.

d) Expose sensitive receptors to substantial pollutant concentrations?

According to the *Mojave Desert Air Quality Management Plan, CEQA Guidelines, February 9, 2009*, the following project types proposed for sites within the specified distance to an existing or planned (zoned) sensitive receptor land use must be evaluated:

- Any industrial project within 1000 feet;
- A distribution center (40 or more trucks per day) within 1000 feet;
- A major transportation project (50,000 or more vehicles per day) within 1000 feet;
- A dry cleaner using perchloroethylene within 500 feet;
- A gasoline dispensing facility within 300 feet.

The project involves the construction of a fuel dispensing facility, but a lower hydrocarbon vapor emitting facility than a traditional gasoline station. The potentially sensitive receptors in the project area are Miller Park, south of W. 14th Avenue, and several motels lying along the south side of W. Donlon Street, north of the project site. None of these potentially sensitive receptors are located within 300 feet of the project site. Moreover, because the project generates total emissions (direct and indirect) less than the thresholds established by the Mojave Desert AQMD, any impacts are considered to be less than significant.

e) Create objectionable odors affecting a substantial number of people?

Projects that typically emit odors include: Agriculture (farming and livestock); Chemical Plants; Composting Operations; Fiberglass Molding; Landfills; Refineries; Rendering Plants; Rail Yards; and Wastewater Treatment Plants. The proposed project is a dispensing facility for LNG and CNG, which are odorless substances.

The project does not propose any uses that will emit objectionable odors, therefore long-term impacts from odors are less than significant. During construction, odors from construction activities, such as laying asphalt will occur. Due to the short-term nature of the construction activities and the small scale of the project, short-term odor impacts will be less than significant.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The project will have a less than significant impact locally and a beneficial impact regionally, by aiding in the reduction of GHG emissions from diesel powered trucks transporting goods between the Ports of Long Beach and Los Angeles and Arizona.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
IV. Biological Resources. Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service?	☐	☐	☐	☒
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☐	☒
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

The *City of Blythe General Plan 2025* planning area includes a rich and diverse range of biological resources. This can be attributed to the quality and quantity of natural habitats and to variations in topography, soil type and elevation. The most notable natural habitat types include lower desert, riparian woodland, and permanent wetland. These are sensitive habitats due to the presence of one or more rare, endangered or threatened species.

The Colorado River is the main aquatic habitat along the eastern edge of the planning area. Surface water is also channeled throughout the planning area in open and piped irrigation ditches which are operated and maintained by the Palo Verde Irrigation District. Riparian habitat and related vegetation occur along the Colorado River, agricultural drains and fringes of agricultural lands.

DISCUSSION

a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service?

The project site is undeveloped, but has been disturbed by human activity (i.e., graded/disked) and is considered to be "highly disturbed." The site is devoid of any significant types of vegetation. The sparse vegetative cover on the site is limited to common ruderal grasses and low growing scrub vegetation. Because of the level of disturbance on the site, there is no habitat on the site that supports any species identified as candidate, sensitive or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service.

b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service?

Section 404 of the Clean Water Act defines wetlands as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." [Ref. EPA Regulations listed at 40 CFR 230.3(t)].

The California Department of Fish and Game found the U.S. Fish and Wildlife Service wetland definition (Section 404 definition above) and classification system to be the most biologically valid. The Department of Fish and Game staff uses this definition as a guide in identifying wetlands.

Based on a field review, the project site does not contain riparian habitat, sensitive natural communities, or wetlands that would fall under the jurisdiction of the U.S. Army Corps of Engineers, the California Department of Fish and Game, or the Regional Water Quality Control Board.

c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?

See response to preceding question.

d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?

Wildlife corridors link together areas of suitable habitat that are otherwise separated by rugged terrain, changes in vegetation, or human development. Corridors effectively act as links between different populations of a species. Interference with the movement of native resident migratory fish or wildlife

species occurs through the fragmentation of open space areas caused by urbanization.

Wildlife nursery sites are areas that provide valuable spawning and nursery habitat for fish and wildlife. Wildlife nursery sites occur in a variety of settings, such as trees, wetlands, rivers, lakes, forests, woodlands and grasslands to name a few. The use of a nursery site would be impeded if the use of the nursery site was interfered with directly or indirectly by a project's development or activities.

The site is located within an urbanized area and is bordered by a motel truck/RV parking area on the north, a public utility service facility on the east, vacant land on the south, and S. Willow Street and vacant land beyond on the west. The site is highly disturbed and is devoid of any significant types of vegetation. Consequently, the site does not serve as a wildlife movement corridor or wildlife nursery site.

e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?

Figure 6-2 of the *City of Blythe General Plan 2025* illustrates the applicability of policies for the protection of biological resources. The primary mechanisms are establishing Resource Conservation Areas or Resource Management Areas. Resource Conservation Areas contain the most sensitive and valuable habitat that requires protection and would be conserved. Resource Management Areas generally contain some resources that merit long-term preservation.

According to Figure 6-2 of the *City of Blythe General Plan 2025*, the project site is not located in either a Resource Conservation Area or a Resource Management Area. Additionally, the City of Blythe does not have a tree preservation ordinance. For these reasons, the project will not be in conflict with local policies or ordinances protecting biological resources, including tree preservation.

f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?

The Lower Colorado River Multiple Species Conservation Program (LCR MSCP) is a coordinated, comprehensive conservation approach for the LCR basin for a period of 50 years. The LCR MSCP covers a portion of the area in the City of Blythe, but does not cover the project site. In addition, a review of the U.S. Fish and Wildlife Service Habitat Conservation Plan database indicated that there are no habitat conservation plans that cover the project site.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The proposed project will have no impact on biological resources.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
V. Cultural Resources. Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in Section 15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?	☐	☒	☐	☐
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☒	☐
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☒	☐

ENVIRONMENTAL SETTING

In March 2005, Senate Bill 18 (SB 18) went into effect requiring local governments to consult with Native American tribes prior to the adoption or amendment of a general plan or specific plan. The intent of SB 18 coordination is to obtain information regarding the presence of traditional lands, cultural places or sacred lands within a planning area. During the course of preparing the *City of Blythe General Plan 2025* the City initiated consultation with the Native American Heritage Commission (NAHC). The City formally requested from the NAHC a list of Native American groups and tribes that are on the "SB 18 Consultation List" so that any tribes with traditional lands or cultural places located within the City of Blythe's jurisdiction could be contacted.

The NAHC provided a formal response directing the City to contact three local Native American tribal representatives and also requested that the City contact the Imperial Valley College Desert Museum and the Eastern Information Center at U.C. Riverside. All groups were contacted and the results of the research are included in the *Final Program EIR, City of Blythe General Plan 2025*. A records search conducted in April 2006 by the Eastern Information Center (EIC) revealed that 17 cultural resources studies have been conducted and 78 cultural resources properties are recorded within the Blythe planning area. No properties within the planning area are listed in the National Register of Historic Places (NRHP). Three sites were listed in the Office of Historic Preservation's (OHP) Archaeological Determinations of Eligibility; however, none of them are eligible for listing on the NRHP. Forty-three properties, which are located in the older core area of the City, are listed in the OHP Directories of Properties in the Historic Property Data File (HPD). As shown on Exhibit 3.4-1 of the *Final Program EIR, City of Blythe General Plan 2025*, Areas of Archaeological Sensitivity are located west, southwest, and northwest of the City's corporate boundaries.

DISCUSSION

a) Cause a substantial adverse change in the significance of a historical resource as defined in Section 15064.5?

Based on CEQA Guidelines Section 15064.5, "historical resources" include a resource that is eligible for listing in the California Register of Historical Resources or a resource listed in a local register of historical resources. There are no structures of any kind located on the project site. Therefore, the project will have no impact on a historical resource.

b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?

The project site is located in an urbanized area and has been disturbed as a result of past human activities on the site. In addition, according to Figure 6-3 of the *Final Program EIR, City of Blythe General Plan 2025*, the site is not located within Areas of Archaeological Sensitivity. (Ref. General Plan EIR Page 3.4-4). However, it is always possible that cultural resources could be detected during site preparation and construction activities. The geotechnical report prepared for the project recommends over-excavation of the existing surface soils to a minimum of 7 feet below existing grade within the building pad and foundation areas of the site. The *Final Program EIR, City of Blythe General Plan 2025*, requires that the mitigation measure identified below be implemented as an environmental mitigation measure or condition of project approval. (Ref. General Plan EIR Page 3.4-3). To ensure potential impacts remain less than significant, the mitigation measure below is recommended.

c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

The potential for paleontological resources to be present on a site is primarily based on the geologic conditions of an area. A formation or rock unit has paleontological sensitivity if it has previously produced, or has characteristics conducive to the preservation of paleontological resources. According to the Riverside County Land Information System, the site has a "Low Potential" for yielding paleontological resources and there are no unique geologic features on the site. Therefore, the project's potential impact on paleontological resources is considered to be less than significant.

d) Disturb any human remains, including those interred outside of formal cemeteries?

The project site has never been formally used as a cemetery and there is no record or known history of any human remains ever being interred on the site. Moreover, in the unlikely event of an accidental discovery or recognition of any human remains, California State Health and Safety Code Section 7050.5 dictates that no further disturbances shall occur until the County Corner has made the necessary findings as to origin and disposition pursuant to CEQA regulations and Public Resources Code Section 5097.98. With adherence to mandatory State Health and Safety Code Section 7050.5, which stipulates the process to be

followed when human remains are encountered, no mitigation measures are necessary.

PROPOSED MITIGATION MEASURES

Mitigation Measure CR-1: In the event that any cultural resources are discovered during clearing, grading or construction, project operations shall cease until a qualified archaeologist has evaluated the situation. Following the evaluation, the project sponsor shall implement recommendations provided by the archaeologist in consultation with the City and the California Energy Commission, which are consistent with State law. Any cultural resources found on the proposed project site will be recorded or described in a professional report and submitted to the University of California at Riverside.

CONCLUSION

With the imposition of the mitigation measure described above, any potential impacts associated with the project will be mitigated to a less than significant level.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
VI. Geology and Soils. Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☒	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☒	☐	☐
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☒	☐	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☒	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

As discussed in the geotechnical engineering report prepared for the proposed project by Earth Systems Southwest, the project site lies within the Mojave Desert geomorphic province of California, an area of interspersed mountain ranges and broad desert plains. The predominant geologic feature in the project area is the Colorado River and associated floodplain of the Palo Verde Valley. Shallow sediments within the floodplain consist of fine- to medium-grained sands with imbedded clays and silts of alluvial origin. On-site soils consist of interbedded Holocene sediments of loosely consolidated fine-grained sands, silts, and clays.

There are no active faults in the immediate vicinity of the site. The site does not lie within a currently delineated Alquist-Priolo Earthquake Fault Zone. The San Andreas Fault is considered to be the primary source for seismic ground shaking and is approximately 65 miles southwest of the site.

DISCUSSION

The following responses are based in part on the document titled: *Geotechnical Engineering Report, Proposed Willow Street LCNG Refueling Station, Blythe, Riverside County, California* prepared by Earth Systems Southwest ("Earth Systems Report") dated June 21, 2012. This report is presented in its entirety in Appendix B.

a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

i) Rupture of a known earthquake fault?

The site is not located within an Alquist-Priolo Earthquake Fault Zone according to maps prepared by the State Geologist and information provided by the Riverside County Land Information System and the Earth Systems Report. According to the Earth Systems Report, there are no well-delineated active fault lines through the Palo Verde Valley shown on California Geological Survey maps and, based upon a review of Google Earth aerial photographs, no obvious air photograph lineaments were noted that would be suggestive of active fault rupture. Therefore, due to the lack of defined fault related photographic lineaments, the presence of a uniform floodplain surface, and the absence of previous mapped faults in the vicinity of the project site, the Earth Systems Report concludes that the potential for active faulting at the project site is very low.

ii) Strong seismic ground shaking?

Seismic ground shaking is influenced by the proximity of the site to an earthquake fault, the intensity of the seismic event, and the underlying soil composition. The Earth Systems Report indicates that the primary seismic hazard at the project site is weak to moderate ground shaking from earthquakes along the San Andreas Fault located approximately 65 miles southwest of the site. However, the design of the LCNG fueling facilities and restroom proposed on the site will at a minimum comply with the seismic design criteria of the California

Building Code. This will ensure that the proposed facilities will withstand the ground shaking associated with future seismic events on the San Andreas Fault, although they may experience some structural and non-structural damage.

iii) Seismic-related ground failure, including liquefaction?

According to the Riverside County Land Information System and the Earth Systems Report, the potential for liquefaction to occur on the site is considered "very high." The Earth Systems Report concluded that the primary geotechnical constraint for development of the site is the potential for liquefaction induced ground settlement. In addressing this constraint, the report contains recommendations intended to reduce the potential distress to the facilities proposed on the site should liquefaction occur. Therefore, **Mitigation Measures GEO-1** through **GEO-4** are recommended below.

iv) Landslides?

The potential for landslides to occur is not present because the site is generally flat with a gentle slope to the south with elevations on the order of 266 feet above mean sea level. There are no significant slopes on or adjacent to the project site.

b) Result in substantial soil erosion or the loss of topsoil?

Development of the site will require grading and excavation, which will result in the disturbance and possible loss of topsoil and the potential for soil erosion. The Earth Systems Report indicates that the project site lies within an area of moderate to high potential for wind and water erosion. However, watering disturbed surfaces to minimize fugitive dust during construction and installing landscaping and hardscape as elements of the project will render any potential erosion impacts less than significant.

c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

Lateral spreading is a term referring to landslides that commonly form on gentle slopes and that have rapid fluid-like flow movement, like water. The Earth Systems Report indicates that the potential for liquefaction induced lateral spreading of the proposed fill pad slopes is considered low as no free-face or sloping ground conditions exist adjacent to the project site.

As noted in the response to Question VI(a)(iv), the site is not susceptible to landslides, since the site is relatively flat.

As noted in the response to Question VI(a)(iii), the potential for liquefaction to occur on the site is considered "very high," and therefore Mitigation Measures GEO-1 through GEO-4 are required.

According to the Earth Systems Report, the project site is located in a geologic environment where the potential for collapsible soil exists. The results of collapse potential tests performed on selected soil samples from varying depths and

above the groundwater table indicated that the soils on the project site have a low potential for collapse as the majority of the soils are below the groundwater table and the soils which are above the groundwater table have a low collapse potential. Similarly, the potential for subsidence is low.

In conclusion, the risks associated with an unstable geologic unit are considered to have "no Impact" or a "less than significant impact" except for liquefaction. With adherence to **Mitigation Measures GEO-1 through GEO-4,** impacts associated with liquefaction will be less than significant. The Earth Systems Report indicates that the recommended on-site soil improvement techniques and specialized foundation system that comprise **Mitigation Measures GEO-1 through GEO-4** will reduce the potential distress to the proposed fueling facility should liquefaction occur. These mitigation measures are intended to reduce the magnitude and severity of potential liquefaction induced differential settlement distress to the proposed restroom building, LCNG tank pad, and the above ground diesel tank pad, such that the estimated ground settlement can be accommodated in structural design.

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

Expansive soils are soils that swell and contract depending on the amount of water that is present. Depending on the extent and location below finished sub-grade, expansive soils can have a detrimental effect on structures. According to the Earth Systems Report, and based on laboratory testing, the expansion potential of the on-site soils is typically "low" as defined by the American Society of Testing and materials.

While this Initial Study Checklist does not identify soil corrosivity as an environmental issue to be addressed, corrosivity is a soil characteristics that can adversely affect a project. High chloride and sulfate content soils can be corrosive to concrete and buried metals. Although it was based on a single near surface soil sample, the Earth Systems Report indicates that corrosion values associated with that soil sample are normally considered as being very severely corrosive to buried metals and as possessing a "severe" exposure to sulfate attack for concrete. Therefore, the report recommends **Mitigation Measure GEO-5** below.

e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?

The project will initially use a portable toilet module and will eventually be served by a permanent restroom facility connected to the sewer main located in S. Willow Street. Therefore, septic tanks will not be utilized by the project.

PROPOSED MITIGATION MEASURES

In addition to recommending adherence to numerous best soils engineering practices during site preparation and construction, the Earth Systems Report contains the

following recommendations to specifically mitigate potential seismic-related ground failure, including liquefaction:

Mitigation Measure GEO-1 (Soil Recompaction): Because of the relatively non-uniform and under-compacted nature of the site soils, as well as the liquefaction potential, the recompaction of soils in building areas is recommended. The over-excavation for the restroom building, LNG tank pad, and above ground diesel tank pad shall be performed as one excavation operation (if possible). The existing surface soils within the building pad and foundation areas shall be over-excavated a minimum of 7 feet below existing grade. The over-excavation shall extend for 7 feet beyond the outer edge of exterior footings or mat slab, where possible. The bottom of the sub-excavation shall be scarified, moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of one foot. Over-excavation of 7 feet will place the excavation bottom in the near vicinity of groundwater. Where compaction of the resultant excavation bottom is difficult or not achievable due the near vicinity of groundwater, this requirement may be reviewed and revised by the project geotechnical engineer. Alternative techniques to stabilize the bottom may be required (such as placing gravel and punching it into the soft soil surface prior to placement of geo-grid).

Auxiliary structures such as perimeter walls and retaining walls, shall be over-excavated a minimum of 2 feet below the bottom of the foundation or existing grade, whichever is lower. The over-excavation shall extend for 2 feet beyond the outer edge of exterior footings, where possible. The bottom of the sub-excavation shall be scarified, moisture conditioned, and recompacted to at least 90% relative compaction
(ASTM D 1557) for an additional depth of one-foot.

Mitigation Measure GEO-2 (Soil Densification): Following soil recompaction as stipulated in **Mitigation Measure GEO-1**, three layers of tri-axial geo-grid (Tensar TX160 or equivalent) shall then be placed within the building pad remedial grading areas. One layer placed at the base of the over-excavation (after the sub-excavation has been moisture conditioned and compacted), and then at one-foot increments as the fill is placed at 7, 6, and 5 feet below grade. Each intervening foot of fill shall be compacted to at least 90% relative compaction (ASTM D 1557). The resultant excavation shall then be covered with a filter fabric (Mirafi 140N) overlain by 18 inches of 1 to 2-inch diameter crushed aggregate. The aggregate shall be lightly moistened and tamped with heavy vibratory equipment into place using 6-9 inch thick lifts to induce consolidation. The aggregate layer shall be enveloped on the top, sides and bottom with the filter fabric (i.e., burrito wrapped). The filter fabric shall be overlapped on top by at least 3 feet. At least one foot of fill shall then be placed to the mat foundation subgrade bottom elevation (see **Mitigation Measure GEO-3** for vent installation recommendations which shall partially occur prior to backfilling). The mat subgrade bottom elevation shall be designed such that this minimum thickness of fill can be accommodated, which may require designing the mat foundation finish surface elevation to be above grade. Placement of underground utilities shall take the geo-grid location into consideration, such that damage to the grid is not allowed during subsequent trench excavations and placement of piping.

Mitigation Measure GEO-3 (Installation of Hydrostatic Pressure Relief Vents): A minimum of 6 uniformly distributed vertical vent pipes consisting of 6-inch diameter Schedule 80 PVC pipe shall be placed around the tank and restroom mats and extend from the ground surface into the middle of the gravel layer. The vent piping shall be cutoff approximately 18 inches above the finished surface, covered with a top cap that is open to the atmosphere yet stops rainwater entry, and covered with a screen to prevent rodent entry. The vent piping shall be protected on all four sides with bollards or concrete encasement. If the pipes are concrete encased, the top of concrete shall be below the top of the pipe to limit water runoff entry. The vent piping is intended to relieve hydrostatic pressures in the event of liquefaction. In no event shall the pipes be capped or encased in boxes such that water outflow would be inhibited during a seismic event.

Mitigation Measure GEO-4 (Design of Tank, Restroom and Other Foundations): Foundations for the tank and restroom structures shall be supported on mat foundations bearing in properly prepared and compacted soils placed as required by **Mitigation Measures GEO-1 and GEO-2**. The requirements for the design of foundations that follow are based on "low" expansion category soils in the upper 7 feet of subgrade. During remedial grading of building pads, the soil expansion potential shall be verified and foundation recommendations confirmed or modified, based on the site specific expansion index at each building site.

Foundation design is the responsibility of the structural engineer, considering the structural loading and the geotechnical parameters identified in the Earth Systems Report. A geotechnical engineer/engineering geologist shall observe foundation excavations before placement of reinforcing steel or concrete. Loose soil or construction debris shall be removed from footing excavations before placement of concrete.

Bearing Capacity - Foundations for Buildings and Tank Pads: A minimum footing depth of 18 inches below lowest adjacent grade shall be maintained (lowest adjacent = lowest grade within 2 feet laterally). Allowable soil bearing pressures are given below for mat foundations bearing on recompacted soils as described in **Mitigation Measures GEO -1 and GEO-3.** Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected). A factor-of-safety of 3.0 was used for determining allowable bearing values.

Mat foundations, 36-inch minimum thickness and 18-inch minimum below grade: 1,000 psf for dead plus design live loads.

Allowable increases of 500 psf for each additional 0.5-foot of footing depth may be used up to a maximum value of 2,500 psf.

Bearing Capacity – Foundations for Retaining Walls, Perimeter Walls and Isolated Pads: A minimum footing depth of 18 inches below lowest adjacent grade shall be maintained (lowest adjacent = lowest grade within 2 feet laterally). Allowable soil

bearing pressures are given below for foundations bearing on recompacted soils as described in **Mitigation Measure GEO-1**. Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected). A factor-of-safety of 3.0 was used for determining allowable bearing values.

Continuous wall foundations, 12-inch minimum width and 18-inch minimum below grade: 1,500 psf for dead plus design live loads.

Allowable increases of 250 psf for each additional 0.5-foot of footing depth may be used up to a maximum value of 3,000 psf.

Isolated pad foundations, 2 x 2-foot minimum in plan and 18-inch minimum below grade: 1,500 psf for dead plus design live loads.

Allowable increases of 250 psf for each additional 0.5-foot of footing depth may be used up to a maximum value of 3,000 psf.

An average modulus of subgrade reaction, k, of 100 pounds per cubic inch (pci) can be used to design footings and slabs founded upon compacted fill. ACI Section 4.3, Table 4.3.1 should be followed for recommended cement type, water cement ratio, and compressive strength for severe exposure conditions.

Minimum Foundation Reinforcement: Minimum reinforcement for continuous footings shall be four No. 4 steel reinforcing bars, two placed near the top and two placed near the bottom of the footing. This reinforcing is not intended to supersede any additional structural requirements provided by the structural engineer.

The Earth Systems Report also contains the following recommendation to mitigate the potential impact that the corrosivity of the on-site soils could have on the project.

Mitigation Measure GEO-5: A soils/geotechnical engineer competent in corrosion mitigation shall review the results of the Earth Systems Report and more conclusively determine the corrosion potential of the on-site soils through a more extensive sampling of the on-site soils, and then appropriately design a corrosion protection plan for the proposed project The plan shall identify the measures/techniques to be used (e.g., cathodic protection, impressed current, or soil modification) to adequately protect foundations and buried pipes and other metals from potential soil corrosion.

CONCLUSION

With adherence to the proposed mitigation measure described above, any potential impacts associated with the project will be mitigated to a less than significant level.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
VII. Greenhouse Gas Emissions. Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	☒	☐
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

The primary regulatory mechanisms in place at the State level to address greenhouse gas emissions are Assembly Bill 32 and Senate Bill 375.

The plans required by Assembly Bill 32 and Senate Bill 375 would be considered an appropriate "applicable plan, policy, or regulation" in order to determine if a project was in conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases.

Generally there are two primary criteria to consider when making this determination.

1. A project is consistent with a greenhouse gas emission plan, policy, or regulation if it will not result in an increase in the frequency or severity of greenhouse gas emissions or delay timely attainment of greenhouse emission reduction goals.

2. A project is consistent a greenhouse gas emission plan, policy, or regulation if it is not in conflict with the recommended actions contained in a plan or the provisions of a policy or regulation to reduce greenhouse gas emissions.

DISCUSSION

a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?

According to CEQA Guidelines Section 15064.4, when making a determination of the significance of greenhouse gas emissions, the "lead agency shall have discretion to determine, in the context of a particular project, whether to (1) use a model or methodology to quantify greenhouse gas emissions resulting from a project, and which model or methodology to use." Moreover, CEQA Guidelines Section 15064.7(c) provides that "a lead agency may consider thresholds of significance previously adopted or recommended by other public agencies or recommended by experts..."

The *Riverside County Climate Action Plan* presents a comprehensive set of actions to reduce the County's internal and external GHG emissions consistent with the AB 32 Scoping Plan and is used in this analysis for purposes of complying with CEQA Guidelines Section 15064.7(c).
The following analysis is based on the *Governor's Office of Planning and Research, Technical Advisory on CEQA and Climate Change.*

Identify Greenhouse Gas Emissions:

Project-generated GHG emissions were modeled using the California Emissions Estimator Model (CalEEMod) and the results of the modeling are presented in Appendix A. Project-generated emissions were modeled based on project specific information and/or default information contained in CalEEMod, The project is estimated to generate 88.34 metric tons of carbon dioxide equivalent (MTCO2e) per year during construction and 372.28 MTCO2e during on-doing operation of the project.

Table 4
Greenhouse Gas Emissions (Annual)

Project MTCO2e Emissions	Riverside County Climate Action Plan Threshold MTCO2e/Yr.	Mojave Desert Air Quality Management District Threshold MTCO2e/Yr.	Exceeds Threshold?
Construction: 88.34 Operation: 372.28	3,000	100,000	No

Determining Significance:

According to Riverside County's Greenhouse Gas Emissions CEQA Thresholds adopted in May, 2012, small projects that do not exceed 3,000 MTCO2e per year will be considered to have a less than significant individual and cumulative impact for GHG emissions. As shown on Table 4, the project's emissions are 88.34 MTCO2e per year during construction and 372.28 MTCO2e during on-going operation of the project. These levels of GHG emissions do not exceed the 3,000 MTCO2e threshold established by Riverside County.

In addition, the Mojave Desert Air Quality Management District has established a threshold of 100,000 tons of MTCO2e per year. The project's emissions are 88.34 MTCO2e per year during construction and 372.28 MTCO2e during on-going operation of the project which does not exceed the 100,000 MTCO2e threshold established by the Mojave Desert Air Quality Management District.

Therefore, the project's GHG emissions are not anticipated to exceed established GHG emissions thresholds and a less than significant impact is expected. However, recognizing that the project will facilitate the replacement of diesel fuel with LCNG in the operation of goods movement vehicles operating between the Southern Califonia ports and Arizona, the project will have a beneficial impact on regional air quality by reducing annual GHG emissions from these vehicles by 4,798 metric tons from 2013-2015.

b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?

As noted in the analysis under Question VII(a) above, the project was analyzed using the *Governor's Office of Planning and Research, Technical Advisory on CEQA and Climate Change* which is intended to address greenhouse gas emissions in a manner consistent with Assembly Bill 32 and Senate Bill 375. In addition, the project implements recommendations contained in the AB 32 Scoping Plan. Therefore, the project is not in conflict with any plans to regulate greenhouse gas emissions.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The project will have a less than significant impact locally and a beneficial impact regionally, by aiding in the reduction of GHG emissions from diesel powered trucks transporting goods between the Ports of Long Beach and Los Angeles and Arizona.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
VIII. Hazards and Hazardous Materials Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and/or accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas where residences are intermixed with wildlands?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

The urban and natural environments of Blythe contain a number of public safety issues and public hazards which have been considered by the City during the course of the land use planning process. The primary goal of this process is to

protect the public's safety. The City is responsible for managing a broad range of issues related to public safety, public health and hazards including those mandated by State policies (such as seismic and building safety) and those associated with natural and man-made disasters including emergency response planning. Some of the potential public safety issues and hazards to the general public include flooding, unstable earth conditions, wildland and urban fires, crime, and exposure to hazardous materials.

DISCUSSION

a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?

According to Section 25371(a) of the California Health and Safety Code, the definition of "hazardous substance" does not include Liquefied Natural Gas (LNG). However, LNG can be considered hazardous under certain conditions due to its cryogenic temperatures, dispersion and flammability characteristics.

The California Energy Commission describes LNG as a clear, colorless, odorless liquid that is neither corrosive nor toxic (See http://www.energy.ca.gov/lng/index.html). The transport and dispensing of LNG operations are heavily regulated to ensure safety and security. According to the Energy Economics Research, under the Bureau of Economic Geology, the LNG industry has an "excellent safety record." Technical and operational practices have evolved to ensure safe and secure operations related to LNG.

The proposed project will be constructed in accordance with the applicable requirements of the National Fire Protection Association (NFPA) 52 Vehicular Gaseous Fuel System Codes (2010 Edition). In it, Chapter 12 of the NFPA 52 establishes a series of regulations related to LNG Fueling Facilities. The chapter applies to the design, siting, construction, installation, spill containment, and operation of containers, pressure vessels, pumps, vaporization equipment, buildings, structures, and associated equipment used for the storage and dispensing of LNG as engine fuel. Chapter 15 of the NFPA imposes requirements on LNG fire protection, personnel safety, security, training, and warning signs. Compliance with NFPA 52 will be determined by an engineered evaluation to ensure that facilities and fueling operations do not pose a hazard to the public.

The U.S. Department of Transportation (DOT) prescribes safety standards concerning the transport of LNG. As required, LNG will be delivered to the site utilizing a heavily insulated (double-walled) transport vessel at atmospheric pressure (LNG will not be under pressure). The tanker truck is anticipated to have a 10,000-gallon capacity.

The proposed project will be designed, constructed, operated, and maintained to ensure the safe use, dispensing, and storage of LNG in compliance with the applicable NFPA, Department of Transportation, and other safety standards. The project will also comply with Chapters 22, 27, 30, 32 and 34 of the California Fire

Code. On-site facilities will include accident prevention and mitigation plans and procedures. The applicability of these safety mechanisms will be determined and customized based on an engineering-level evaluation. Therefore, less than significant impacts are anticipated.

b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and/or accident conditions involving the release of hazardous materials into the environment?

The practices of transport, storage and dispensing of LNG as engine fuel are regulated to reduce the potential risk of accidents or other abnormal operating conditions. The safety practices related to the handling of LNG are governed by: industry standards; regulations; industry experience and training; and design/technology. The integration of these factors and associated engineering-level requirements is inherent to the proposed project.

Two publications are used to determine risks associated with LNG fueling operations in respect to foreseeable accident conditions. One is "Qualitative Risk Assessment for an LNG Refueling Station and Review of Relevant Safety Issues," prepared by the Idaho National Engineering Laboratory (INEL). The second is "LNG Safety and Security," a report prepared by the Center for Energy Economics. According to these reports, Liquefied Natural Gas is handled at 260 degrees below zero and without pressurization. LNG is only flammable after it returns to a gaseous state and reaches a concentration range of 5% to 15% per volume. Furthermore, LNG is less subject to accidental fire than gasoline or diesel if vapors come into contact with a spark or flame.

The following incidents are individual scenarios leading to a potential on-site accident condition:

- LNG release due to construction accident
- LNG release due to external event
- Hose failure
- Drive-away
- Filling error
- LNG release due to maintenance error
- Pipe failure
- Seal failure
- Storage tank failure
- Truck fuel tank failure (on-site)
- LNG release due to vehicular accident
- Valve failure

In the event of equipment failure (hose, seal, pipe, etc.), any moderate amount of LNG (mostly methane) would evaporate rapidly. In this form, natural gas vapors are lighter than air, causing them to rise and dissipate. LNG vapors would not accumulate. A leak would be unlikely to reach a flame or spark due to industry-standard refueling station restrictions (e.g. smoking prohibition). In the event that evaporated LNG reached an ignition source, only a small percentage of the gas vapors would burn. Flammability would only be reached

with an LNG vapor concentration between 5% and 15% (percent per volume). Concentrations higher or lower than this limited range would not cause a fire. At project buildout, the facility does not include any buildings except for a single restroom located away from the dispensing stations. Consequently, there are few confined areas where accidental leaked vapors would be contained at the flammability-prone levels. In the event of accidental fire, methane vapors would burn along the flame rather than explode.

A larger volume of LNG would only be released by a catastrophic failure or accident, primarily associated with the storage tank or truck tank. In this scenario, LNG would retain its liquefied state for a short duration of time. LNG would reach the floor and begin draining to the on-site retention basin as it rapidly evaporates. If this material reached an ignition source, only the vapors within the limited gas concentration (5 – 15% per volume) would burn, but not explode due to the open environment nature of the proposed fueling facility.

LNG dispensing will only be performed by trained fuelers in a gate controlled facility. The fuel dispenser stations, supporting equipment and LNG tanks will be physically protected from vehicular accidents with the construction of strategically placed bollards. The project will also incorporate a series of safety measures to ensure that the public is not compromised from any foreseeable accident conditions due to fueling operations. A programmable logic controller (PCL) will be utilized to monitor and control all essential functions of the on-site system. This includes temperature, pressure, flow rates, emergency conditions, and others operating variables. The PCL will be connected by modem to operating personnel who can constantly check existing and historical operating conditions remotely. The PCL will adjust performance conditions and execute system-wide shut-down if deemed necessary. In accordance with NFPA 52, additional monitoring equipment and emergency stop devices will be installed as part of the project.

Taking into account the limited flammability characteristics of LNG and the industry-standard safety measures (structural and operational) to which the facility must adhere, a foreseeable accident condition caused by the project is not expected to create a significant hazard to the public or the environment. Therefore, less than significant impacts are anticipated.

c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?
There are no existing or proposed schools located within one-quarter mile of the project site.

d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?
Neither the project site nor any surrounding properties are included on the Hazardous Waste and Substances Site List maintained by the State Department of Toxic Substances Control.

e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?
According to the Riverside County Land Use Information System, the project site is not located within an Airport Influence Area or Airport Compatibility Zone. The project is located approximately 5 miles from Blythe Municipal Airport. Therefore, there will be no impact.

f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?
A review of the area surrounding the project site revealed that there are no personal use airports (i.e., private airstrips) operating in the vicinity (i.e., area that could be impacted by aircraft take offs and landings) of the project site. Therefore, there will be no impact.

g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?
Access to the site is provided from S. Lovekin Boulevard, via W. Wells Street, and from W. 14th Avenue via S. Willow Street. All of these streets will remain open during construction activities. Therefore, the project will not impair implementation of, or physically interfere with, an emergency evacuation or response plan.

h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?
According to the Riverside County Land Information System, the project site is not located within a High Fire Hazard Area. The project site is not adjacent to or intermixed with wildlands. Therefore, no impacts are expected with regard to wildland fires.

PROPOSED MITIGATION MEASURES
No mitigation measures are proposed or required.

CONCLUSION
The project will have less than significant impacts with regard to hazards and hazardous materials.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
IX. Hydrology and Water Quality. Would the project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☒	☐	☐

b)	Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☒	☐
c)	Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	☐	☐	☒	☐
d)	Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?	☐	☐	☒	☐
e)	Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☐
f)	Otherwise substantially degrade water quality?	☐	☐	☒	☐
g)	Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒
h)	Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☒
i)	Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☒	☐
j)	Inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

The following discussion of the environmental setting is taken from the *Final Program EIR, City of Blythe General Plan 2025*.

Surface Water Hydrology

The City of Blythe is located in the Colorado Desert (a subdivision of the Sonoran Desert) and the climate is characterized by low annual precipitation, low relative humidity and high summer temperatures. Mean annual rainfall at the Blythe Airport is 3.61 inches. Precipitation is typically concentrated in the summer period (July-October). Summer

storms originating in Baja California often release substantial amounts of rain in short periods.

The Blythe planning area is located on an alluvial terrace formed by deposition within the lower Colorado River basin. The Colorado River drainage basin includes portions of seven states, and a significant region of northern Mexico. A series of dams in both the Upper Colorado River Basin and the Lower Colorado River Basin control the Colorado River for the purposes of water supply, flood management, hydropower generation, recreation, and habitat uses. Water supply in the River is allocated by interstate compact and international treaty.

The Palo Verde Irrigation District (PVID) canals and drain system consists of about 244 miles of main and lateral canals that divert and route Colorado River water to a maximum of 120,500 acres of cultivated land in the Palo Verde Valley and adjacent Mesa. Another 141 miles of drainage system collect and return water to the River.

Groundwater Conditions and Quality

The Blythe area is underlain by the Palo Verde Valley Groundwater Basin that covers approximately 200 square-miles. Irrigated agriculture was first initiated in the Blythe area in the late 1800s. As a result of widespread irrigation, the groundwater table level also increased. Drainage networks were built to prevent groundwater levels from reaching the ground surface. Agricultural water supplies are primarily provided via surface canals from the Colorado River and are administered by the PVID.

The groundwater basin underlying Blythe supplies the majority of municipal water demands of the City and surrounding area. The groundwater system is sustained by applied irrigation water, infiltration from the Colorado River, and to a much lesser degree by direct infiltration of precipitation and recharge from local surface water drainage washes. There is no evidence of overdraft in the Blythe area. The Palo Verde groundwater basin ranges from the Colorado River on the east, the Palo Verde Diversion Dam and the Big Maria Mountains on the north, the Palo Verde Mesa on the west, and the Palo Verde Mountains to the south. The principal water-bearing deposits in the Palo Verde Valley Groundwater Basin are two units of Colorado River alluvium overlying the upper Bouse Formation limestone, and a fanglomerate deposit of course older alluvium deposited under older (Miocene) high flow regimes. Groundwater aquifer levels in the Palo Verde Valley have been observed ranging from 3.9 to 22.6 feet below the surface.

Domestic water for the City of Blythe is obtained from 14 deep water wells and 5 storage tanks capable of storing 4.0 million gallons of water. The City supplies approximately 1.75 billion gallons of water per year to the City and surrounding area. The predominant chemical character of groundwater in the Colorado Desert is sodium sulfate or sodium chloride. Calcium and bicarbonate are also present in significant concentrations in some areas which is typical of the water chemistry of the Colorado River – Sonoran Desert area. With normal treatment, this water meets drinking water standards.

Extensive agricultural production offers the potential for high nitrate concentrations. However, this is not the case locally. Extensive testing of groundwater in the Blythe area by the Department of Environmental Health has not found nitrate levels that exceed the State's Maximum Contaminant Level (45 mgl). This may be because the extensive irrigation system utilized in the Blythe area flushes the nitrates away. The eventual transition of residences from septic systems to wastewater treatment service and limitations on the issuance of new septic system permits may serve to further safeguard Blythe's groundwater from higher nitrate levels in the future.

Floodplains and Flooding Hazards

The Federal Emergency Management Agency (FEMA) has mapped special flood hazard areas, which includes lands subject to a 100-year flood, defined as an area that has a one percent (1%) chance of being flooded in any given year. According to the FEMA, the easternmost portion of the planning area, closest to the Colorado River, is located within a 100-year flood hazard zone.

DISCUSSION

The following responses are based in part on the documents titled: *Blythe LCNG Site Drainage Study* prepared by The Holt Group, Inc. ("Holt Group Report") dated July 16, 2012 and *Geotechnical Engineering Report, Proposed Willow Street LCNG Refueling Station, Blythe, Riverside County, California* prepared by Earth Systems Southwest ("Earth Systems Report") dated June 21, 2012.

a) Violate any water quality standards or waste discharge requirements?

According to the Earth Systems Report, groundwater was encountered during the geotechnical field investigation at a depth of approximately 8 feet below ground surface and dewatering may be required during excavation and construction. Water quality standards and waste discharge requirements could potentially be violated if any contaminated groundwater encountered during utility trenching and retention basin excavation is discharged on the surface during construction dewatering. Therefore, **Mitigation Measure HYD-1** below is recommended for dewatering during excavation and construction.

In addition, any construction on-site would be required to comply with the National Pollutant Discharge Elimination System (NPDES) and related implementing documents, which include the Water Quality Management Plan (WQMP) of the countywide Municipal Separate Storm Sewer System Permit (MS4 Permit) as issued by the Colorado River Regional Water Quality Control Board. The WQMP requires that construction projects must use Best Management Practices (BMPs).

Based on the above, the proposed project would not violate any water quality standards or waste discharge requirements.

b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a

lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?

The restroom facility that is proposed to be constructed during Phase 2 of the project would utilize a minor amount of domestic water. The only other water usage that might occur on-site would be in conjunction with periodic maintenance activities and irrigation to assist with the initial establishment of drought tolerant landscaping. Runoff from the impervious surfaces to be constructed on the site will be collected and retained on-site for percolation and groundwater recharge.

The total storage capacity of the Palo Verde Valley Groundwater Basin is estimated at 4,960,000 acre feet. In addition, the Colorado River recharges the shallow aquifer by seepage in some reaches and by diversions from the Colorado River in the form of seepage from canals and irrigated land (Metzger 1973). The groundwater levels have tended to remain relatively stable in the basin (Owen- Joyce 1984). The City has not seen any reduction in the groundwater table. Bulletin 118 – Update 2003 does not indicate any potential overdraft of the Palo Verde Valley Groundwater Basin. (Ref. *2010 Urban Water Management Plan, Blythe 2010, March 2011*).

Therefore, it is not anticipated that the project would substantially deplete groundwater supplies or interfere substantially with groundwater recharge.

c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?

The conditions stipulated by the City of Blythe with regard to drainage are:
The applicant shall prepare a hydrology report addressing a 10 and 100-year storm event as per the City of Blythe Standard Drawings and Specifications and design a storm water retention basin capable of accommodating the proposed runoff from the project for a ten-year event and shall be dry within 72 hours. The retention basin shall have five feet of separation between the groundwater table and the invert elevation and shall be maintained by the owner and/or applicant. The basin shall not reside within city right-of-way.

The proposed drainage system for the project is described as follows:

- On-Site Retention Basin – Based on the hydrology calculations for the site, The Holt Group is recommending a 3-foot deep basin that is 10'x150' at the bottom with 5:1 side slopes. The basin would be 40'x180' at the top. The basin would retain a maximum of 12,670 cubic feet of runoff.

  Assuming a percolation rate of 1 inch per hour, per the Earth Systems Report, at a depth of 2.85 feet (34 inches), the basin would drain in 34 hours. This would meet the City's requirement of draining within 72 hours with a safety factor of almost 3.

The drainage system will be designed to manage soil erosion, siltation, and any sources of polluted runoff in accordance with the mandatory requirements of the Colorado River Water Quality Control Board. In addition, the project site does not contain any streams or rivers that would be altered by the construction of the drainage improvements described above. Therefore, impacts will be less than significant.

d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?

As indicated in the preceding response, there are no streams or rivers on or in the vicinity of the project site. The development of the proposed LCNG fueling station will involve the construction of impervious surfaces on the currently undeveloped site and result in increased runoff from the site. However, the site will be graded so that all runoff from the site will be collected in an on-site retention basin for percolation and groundwater recharge. Therefore, impacts will be less than significant.

e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?

There are no existing storm water drainage facilities on or in the vicinity of the site. However, a retention basin will be constructed on-site as a component of the project. The basin has been designed to accommodate anticipated runoff from the site in accordance with the requirements of the City of Blythe. Therefore, impacts will be less than significant.

f) Otherwise substantially degrade water quality?

As previously indicated, the drainage system for the proposed project will be designed to manage soil erosion, siltation, and any sources of polluted runoff in accordance with the mandatory requirements of the Colorado River Water Quality Control Board. Therefore, the project is not expected to substantially degrade water quality.

g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?

The project does not involve the development of housing and according to Figure 7-1 of the *Safety Element of the City of Blythe General Plan 2025*, the project site is located significantly to the west of the FEMA designated 100-year flood hazard zone for the Blythe area.

h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?

As indicated in the response to the preceding question, the project site is located significantly to the west of the FEMA designated 100-year flood hazard zone for the Blythe area.

i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?

According to Figure 7-1 of the *Safety Element of the City of Blythe General Plan 2025*, the project site is located significantly to the west of the FEMA designated 100-year flood hazard zone for the Blythe area. However, Figure 7-1 does indicate that the project site is located within a "Dam Inundation Area" as is much of the City of Blythe.

Future development along the Colorado River is subject to the failure of numerous dams and water control facilities that exist upstream of the City of Blythe. The Colorado River is damned approximately 60 miles upstream of the City at Parker Dam, and the Palo Verde Diversion Dam is located approximately 9 miles north of Blythe. It would take a catastrophic event such as a total dam failure to compromise the integrity of Parker Dam and the Palo Verde Diversion Dam. The likelihood of this event to occur is considered extremely remote according to the Bureau of Reclamation, (Ref. *Final Program EIR, City of Blythe General Plan 2025*, Page 3.6-13).

In the unlikely event of an upstream dam failure, there is an estimated minimum of 23 hours before the flood waters reach the Blythe area. The City of Blythe also has an Emergency Operations Plan in place which designates the proper procedures to follow in the case of a major emergency or disaster. (Ref. *Final Program EIR, City of Blythe General Plan 2025*, Page 3.6-14).

j) Inundation by seiche, tsunami, or mudflow?

Being located approximately 160 miles east of the Pacific Ocean, the project area is not identified on the Tsunami Inundation Maps prepared by the California Department of Conservation.

There are no bodies of water in the vicinity of the project site that are large enough to produce a seiche that could impact the project site.

Based on the responses to Questions VI (a) and VI(c) of this Initial Study Checklist, the project site is not located in an area prone to landslides, soil slips, or slumps. Therefore, there is no potential for the proposed project to be inundated by seiches, tsunamis, or mudflows.

PROPOSED MITIGATION MEASURES

HYD-1: If significant groundwater is encountered within utility trench or retention basin excavations, the applicant shall obtain permits from the City of Blythe Department of Public Works and Colorado River Regional Water Quality Control Board for the surface discharge of groundwater generated by construction dewatering. Permit regulations may require treatment of groundwater generated by construction dewatering activities prior to surface discharge.

CONCLUSION

With adherence to the proposed mitigation measure described above, the project will have a less than significant impact on hydrology and water quality.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
X. Land Use and Planning. Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to, a general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

The City of Blythe was incorporated in 1916, with the predominant land use being agriculture.

The City comprises approximately 16,400 acres (approximately 27 square-miles) of incorporated lands. The City's sphere of influence (SOI) surrounds the incorporated city limits and comprises approximately 12,800 acres (approximately 20 square miles). The SOI surrounds the incorporated City limits and extends from the Colorado River on the east, west to and including, the Blythe Airport, and from Second Avenue on the north to Eighteenth Avenue on the south although not all lands within these boundaries are included in the SOI.

As part of the *City of Blythe General Plan 2025*, the City has identified three Planning Areas that are relevant to the City's long term land use planning and policy efforts: Planning Area 1 is located north and west of the Blythe Municipal Golf Course; Planning Area 2 is located north of the existing city limits and/or SOI adjacent to the Colorado River; and Planning Area 3 is located south of the existing SOI boundary along the Colorado River.

The City has also prepared the Colorado River Corridor Plan. The Corridor Plan represents a comprehensive vision for growth of all lands along the Colorado River within the City of Blythe and its SOI. The Plan is intended to facilitate the implementation of the *City of Blythe General Plan 2025* policies applicable to the Colorado River Corridor area and will guide the long-term evolution of this portion of the City with planning, policy and development implications for the entire City.

DISCUSSION

a) Physically divide an established community?

The site is bordered by vacant land on the north, a public utility (i.e., Southern California Edison) service facility on the east, vacant land on the south, and Willow Street and vacant land beyond to the west. The project is consistent with the existing and planned pattern of commercial and other non-residential uses in the surrounding area. Establishment of the project would not create physical barriers or impede vehicle or pedestrian access to the surrounding area. Therefore, a physical division of an established community will not occur.

b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to, a general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?

The project is consistent with the City's General Plan and is a principally permitted use (i.e., permitted by right) in the C-G (General Commercial) Zoning District in which it is proposed. The project site does not lie within a Specific Plan area and is located well outside the California Coastal Zone. There are no regional, state or federal habitat conservation plans or programs that apply to the project site. Therefore, the proposed project does not conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project adopted for the purpose of avoiding or mitigating an environmental effect.

c) Conflict with any applicable habitat conservation plan or natural community conservation plan?

The Lower Colorado River Multiple Species Conservation Program (LCR MSCP) is a coordinated, comprehensive conservation approach for the LCR basin for a period of 50 years. The LCR MSCP covers a portion of the area in the City of Blythe but does not cover the project site. In addition, a review of the U.S. Fish and Wildlife Service Habitat Conservation Plan database indicated that there are no habitat conservation plans that cover the project site.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The proposed project will have no impact on existing land uses or the applicable planning programs of local, regional, state, or federal agencies.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XI. Mineral Resources. Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

Urban preemption of prime mineral deposits and conflicts between mining and other uses throughout California led to passage of the Surface Mining and Reclamation Act of 1975 (SMARA), which establishes policies for conservation and development of mineral lands, and contains specific provisions for the classification of mineral lands by the State Geologist.

SMARA requires all cities and counties to incorporate in their general plans mapped designations approved by the state Division of Mines and Geology. These designations are to include lands categorized as Mineral Resource Zones, the most significant of which is a designation of mineral resources that are of regional or statewide significance.

According to the *Final Program EIR, City of Blythe General Plan 2025,* there are no active mines within the planning area for the *City of Blythe General Plan 2025*, although several areas along Midland Road were historically mined for gypsum and gravel. The majority of the closest mining operations are located north, outside of the planning area.

DISCUSSION

a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?

According to reports and maps prepared by the California Geological Survey, the site is not located in Mineral Resource Zone-2a or 2b (areas underlain by mineral deposits where geologic data show that significant measured or indicated resources are present or areas underlain by mineral deposits where geologic information indicates that significant inferred resources are present).

In addition, according to the California Geological Survey's Aggregate Availability Map, the project is not located within the vicinity of an aggregate production area. Therefore, the project has no potential to result in the loss of availability of a known mineral resource.

b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?

The City's General Plan does not delineate any mineral resource recovery sites within the City limits. Therefore, the project would have no impact on mineral resources.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The proposed project will have no impact on mineral resources.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XII. Noise. Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☒	☐
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☒	☐	☐
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

According to the *Final Program EIR, City of Blythe General Plan 2025*, in most areas of Blythe, automobile and truck traffic is the major source of environmental noise. Traffic generally produces an average sound level that remains fairly constant with time. Air and rail traffic, and commercial and industrial activities are also major sources of noise in some areas. Generally, the federal government has established noise standards for transportation-related noise sources that are closely linked to interstate commerce, such as aircraft, locomotives, and trucks, and, for those noise sources, the state government is preempted from establishing more stringent standards. The state government sets noise standards for those transportation noise sources that are not preempted from regulation, such as automobiles, light trucks, and motorcycles. Noise sources associated with industrial, commercial, and construction activities are generally subject to local control through the City's noise ordinances and general plan policies.

DISCUSSION

a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

The project involves the development of an LCNG fueling station. The applicable noise regulations are contained in the *City of Blythe General Plan 2025 Noise Element*. The General Plan establishes the following policy/standard with respect to noise:

"S-1 Policy: Areas shall be recognized as noise impacted if exposed to existing or projected future noise levels at the property line which exceed 65dBL$_{dn}$ (CNEL)." (Ref. General Plan Page 8-3).

The predominant source of noise in the project area is traffic on I-10, which is located approximately 1,000 feet to the north of the site. Figure 8-2 of the *City of Blythe General Plan 2025 Noise Element*, *Future Generalized Noise Contours* indicates that the project site lies within the existing and future 60 dBL$_{dn}$ (CNEL) noise contour for traffic on I-10. This is less than the *65* dBL$_{dn}$ (CNEL) identified as the threshold of significance in General Plan Policy S-1 above. Table 3.8-2 of the *City of Blythe General Plan 2025 Noise Element, Land Use Compatibility for Community Noise Environment, further indicates that the proposed fueling station is a land use that is "Normally Acceptable" within noise exposure areas of up to 70* dBL$_{dn}$ (CNEL).

b) Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels?

Some common sources of ground-borne vibration are trains, buses, large trucks, and construction activities such as blasting, pile-driving and operating heavy earth-moving equipment. Ground-borne noise is the result of the vibration and movement of a building, rattling of windows, and shaking of interior items such as dishes, wall pictures, etc. In essence, the room surfaces project the noise so it is perceptible to the ear.

Impacts are not anticipated to be significant because a substantial amount of grading and blasting or pile-driving are not required to construct the project. However, because the site is to be used as an LCNG fueling station for goods movement vehicles (i.e., heavy duty trucks) traveling on I-10 between Los Angeles and Phoenix, trucks refueling at the station could result in noise caused by ground-borne vibration or ground-borne noise. Truck traffic will access the site from I-10 via S. Lovekin Boulevard (a major arterial roadway). The S. Lovekin Boulevard interchange on I-10 is located approximately 1,000 feet to the north of the site, and much of the intervening area is developed with freeway oriented businesses and other non-residential uses. Therefore, it is not anticipated that noise generated by truck traffic using the LCNG station will cause a significant impact on the surrounding area.

c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?

The ambient noise levels in the project vicinity are primarily attributable to traffic on I-10, which is located approximately 1,000 feet north of the project site. The fueling facilities proposed on the site will generate noise that will be undetectable beyond the project site and the trucks refueled at the site (estimated at up to 200 per day or an average of 8.3 per hour) will not appreciably contribute to an increase in ambient noise levels. The truck trips generated by the project will largely consist of a redistribution of existing trips within the City, away from other fueling facilities, or the capture of existing pass-by trips on I-10 and, as such, are already reflected in the current and projected ambient noise levels in the project vicinity.

d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

Noise generated during the construction of the proposed project will likely exceed 65dB A threshold of significance for short durations. Therefore, as required by the *City of Blythe General Plan 2025 Noise Element,* **Mitigation Measure NOI-1** is recommended below.

e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

The *Compatibility Plan for Blythe Airport* is based upon the *Airport Master Plan* adopted by the Riverside County Board of Supervisors in 2001. According to Figure 8.5, *Ultimate Noise Impacts,* the project site is not located within an area impacted by noise from the Blythe Airport.

f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?

A review of the area surrounding the project site revealed that there are no personal use airports (i.e., private airstrips) operating in the vicinity that would expose people using the project to excessive aircraft noise levels.

PROPOSED MITIGATION MEASURES

Mitigation Measure NOI-1: Construction hours shall be limited to the daytime hours of 7am to 5pm Monday through Saturday. No construction shall be allowed on Sundays or Holidays. (Ref. General Plan EIR page.3.8-20).

CONCLUSION

With adherence to the proposed mitigation measure described above, the project will not significantly impact noise levels in the project area. Conversely, the project will not be adversely affected by the existing or future noise levels in the project vicinity.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XIII. Population and Housing. Would the project:				
(a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
(b) Displace a substantial number of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
(c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

According to the 2010 U.S. Census, the City's population is 20,817. These persons reside in 5,473 housing units. The *City of Blythe General Plan 2025* envisions a planning area population of 24,563 by 2025 and 89,542 upon build out, which is expected to occur over a 40-50 year period. It should be noted that of the 20,817 existing residents, 12,972 live "in households" while 7,845 occupy group quarters.

DISCUSSION

a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?

The project consists of the construction of an LCNG fueling facility and does not involve any residential dwelling units. All public infrastructure necessary to support the project is available at the project site and no extension of streets or other infrastructure is required. Therefore, the project will neither directly nor indirectly induce population growth in the Blythe area.

g) Displace a substantial number of existing housing, necessitating the construction of replacement housing elsewhere?

The project site is currently vacant and devoid of any structures. Therefore, the proposed project does not involve the demolition of any residences and there will be no displacement of housing.

h) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?

The proposed project does not involve the demolition of any housing units. Therefore, there will be no displacement of people.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The proposed project will have no impact on population and housing

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XIV. Public Services. Would the project:				
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, or the need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:				
Fire protection?	☐	☐	☒	☐
Police protection?	☐	☐	☒	☐
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

Law enforcement within the City is performed by the City of Blythe Police Department, with secondary backup from the Riverside County Sheriff's Department. Fire protection services are provided by the City of Blythe Volunteer Fire Department and the Riverside County Fire Department/California Department of Forestry through an automatic aid agreement. The City of Blythe and surrounding area are served by the Palo Verde Unified School District. The District operates three elementary schools, one middle school, one high school, and one continuation high school for adult education in the City of Blythe. The City of Blythe's Parks Department currently operates eight (8) park sites encompassing approximately 74.01 acres.

Other recreational facilities in the City include Blythe Municipal Golf Course, the Colorado River, Desert Resource Areas, and campground facilities such as Mayflower Park, McIntyre Park, and the Blythe Marina.

DISCUSSION

a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, or the need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:

Fire Protection?

Fire protection services are provided by the City of Blythe Volunteer Fire Department and the Riverside County Fire Department/California Department of Forestry through an automatic aid agreement. The Blythe Volunteer Fire Department station is located at 201 North Commercial Street and is staffed with a full-time fire chief and paid volunteers. The Riverside County Fire Department station is located at 140 West Barnard Street and provides additional back up to the Blythe Volunteer Fire Department.

As discussed in the response to Question XIII(a), the project would not cause any additional permanent population growth. Therefore, while the project and the resulting project activities generate some additional demand for fire protection services, the project is not of the size and scale that would require the provision of new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, because adequate fire protection facilities and services exist to serve the project.

Police Protection?

The City of Blythe and the Riverside County Sheriff's Department provide police protection services to the City. The City of Blythe Police Department is located at 240 North Spring Street in Blythe and its service area covers all land in the City limits.

As discussed in the response to Question XIII(a), the project would not cause any additional permanent population growth. Therefore, while the project and the resulting project activities will generate some additional demand for police protection services, the project is not of the size and scale that would require the provision of new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, because adequate police protection facilities and services exist to serve the project.

Schools?

The project is located within the Palo Verde Unified School District. As discussed in the response to Question XIII(a), the project would not result in any permanent population growth. Therefore, the project would have no impact on schools/educational services.

Parks?

The proposed project involves the construction of a self-service LCNG fueling station. As discussed in the response to Question XIII(a), the project would not result in any additional permanent population growth. Therefore, the project

would have no impact on the need for new or expanded park and recreational facilities.

Other Public facilities?
The proposed project involves the construction of a self service LCNG fueling station. As discussed in the response to Question XIII(a), the project would not cause any additional permanent population growth. Therefore, the project would have no impact on other public services.

PROPOSED MITIGATION MEASURES
No mitigation measures are proposed or required.

CONCLUSION
The project will have a less than significant effect on the provision of public services to residents and businesses within the City of Blythe.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XV. Recreation. Would the project:				
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

The *Final Program EIR, City of Blythe General Plan 2025* indicates that the City of Blythe's Parks Department currently operates eight (8) park sites encompassing approximately 74.01 acres. The City's goal is a minimum level of park service of 4.5 acres of parkland per 1,000 residents. The City currently provides a level of service of 5.4 acres of existing park land per 1,000 residents (excluding the prison population).

Other recreational facilities in the City include Blythe Municipal Golf Course, the Colorado River, Desert Resource Areas, and campground facilities such as Mayflower Park, McIntyre Park, and the Blythe Marina. There are numerous existing public and private boat ramps and beach areas along the Colorado River that are used by local area residents and visitors for recreational purposes including boating, picnicking, canoeing, and fishing. The City of Blythe hosts periodic regional and recreational events

along the Colorado River that provide outdoor recreational activities for residents and visitors.

DISCUSSION

a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?

The proposed project involves the construction of an LCNG fueling station. As discussed in the response to Question XIII(a), the project will neither directly nor indirectly cause any additional population growth. Therefore, construction of the project has no potential to lead to the substantial physical deterioration of any existing recreational facilities through the increased use of such facilities.

b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?

The proposed project involves the construction of an LCNG fueling station and does not include any recreational facilities. Further, since the project will not contribute to population growth that could result in an increased demand for recreational facilities, it does not require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The proposed project will have no impact on recreational facilities.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XV. Transportation/Traffic. Would the project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?	☐	☐	☒	☐
b) Exceed, either individually or cumulatively, a level-of-service standard established by the county congestion management agency for designated roads or highways?	☐	☐	☒	☐
c) Result in a change in air traffic patterns, including either an increase in traffic levels or	☐	☐	☐	☒

	a change in location that results in substantial safety risks?				
d)	Substantially increase hazards due to a design feature (e.g. sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e)	Result in inadequate emergency access?	☐	☐	☐	☒
f)	Result in inadequate parking capacity?	☐	☐	☐	☒
g)	Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

As described in the *Final Program EIR, City of Blythe General Plan* 2025, the City's transportation network is characterized by I-10 running east-west, State Highway 78 and 95 running north-south, and a number of arterial streets providing regional and local access. The I-10 is a four-lane freeway (i.e., two lanes in each direction) and carries approximately 25,500 vehicles per day (Caltrans, 2004). State Highway 78 (SR78) links the Palo Verde Valley with Imperial Valley to the southwest. U.S. 95 links the Palo Verde Valley with communities along the Colorado River, including Laughlin, Nevada and Bullhead City, Arizona. There is currently no congestion on any of the City's major arterials and all intersections are operating within design capacities (Blythe, 2006).

DISCUSSION

a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume-to-capacity ratio on roads, or congestion at intersections)?

The arterial streets providing access to the project site are S. Lovekin Boulevard and W. 14th Avenue. According to the *Final Proram EIR, City of Blythe General Plan 2025*, S. Lovekin Boulevard between I-10 and W. 14th Avenue is currently operating at a Level of Service (LOS) A. Similarly, the unsigalized intersection of S. Lovekin Boulevard at 14th Avenue and the signalized intersection of the I-10 freeway ramps at S. Lovekin Boulevard are also operating at an LOS A. By comparison, the City has established a target (threshold of significance) LOS B for roadway segments and LOS D for intersections.

The project is expected to ultimately generate 200 truck trips per day, or an average of 8.3 per hour over a 24-hour business day. When added to the existing

traffic volumes on the street network serving the project, this will result in a minor incremental deterioration in the level of service. Moreover, the truck trips generated by the project will largely consist of a redistribution of existing trips within the City, away from other fueling facilities, or the capture of existing pass-by trips on I-10 and, as such, are already reflected in the existing traffic volumes on the I-10 and the local street network providing access to the project site.

b) Exceed, either individually or cumulatively, a level-of-service standard established by the county congestion management agency for designated roads or highways?
The *2010 Riverside County Congestion Management Program* adopted on March 10, 2010 is the applicable Congestion Management Program for the project area. Neither S. Lovekin Boulevard nor W. 14th Avenue are identified as a Congestion Management Program roadway. The nearest Congestion Management Program roadway is I-10, which is located at the intersection of S. Lovekin Boulevard and I-10, approximately 1,000 feet north of the project site.

Based on the current levels of service on these roadways and the 200 trips per day that could ultimately be generated by the proposed project, the project will not have a significant impact on the Congestion Management Program roadway system.

In addition, the project is not anticipated to have an adverse impact on the other components of the Congestion Management Program, such as the frequency and routing of public transit, jobs-housing balance, or the measures to improve air quality (e.g., use of carpools, vanpools, public transit, bicycles, etc.) because it does not impede the use of these forms of transportation.

c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?
According to the Riverside County Land Use Information System, the project site is not located within an Airport Influence Area or Airport Compatibility Zone. The project is located approximately 5 miles from Blythe Municipal Airport. Therefore, the project will have no impact on air traffic patterns for aircraft operations at Blythe Municipal Airport.

d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?
The proposed project can be adequately served by the existing street system and does not involve the construction of any new streets or modifications to existing streets. The project will not increase traffic hazards through the introduction of street design features or incompatible uses.

e) Result in inadequate emergency access?
As indicated in the preceding response, the project does not involve any modifications to the existing street system in the project area. The project will in no way hinder or impede emergency access in the surrounding area.

f) Result in inadequate parking capacity?

The proposed project involves the construction of a self-service LCNG fueling facility. Trucks will be refueled by drivers properly trained in the use of the facility while the operations are monitored remotely. Therefore, there is no need for on-site employee or customer parking and the project will not affect availability of parking in the surrounding area.

g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?

As a fueling facility for heavy duty trucks largely transporting goods within the region and between Arizona and California, the project does not include any specific improvements in support of alternative transportation modes. However, full street improvements (i.e., curb, gutter and sidewalk) already exist on S. Willow Street at the project site and the project does not include any features that would conflict with adopted policies, plans, or programs supporting alternative transportation.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The project will have a less than significant impact on transportation and traffic in the project area.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XVI. Utilities and Service Systems. Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☒	☐
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☒	☐
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☒	☐
e) Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the project's projected demand, in addition to the provider's existing commitments?	☐	☐	☒	☐
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☒	☐
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒

ENVIRONMENTAL SETTING

Water, wastewater and storm water services within the Blythe city limits are provided by the City of Blythe. Solid waste collection is performed by the Palo Verde Valley Disposal Company, with solid waste being transported to the Quartzite Transfer Station, which is located in Arizona on Highway 95 approximately two and a half miles north of Interstate 10, and eventually disposed of at the La Paz County Municipal Solid Waste Landfill located on Highway 95 approximately 10 miles south of Parker, Arizona. Gas and electric services are provided to residents and businesses within the City by The Gas Company and Southern California Edison, respectively.

DISCUSSION

a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board (RWQCB)?

The project involves the construction of an LCNG fueling station on a currently undeveloped site. The site will be graded in a manner so that all storm and nuisance runoff from the site will be retained on-site. The project will eventually involve the construction of a restroom facility, which is the only improvement proposed on the site that will generate domestic wastewater, and it will be connected to the existing sewer main located in S. Willow Street adjacent to the site. Therefore, the project has no potential to exceed the wastewater treatment requirements of the Colorado River Regional Water Quality Control Board.

b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?

As indicated in the response to the preceding question, the project will generate a minor amount of wastewater upon the construction of a proposed restroom facility. Water and wastewater facilities are available adjacent to the project site in S. Willow Street. The only water and wastewater improvements required for the project are on-site pipelines and unit connections to the infrastructure systems, which are subject to connection fees. Therefore, the proposed project would not require or result in the construction of new water or wastewater treatment facilities or the expansion of existing facilities off-site, and the project would therefore have less than significant impacts.

c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?

The storm drainage improvements required for the project consist of an on-site retention basin. [Please see responses to Questions IX(c-e) for additional details]. The construction of the storm water retention basin has been addressed as part of this Initial Study and impacts were found to be less than significant. Therefore, the project would not require or result in the construction or expansion of new regional or off-site storm drain facilities which could cause significant environmental effects.

d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?

The restroom facility that is proposed to be constructed during Phase 2 of the project would utilize a minor amount of domestic water. The only other water usage that might occur on-site would be in conjunction with periodic maintenance activities and irrigation to assist with the initial establishment of drought tolerant landscaping. Based on the water supply information contained

in the *Final Program EIR, City of Blythe General Plan 2025,* the project's water demands can readily be served from existing entitlements and resources.

e) Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the project's projected demand, in addition to the provider's existing commitments?

According to the *Final Program EIR, City of Blythe General Plan 2025,* the minor amount of wastewater eventually generated by the project can readily be accommodated by the City's existing wastewater treatment facilities without requiring the construction of new facilities or the expansion of existing facilities.

f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?

The project will generate a minor amount of solid waste, primarily in conjunction with the restroom facility proposed to be constructed during Phase 2 of the project. The La Paz County Municipal Solid Waste Landfill, which will serve the project site, has adequate capacity to accommodate the minor amount of solid waste that could be generated by the project.

g) Comply with federal, state, and local statutes and regulations related to solid waste?

The California Integrated Waste Management Act requires that jurisdictions maintain a 50% or better diversion rate for solid waste. The City implements this requirement through Chapter 8.24 of the City's Municipal Code, which establishes regulations for the collection of solid waste between the City and waste disposal contractors. This section requires agreements between the City and the contracted waste disposal companies to establish procedures for complying with all state and federal laws, rules and regulations pertaining to solid waste handling services, and for implementing state-mandated programs.

The City of Blythe has a contract with Palo Verde Valley Disposal for trash pickup and recycling. The City of Blythe in partnership with Palo Verde Valley Disposal Service sponsors several diversion programs within the City, including: school recycling programs, Colorado River clean-up, and recycling bins located throughout the community. All waste generated through these programs is taken to a materials recycling facility to sort and capture recyclables. Therefore, the project would be in compliance with statutes or regulations related to solid waste.

PROPOSED MITIGATION MEASURES

No mitigation measures are proposed or required.

CONCLUSION

The project will have a less than significant impact on utilities and service systems.

ENVIRONMENTAL ISSUES	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
XVIII. Mandatory Findings of Significance.				
a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of an endangered, rare, or threatened species, or eliminate important examples of the major periods of California history or prehistory?	☐	☒	☐	☐
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	☐	☐	☒	☐
c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☒	☐	☐

DISCUSSION

a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of an endangered, rare, or threatened species, or eliminate important examples of the major periods of California history or prehistory?

Based on the analysis contained in this Initial Study, impacts to Aesthetics, Agriculture and Forestry Resources, Air Quality, Biological Resources, Hazards and Hazardous Materials, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Land Use and Planning, Mineral Resources, Population and Housing, Public Services, Recreation, Transportation and Traffic, and Utilities and Service Systems are considered as having a less than significant or no impact on the environment.

The results of the Initial Study show that there are potentially significant impacts to Cultural Resources (archaeological resources), Geology and Soils (liquefaction

and soil corrosivity), Hydrology and Water Quality (possible construction dewatering), and Noise (construction noise). These impacts will be reduced to less than significant with the implementation of the proposed mitigation measures.

Therefore the project will not degrade the quality of the environment and no habitat, wildlife populations, or plant and animal communities or examples of the major periods of California history or prehistory would be impacted.

b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)

The analysis in this Initial Study demonstrated that the project is consistent with the growth projections and land use and other policies of the City's General Plan, which serves as the basis for all applicable regional and state mitigation plans. Therefore, the project is in compliance with all such plans including but not limited to: water quality control plan; air quality maintenance plan; integrated waste management plan; and plans or regulations for the reduction of greenhouse gas emissions such as AB 32 and SB 375.

In addition, the project would not produce impacts that, when considered with the effects of other past, present, and probable future projects, would be cumulatively considerable because potential adverse environmental impacts were determined to be less than significant with the implementation of mitigation measures identified in this Initial Study**.**

c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?

As discussed in this Initial Study, the project would not expose persons to adverse impacts related to Air Quality, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Land Use and Planning, or Transportation/Traffic hazards. These impacts were identified as less than significant or non-existent.

Impacts from Cultural Resources (archaeological resources), Geology and Soils (liquefaction and soil corrosivity), Noise (construction noise), and Hydrology and Water Quality (potential construction dewatering) would be potentially significant unless mitigated.

The implementation of the mitigation measures identified in this Initial Study would result in a less than significant impact and there would be no substantial adverse effects on human beings, either directly or indirectly

MITIGATION MEASURES

See Mitigation Monitoring and Reporting Program (Attachment 1).

4. MITIGATION MONITORING & REPORTING PROGRAM

The mitigation measures listed on Attachment 1 shall be incorporated into the project and the California Energy Commission shall ensure that the mitigation measures have been properly implemented. This verification shall be maintained as part of the project record to demonstrate that the Mitigation Monitoring and Reporting Program required pursuant to Public Resources Code Section 21081.6 was implemented.

5. INCORPORATION BY REFERENCE

This Initial Study is based in part on the information and analysis contained in the documents listed below. These documents are hereby incorporated by reference in their entirety into this Initial Study. Copies of documents incorporated herein are available for review at the California Energy Commission Library, 1516 Ninth Street, Sacramento, CA 95814, in the City of Blythe Planning Department, 235 N. Broadway, Blythe, California, 92225 or on the internet at http:// www.energy.ca.gov/altfuels.

A. City of Blythe General Plan 2025

This document provides a vision for the future development of the community. It is the official policy statement of the City Council intended to guide the private and public development of the City.

B. Final Program EIR, City of Blythe General Plan 2025

The document serves as the first tier analysis of the potential environmental impacts that could result from land uses and development described in *General Plan 2025.*

C. Title 17 of the Blythe Municipal Code (Zoning, Land Use and Development Regulations).

This document contains the zoning regulations and development standards that govern the use and development of properties within the City.

6. LIST OF PREPARERS

Listed below are the persons who prepared or participated in the preparation of the Initial Study:

Project Manager:
Al Warot, Director of Planning, Willdan Engineering

Technical Support Staff:
Ernest Perea, Contract Senior Planner, Willdan Engineering

ATTACHMENT 1
MITIGATION MONITORING and REPORTING PROGRAM

CULTURAL RESOURCES			
MITIGATION MEASURE	**TIMING**	**DEPARTMENT**	**SIGNATURE**
Mitigation Measure CR-1: In the event that any cultural resources are discovered during clearing, grading or construction, project operations shall cease until a qualified archaeologist has evaluated the situation. Following the evaluation, the project sponsor shall implement recommendations provided by the archaeologist in consultation with the City, which are consistent with State law. Any cultural resources found on the proposed project site will be recorded or described in a professional report and submitted to the University of California at Riverside.	During grading	Public Works and Building & Safety	
GEOLOGY AND SOILS			
Mitigation Measure GEO-1 (Soil Recompaction): Because of the relatively non-uniform and under-compacted nature of the site soils, as well as the liquefaction potential, the soils in building areas shall be recompacted. The over-excavation for the restroom building, LNG tank pad, and above ground diesel tank pad shall be performed as one excavation operation (if possible). The existing surface soils within the building pad and foundation areas shall be over-excavated a minimum of 7 feet below existing grade. The over-excavation shall extend for 7 feet beyond the outer edge of exterior footings or mat slab, where possible. The bottom of the sub-excavation shall be scarified, moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional	During grading and construction	Public Works	

depth of one foot. Over-excavation of 7 feet will place the excavation bottom in the near vicinity of groundwater. Where compaction of the resultant excavation bottom is difficult or not achievable due the near vicinity of groundwater, this requirement may be reviewed and revised by the project geotechnical engineer. Alternative techniques to stabilize the bottom may be required (such as placing gravel and punching it into the soft soil surface prior to placement of geo-grid). Auxiliary structures such as perimeter walls and retaining walls, shall be over-excavated a minimum of 2 feet below the bottom of the foundation or existing grade, whichever is lower. The over-excavation shall extend for 2 feet beyond the outer edge of exterior footings, where possible. The bottom of the sub-excavation should be scarified, moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of one-foot.			
Mitigation Measure GEO-2 (Soil Densification): Following soil recompaction as stipulated in **Mitigation Measure GEO-1**, three layers of tri-axial geo-grid (Tensar TX160 or equivalent) shall then be placed within the building pad remedial grading areas. One layer placed at the base of the over-excavation (after the sub-excavation has been moisture conditioned and compacted), and then at one-foot increments as the fill is placed at 7, 6, and 5 feet below grade. Each intervening foot of fill should be compacted to at least 90% relative compaction (ASTM D 1557). The resultant excavation shall then be covered with a filter fabric (Mirafi 140N) overlain by 18 inches of 1 to 2-inch diameter crushed aggregate. The aggregate shall be lightly moistened and tamped with heavy	During grading	Public Works	

vibratory equipment into place using 6-9 inch thick lifts to induce consolidation. The aggregate layer shall be enveloped on the top, sides and bottom with the filter fabric (i.e., burrito wrapped). The filter fabric shall be overlapped on top by at least 3 feet. At least one foot of fill shall then be placed to the mat foundation subgrade bottom elevation (see **Mitigation Measure GEO-3** for vent installation requirements which shall partially occur prior to backfilling). The mat subgrade bottom elevation shall be designed such that this minimum thickness of fill can be accommodated, which may require designing the mat foundation finish surface elevation to be above grade. Placement of underground utilities shall take the geo-grid location into consideration, such that damage to the grid is not allowed during subsequent trench excavations and placement of piping.			
Mitigation Measure GEO-3 (Installation of Hydrostatic Pressure Relief Vents): A minimum of 6 uniformly distributed vertical vent pipes consisting of 6-inch diameter Schedule 80 PVC pipe shall be placed around the tank and restroom mats and extend from the ground surface into the middle of the gravel layer. The vent piping shall be cutoff approximately 18 inches above the finished surface, covered with a top cap that is open to the atmosphere yet stops rainwater entry, and covered with a screen to prevent rodent entry. The vent piping shall be protected on all four sides with bollards or concrete encasement. If the pipes are concrete encased, the top of concrete shall be below the top of the pipe to limit water runoff entry. The vent piping is intended to relieve hydrostatic pressures in the event of liquefaction. In no event shall the pipes be capped or encased in boxes such that water outflow would be inhibited during a seismic event.	During grading	Public Works	

Mitigation Measure GEO-4 (Design of Tank, Restroom and Other Foundations): Foundations for the tank and restroom structures should be supported on mat foundations bearing in properly prepared and compacted soils placed as required by **Mitigation Measures GEO-1 and GEO-2**. The requirements for the design of foundations that follow are based on "low" expansion category soils in the upper 7 feet of subgrade. During remedial grading of building pads, the soil expansion potential shall be verified and foundation requirements confirmed or modified, based on the site specific expansion index at each building site. Foundation design is the responsibility of the structural engineer, considering the structural loading and the geotechnical parameters identified in the Earth Systems Report. A geotechnical engineer/engineering geologist shall observe foundation excavations before placement of reinforcing steel or concrete. Loose soil or construction debris shall be removed from footing excavations before placement of concrete. **Bearing Capacity - Foundations for Buildings and Tank Pads:** A minimum footing depth of 18 inches below lowest adjacent grade shall be maintained (lowest adjacent = lowest grade within 2 feet laterally). Allowable soil bearing pressures are given below for mat foundations bearing on recompacted soils as described in **Mitigation Measures GEO -1 and GEO-3.** Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected). A factor-of-safety of 3.0 was used for determining allowable bearing values. Mat foundations, 36-inch minimum thickness and 18-inch minimum below grade: 1,000 psf for dead plus design live loads.	Prior to issuance of grading permit	Building and Safety	

Allowable increases of 500 psf for each additional 0.5-foot of footing depth may be used up to a maximum value of 2,500 psf. **Bearing Capacity – Foundations for Retaining Walls, Perimeter Walls and Isolated Pads:** A minimum footing depth of 18 inches below lowest adjacent grade shall be maintained (lowest adjacent = lowest grade within 2 feet laterally). Allowable soil bearing pressures are given below for foundations bearing on recompacted soils as described in **Mitigation Measure GEO-1**. Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected). A factor-of-safety of 3.0 was used for determining allowable bearing values. Continuous wall foundations, 12-inch minimum width and 18-inch minimum below grade: 1,500 psf for dead plus design live loads. Allowable increases of 250 psf for each additional 0.5-foot of footing depth may be used up to a maximum value of 3,000 psf. Isolated pad foundations, 2 x 2-foot minimum in plan and 18-inch minimum below grade: 1,500 psf for dead plus design live loads. Allowable increases of 250 psf for each additional 0.5-foot of footing depth may be used up to a maximum value of 3,000 psf. An average modulus of subgrade reaction, k, of 100 pounds per cubic inch (pci) can be used to design footings and slabs founded upon compacted fill. ACI Section 4.3, Table 4.3.1 shall be followed for recommended cement type, water cement ratio, and compressive strength for severe exposure conditions.			

Minimum Foundation Reinforcement: Minimum reinforcement for continuous footings shall be four No. 4 steel reinforcing bars, two placed near the top and two placed near the bottom of the footing. This reinforcing is not intended to supersede any additional structural requirements provided by the structural engineer.			
Mitigation Measure GEO-5: A soils/geotechnical engineer competent in corrosion mitigation shall review the results of the Earth Systems Report and more conclusively determine the corrosion potential of the on-site soils through a more extensive sampling of the on-site soils, and then appropriately design a corrosion protection plan for the proposed project. The plan shall identify the measures/techniques (e.g., cathodic protection, impressed current, or soil modification) to be used to adequately protect foundations and buried pipes and other metals from soil corrosion.	Prior to issuance of grading permit	Building and Safety	

HYDROLOGY AND WATER QUALITY			
MITIGATION MEASURE	**TIMING**	**DEPARTMENT**	**SIGNATURE**
HYD-1: If significant groundwater is encountered within utility trench or retention basin excavations, the applicant shall obtain permits from the City of Blythe Department of Public Works and Colorado River Regional Water Quality Control Board for the surface discharge of groundwater generated by construction dewatering. Permit regulations may require treatment of groundwater generated by construction dewatering activities prior to surface discharge.	During utility trench and retention basin excavations	Public Works	
NOISE			
Mitigation Measure NOI-1: Construction hours shall be limited to the daytime hours of 7am to 5pm Monday through Saturday. No construction shall be allowed on Sundays or Holidays. (Ref. General Plan EIR page.3.8-20).	During construction	Public Works and Building & Safety	

APPENDIX A
Californian Emission Estimator Model (CalEEMod)
Air Quality Calculations

Construction Emissions:

125 total days for construction.

Site Prep – 2 days
Grading & Retention Basin - 28 days
Facility Construction - 80 days
Paving (concrete drives and pads) – 15 days

Equipment: (CalEEMod Default Equipment used to model project)

Site Prep: 1 Grader (8-hrs/day), 1 Rubber Tire Dozer (7-hrs/day), 1 Tractor/Loader/Backhoe (8-hrs/day)
Grading & Retention Basin: 1 Grader (6-hrs/day), 1 Rubber Tire Dozer (6-hrs/day), 2 Scrapers (7-hrs/day)
Facility Construction: 1 Crane (6-hrs/day), 1 Forklift (6-hrs/day), 1 Gen Set (8-hrs/day), 1 Tractor/Loader/Backhoe (6-hours/day), 3 Welders (8-hrs/day).
Paving (concrete work): 1 Cement/Mortar Mixer (6-hrs/day), 5 Dumpers/Tenders (represents concrete trucks) (8-hrs/day), 1 Other Construction Equipment (7-hrs/day), 1 Tractor/Loader/Backhoe (8-hrs/day).

Emissions Source	**ROG**	**Nox**	**CO**	**Sox**	**PM10 Total**	**PM2.5 Total**	**CH4**	**CO2e**	**MTCO2e /year**
Unmitigated Construction	5.97	33.67	25.35	0.04	8.02	4.64	0.54	3,902.32	**88.34**
Total Emissions lbs/day	**5.97**	**33.67**	**25.35**	**0.04**	**8.02**	**4.64**	**0.54**	**3,902.32**	
MDAQMD Thresholds	137	137	548	137	82	82			
Significant	**No**	**No**	**No**	**No**	**No**	**No**			**No**

Mitigation for construction includes watering 3-times per day.

Emissions Source	ROG	Nox	CO	Sox	PM10 Total	PM2.5 Total	CH4	CO2e	MTCO2e /year
Mitigated Construction	5.97	33.67	25.35	0.04	4.25	2.92	0.54	3,902.32	**88.34**
Total Emissions lbs/day	**5.97**	**33.67**	**25.35**	**0.04**	**4.25**	**2.92**	**0.54**	**3,902.32**	
MDAQMD Thresholds	137	137	548	137	82	82			
Significant	**No**	**No**	**No**	**No**	**No**	**No**			**No**

Project Area and Operations Emissions

Emissions Source	ROG	Nox	CO	Sox	PM10 Total	PM2.5 Total	CH4	CO2e	MTCO2e /year
Mobile Sources	4.00	18.89	30.86	0.02	2.07	0.51	0.29	2,506.45	366.12
Area	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.18
Waste									0.98
Water									0.00
Total Emissions lbs/day	**4.04**	**18.89**	**30.86**	**0.02**	**2.07**	**0.51**	**0.29**	**2,506.45**	
Total Emissions MT/yr									**372.28**
MDAQMD Thresholds	137	137	548	137	82	82			100.000
Significant	**No**	**No**	**No**	**No**	**No**	**No**			**No**

APPENDIX B
Geotechnical Engineering Report

HAY DAY FARMS
15500 SOUTH COMMERCIAL DRIVE
BLYTHE, CA 92225

GEOTECHNICAL ENGINEERING REPORT
PROPOSED WILLOW STREET LCNG REFUELING STATION
BLYTHE, RIVERSIDE COUNTY, CALIFORNIA

June 21, 2012

File No.: 12068-01
Doc. No.: 12-06-724

Earth Systems
Southwest

79-811B Country Club Drive
Bermuda Dunes, CA 92203
(760) 345-1588
(800) 924-7015
FAX (760) 345-7315

June 21, 2012

File No.: 12068-01
Document No.:12-06-724

Hay Day Farms
% Mr. Ulrich Sauerbrey
15500 South Commercial Drive
Blythe CA 92225

Attention: Mr. Dale Tyson

Subject: **Geotechnical Engineering Report**

Project: **Proposed Willow Street Liquefied Compressed Natural Gas (LCNG) Refueling Station**
Blythe, Riverside County, California

Earth Systems Southwest [Earth Systems] is pleased to submit this geotechnical report for the project referenced above. The proposed project site is located at the northeast corner of 14th Avenue and Willow Street in Blythe, Riverside County, California. This report presents our findings and recommendations for site grading, foundation design, and on-site water detention incorporating the information provided to our office. The site is suitable for the proposed development, provided the recommendations in this report are followed in design and construction. This report should stand as a whole and no part of the report should be excerpted or used to the exclusion of any other part. This report completes our scope of services in accordance with our proposal SWP-12-062, dated April 30, 2012.

Other services that may be required, such as plan review and grading observation, are additional services and will be billed according to our Fee Schedule in effect at the time services are provided. Unless requested in writing, the client is responsible for distributing this report to the appropriate governing agency or other members of the design team.

We appreciate the opportunity to provide our professional services. Please contact our office if there are any questions or comments concerning this report or its recommendations.

Respectfully submitted,
EARTH SYSTEMS SOUTHWEST

REGISTERED PROFESSIONAL ENGINEER
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Distribution: 5/Hay Day Farms
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GEOTECHNICAL ENGINEERING REPORT
PROPOSED WILLOW STREET LCNG REFUELING STATION
BLYTHE, RIVERSIDE COUNTY, CALIFORNIA

Section 1
INTRODUCTION

1.1 Project Description

We understand that proposed development to the site consists of the construction of a Liquefied, Compressed Natural Gas [LCNG] refueling facility consisting of an above ground compressed natural gas tank(s) mounted lengthwise (approximately 50 feet vertical height), an approximate 4,000 square foot restroom building, paved asphalt concrete and Portland Cement concrete driveways, and an onsite retention basin.

We assume the restroom building will be of single story wood framed or masonry construction founded upon shallow foundations with a slab-on-grade floor and will have no below-grade basement levels. We have assumed the LCNG tanks will be founded upon mat-type foundations. We understand Willow Street (bounded by 14th Avenue) and West Wells Street (bounded by South Lovekin Boulevard) will be used for access to the LCNG site by heavy 18-wheel type truck traffic. We also understand that storm water will be managed using an onsite retention basin. The proposed retention basin location is shown on Plate 1; however, the exact and final location and elevation of this system is not yet determined. Based on existing site topography and ground conditions, we anticipate site grading may consist of fills not exceeding 5 feet.

1.2 Site Description

The proposed facility is to be constructed on approximately 2 acres located at the northeast corner of 14th Avenue and Willow Street in Blythe, Riverside County, California. Coordinates near the center of site are 33.6039°N latitude and 114.6033°W longitude. Access to the site is via Willow Street, a paved street. The approximate site location is shown on Plate 1 in Appendix A.

Topographically, the site is generally flat with a gentle slope to the south with elevations on the order of 266 feet above mean sea level. The site currently has no existing buildings, but appears to have been graded or previously disturbed. Drainage is predominantly by sheet flow to the south.

Although not specifically located as a part of this study, undocumented fill and buried utilities may be located in the vicinity of the existing surrounding offsite structures adjacent to the project site.

1.3 Purpose and Scope of Services

The purpose for our services was to evaluate the site soil conditions and to provide professional opinions and recommendations regarding the proposed development. The scope of services for this report included:

1. Surface conditions were visually observed and select available published reports for the site and vicinity were reviewed for significant conditions that may affect the proposed development.
2. Boring locations were pre-marked and Underground Service Alert was contacted to mark the location of underground utilities in the work area. An encroachment permit (city of Blythe, No. BL205-007) was obtained in order to drill within the public roadway.
3. Onsite subsurface soil conditions were explored using a truck-mounted hollow-stem-auger drilling rig. One boring was advanced to approximately 50 feet at the proposed location of the tank and one boring to approximately 30 feet at the proposed location of the restroom. Two borings to approximately 7-½ feet were advanced in the driveway areas to evaluate pavement support characteristics and the potential for poor subgrade support soils. Soil samples were collected during drilling, examined in the field for soil type, and described on a log of the boring. Selected samples were retained and returned to our laboratory. The borings were abandoned by backfilling with cuttings.
4. Offsite subsurface soil conditions beneath Willow Street and West Wells Street were explored using a truck-mounted hollow-stem-auger drilling rig. Three borings to 5 feet along Willow Street and three borings to 5 feet along West Wells Street were advanced to evaluate the existing pavement section and to evaluate pavement support characteristics of the underlying soil. Borings were placed near the site entry and exit approaches to evaluate soil conditions at the points of highest loading (truck turning areas), and along the roadway centerline and roadway margins to evaluate if differing pavement section thicknesses exist across the roadway width which may limit potential repair options. Soil samples were collected during drilling, examined in the field for soil type, and described on a log of the boring. Selected samples were retained and returned to our laboratory. The borings were abandoned by backfilling with cuttings and capping with black dyed quickset concrete.
5. A visual site reconnaissance of Willow Street (bounded by 14th Avenue) and West Wells Street (bounded by South Lovekin Boulevard) was performed in order to visually observe the overall pavement condition and presence and severity of cracking.
6. Infiltration testing was performed in the proposed retention basin location using a double-ring infiltrometer system in general accordance with ASTM D 3385 criteria. Double ring test procedures simulate the low water head conditions typically present in shallow infiltration basins. A backhoe was used to excavate two test pits to the assumed depth of the proposed basin (3 to 5 feet). We understand a minimum of 5 feet buffer between the bottom of the basin and groundwater may be required.

The infiltration rate at each of the two locations was monitored for 6 hours, per ASTM guidelines. A logging trench was excavated next to the infiltration test pits to look for adverse impermeable strata below the depth of the test pits. The logging trench was excavated to a depth of approximately 12 feet below the existing site grade.

7. Laboratory testing was performed on selected soil samples obtained from the exploratory borings. Testing included unit densities, moisture content, particle size analysis, consolidation, shear strength, moisture-density relationship, R-Value, Expansion Index and soil chemical analyses. These test results aided in the classification and evaluation of the pertinent engineering properties of the various soils encountered at the site.

8. An engineering analysis of the data generated from the testing was performed. This report presents our findings and recommendations related to the following:

   - A description of the proposed project including a site plan showing the approximate boring locations. The proposed boring locations were located in the field by hand measuring devices such as tape or a wheel, based on the control provided.
   - A description of the subsurface site conditions encountered during our field exploration including groundwater conditions, as encountered.
   - A description of the site geologic setting and possible associated geology-related hazards, including liquefaction, hydro-collapse potential, subsidence, and seismic settlement analysis.
   - A discussion of regional geology and site seismicity.
   - A description of local and regional active faults, their distances from the site, and their potential for future earthquakes.
   - A discussion of other geologic hazards such as ground shaking, flooding, and tsunamis.
   - A discussion of site conditions, including the excavation characteristics and geotechnical suitability of the site for the general type of construction proposed.
   - 2010 California Building Code seismic design values.
   - Corrosion potential of the site soils tested (Soluble sulfate, chlorides, pH, resistivity).
   - Recommendations for imported fill (if required) for use in compacted fills.
   - Recommendations for site grading and earthwork, including requirements for site preparation, shoring and specifications for placement of fill and utility trench backfill.
   - General design criteria for the foundations of the proposed structures, including bearing capacity, anticipated building settlement due to static foundation loading, and lateral resistance.
   - Recommendations for concrete slabs-on-grade as related to moisture vapor protection, modulus of subgrade reaction, and soil corrosivity.

- Asphalt concrete and Portland cement concrete pavement structural sections for associated drive areas.
- Infiltration capacity of the soil at the retention basin area.
- Presentation of the pavement section thicknesses observed in our borings on Willow Street and West Wells Street and discussion on the suitability of the existing section to support the anticipated truck loading (truck type/loading and number of truck trips supplied to Earth Systems by the client).

Section 2
METHODS OF EXPLORATION AND TESTING

2.1 Field Exploration

The subsurface exploration program included advancing ten exploratory borings and three test pits between May 15 and May 17, 2012. The borings were drilled to depths ranging from approximately 6½ to 51½ feet BGS using mud-rotary techniques with 8-inch outside diameter hollow-stem augers (4 inch inside diameter) powered by a Mobile B-61 truck mounted drill rig, provided by Whitcomb Drilling and WDC Drilling, respectively. The borings were drilled to observe soil profiles and obtain samples for laboratory testing. The site is generally flat and borings were excavated at the existing ground surface (elevation on the order of 266 feet above mean sea level).

Three exploratory backhoe trenches were excavated to depths of approximately 3 to 12 feet BGS to observe soil profiles adjacent to the infiltration testing performed within the proposed retention basin area. The pits were excavated using a rubber tire backhoe with a 24-inch bucket. Each pit was visually logged by our representative and samples collected and returned to the laboratory. The boring and trench locations are shown on the Boring and Trench, Location map, Plate 2, in Appendix A. The locations shown are approximate, established by consumer grade Global Positioning System [GPS] accurate to approximately 15 feet in conjunction with pacing from local site features.

A representative from Earth Systems maintained a log of the subsurface conditions encountered and obtained samples for visual observation, classification and laboratory testing. Subsurface conditions encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2487 and 2488 (current edition). Our typical sampling interval within the borings was approximately every 2½ to 5 feet to the full depth explored; however, sampling intervals were adjusted depending on the materials encountered onsite. Samples were obtained within the test borings using a Standard Penetration [SPT] sampler (ASTM D 1586) and a Modified California [MC] ring sampler (ASTM D 3550 with those similar to ASTM D 1586). The SPT sampler has a 2-inch outside diameter and a 1.38-inch inside diameter. The MC sampler has a 3-inch outside diameter and a 2.4-inch inside diameter.

In the small diameter borings, both ring and SPT samplers were mounted on drill rod and driven using a 140-pound automatic hammer falling for a height of 30 inches. The number of blows necessary to drive either a SPT sampler or a MC type ring sampler within the borings was recorded.

Design parameters provided by Earth Systems in this report have considered an estimated 70% hammer efficiency. The number of blows necessary to drive either a SPT sampler or a MC type ring sampler within the borings was recorded. Since the MC sampler was used in our field exploration to collect ring samples, the N-values using the California sampler can be roughly correlated to SPT N-values using a conversion factor that may vary from about 0.5 to 0.7. In general, a conversion factor of approximately 0.63 from the recent study at the Port of Los Angeles (Zueger and McNeilan, 1998) is considered satisfactory. A value of 0.63 was applied in our calculations for this project.

Bulk samples of the soil materials were obtained from the drill auger cuttings, representing a mixture of soils encountered at the depths noted. Following drilling, sampling, and logging the borings and test pits were backfilled with native cuttings and tamped upon completion. Borings performed within asphalt concrete paved areas were patched at the surface with black dyed quickset concrete. Our field exploration was provided under the direction of a registered Geotechnical Engineer from our firm.

The final logs of the borings and test pits represent our interpretation of the contents of the field logs and the results of laboratory testing performed on the samples obtained during the subsurface exploration. The final logs are included in Appendix A of this report. The stratification lines represent the approximate boundaries between soil types, although the transitions may be gradational. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. The logs present field blowcounts per 6 inches of driven embedment (or portion thereof) for a total driven depth attempted of 18 inches. The blowcounts are uncorrected (i.e. not corrected for overburden, sampling, etc.). Consequently, the user must correct the blowcounts per standard methodology if they are to be used for design and exercise judgment in interpreting soil characteristics, possibly resulting in soil descriptions that vary somewhat from the legend.

2.2 Retention Basin Infiltration Testing

The site soils at the test locations consisted of interbedded silty sand (SM), Silty Clay (CL) and Sandy Silt (ML) soils. Typically, the sandy soils which may have an increased potential to infiltrate water were observed at depths of approximately 2 to 4½ feet below the existing grades. Above these depths soils were clayey and not suitable to infiltrate water. Below these approximate depths, soils were silty and clayey to a depth of approximately 9½ feet where sandy (SP) soils were encountered. At a depth of 8 feet, groundwater was encountered. As such, there appears to be a very narrow range of depth where water in a retention basin could infiltrate (laterally in the SM type soils), see the *Double Ring Infiltration Test Exploratory Log* in Appendix A for a depiction of the soil strata at the test location. To evaluate the soils encountered two infiltration tests were performed. One test was performed in the silt type soils, and one test in the silty sand type soils. The infiltration testing was performed with double-ring infiltrometers, following the general guidelines contained in ASTM D3385, *Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer*. Tests were performed at two locations, as indicated on Plate 2.

For each test location, an approximately 4-inch deep circular concentric trench was excavated by hand and the inner and outer rings driven with a sledgehammer into the ground an additional 2 inches. As necessary, powdered bentonite was placed around the edges of the rings in order to create a watertight seal. Care was taken to not alter the structure of the soil during hand excavation. Per ASTM test procedure, potable water was used to evaluate the basic infiltration rate. The tests were performed for a period of 6 hours. Test results are summarized below.

Table 1
Retention Basin Infiltration Results

Test Pit	Test Description	Soil Condition	USCS Soil Description in Test Zone	Test Zone Below Existing Grade (feet)	Estimated Basic Infiltration Rate*
P-1	Double Ring Infiltrometer (12" and 24" Rings)	Alluvium (Native Soil Surface)	Silty Sand (SM)	3	15.9 in/hr
P-2	Double Ring Infiltrometer (12" and 24" Rings)	Alluvium (Native Soil Surface)	Sandy Silt (ML)	4.5	0.2 in/hr

*Field Values, No factor of safety applied. Typical factors of safety range from 3 to 12 depending on the type of system which will be designed using the field values and depending on the level of pre-treatment and influent which will be discharged into the basins. See Section 5.10.

Logs of the exploratory test pits are presented in Appendix B. Please refer to Section 5.10 for design and maintenance recommendations. We understand a minimum of 5 feet buffer between the bottom of the basin and groundwater may be required.

2.3 Laboratory Testing

Samples were reviewed along with field logs to select those that would be analyzed further. Those selected for laboratory testing include, but were not limited to, soils that would be exposed and those deemed to be within the influence of the proposed structures. Test results are presented in graphic and tabular form in Appendix B of this report. Testing was performed in general accordance with American Society for Testing and Materials (ASTM) or other appropriate test procedure. Selected samples were also tested for a screening level of corrosion potential (pH, electrical resistivity, water-soluble sulfates, and water-soluble chlorides). Earth Systems does not practice corrosion engineering; however, these test results may be used by a qualified corrosion engineer in designing an appropriate corrosion control plan for the project.

Our testing program consisted of the following:

- Density and Moisture Content of select samples of the site soils collected (ASTM D 2937 & 2216).
- Maximum density tests to evaluate the moisture-density relationship of typical soils encountered (ASTM D 1557).
- Particle Size Analysis to classify and evaluate soil composition. The gradation characteristics of selected samples were made by hydrometer and sieve analysis procedures (ASTM D 422).
- Plasticity evaluation to classify and evaluate soil composition. (ASTM D 4318).
- Consolidation (Collapse Potential) to evaluate the compressibility and hydroconsolidation (collapse) potential of the soil upon wetting (ASTM D 5333).

- Direct Shear to evaluate the relative frictional strength of the soils. Specimens were placed in contact with water before testing and were then sheared under normal loads ranging from 0.5 to 4.0 kips per square foot (ASTM D 3080).
- Expansion index test to evaluate the expansive nature of the soil. The sample was surcharged under 144 pounds per square foot at moisture content of near 50% saturation. The sample was then submerged in water for 24 hours and the amount of expansion was recorded with a dial indicator (ASTM D 4829).
- Chemical Analyses (Soluble Sulfates and Chlorides (ASTM D 4327), pH (ASTM D 1293), and Electrical Resistivity/Conductivity (ASTM D 1125) to evaluate the potential for adverse effects of the soil on concrete and steel.
- R-Value testing to evaluate pavement support characteristics (CTM 301).

Section 3
DISCUSSION

3.1 Geologic Setting

Regional Geology: The site lies within the Mojave Desert geomorphic province of California, an area of interspersed mountain ranges and broad desert plains. The predominant geologic feature in the site area is the Colorado River and associated flood plain of Palo Verde Valley. In this area, deep profiles of Quaternary sediments exist.

Regionally, no major active faults are in the immediate vicinity of the site. The San Andreas fault is considered the primary source for seismic ground shaking and is approximately 65 miles southwest of the site.

Local Geology: The project site is located within Palo Verde Valley, adjacent to the Colorado River, and is situated upon the associated flood plain. Shallow sediments within the flood plain consist of fine- to medium-grained sands with interbedded clays and silts of fluvial origin. On-site shallow soils consist of interbedded Holocene sediments composed of loosely consolidated fine-grained sands, silts and clays.

No active faults are in the vicinity of the project. The site is not zoned within a currently delineated Alquist-Priolo Earthquake Fault Zone.

3.2 Soil Conditions

Holocene fluvial soils are present and consist predominantly of interbedded sand with varying amounts of silt, and silts and clays with varying amounts of sand (Unified Soils Classification System symbols of, SM, SP-SM, SP, CL, and ML). Appendix A presents the Logs of the Borings which present greater detail. Samples as depth in the deeper borings advanced at the site were logged as having a hydrocarbon odor. It is our understanding that an environmental assessment will be performed to evaluate these conditions.

The site lies within an area of moderate to high potential for wind and water erosion. Fine particulate matter (PM_{10}) can create an air quality hazard if dust is blowing. Watering the surface, planting grass or landscaping, or placing hardscape normally mitigates this hazard.

3.3 Groundwater

Free groundwater was encountered in the deep borings during exploration at an approximate depth of 8 feet below the ground surface. Readily available data obtained from the California Department of Water Resources database indicates multiple wells in the site vicinity. Historically, one well, located approximately 1,000 feet southwest of the site and at an elevation of 262 feet (msl) (Well 07S23E06A0015) indicated a static water level of 8 feet in 1971. Another well, located approximately 1,200 feet south of the site and at an elevation of 265 feet (msl) (Well 07S23E05D0015) indicated a static water level of 8 feet in 1972.

Due to the recorded depths of historical and present groundwater depths, it is our opinion that a groundwater depth of 8 feet below existing grades may be considered for design and construction. Fluctuations of the groundwater level, localized zones of perched water, and soil moisture content should be anticipated during and following the rainy season or from irrigation. Additionally, if excavation is performed in the near vicinity of the groundwater (i.e. soils above, but near the groundwater elevation), increased moisture content and unstable soils should be anticipated.

3.4 Collapse Potential

Collapsible soil deposits generally exist in regions of moisture deficiency. Collapsible soils are generally defined as soils that have potential to suddenly decrease in volume upon increase in moisture content even without an increase in external loads. Soils susceptible to collapse include loess, weakly cemented sands and silts where the cementing agent is soluble (e.g. soluble gypsum, halite), valley alluvial deposits within semi-arid to arid climate, and certain granite residual soils.

In arid climatic regions, granular soils may have a potential to collapse upon wetting. Collapse (hydroconsolidation) may occur when the soluble cements (carbonates) in the soil matrix dissolve, causing the soil to densify from its loose configuration from deposition.

The degree of collapse of a soil can be defined by the Collapse Potential [CP] value, which is expressed as a percent of collapse of the total sample using the Collapse Potential Test (ASTM Standard Test Method D 5333). Based on the Naval Facilities Engineering Command (NAVFAC) Design Manual 7.1, the severity of collapse potential is commonly evaluated by the following Table 2, Collapse Potential Values.

Table 2
Collapse Potential Values

Collapse Potential Value	Severity of Problem
0-1%	No Problem
1-5%	Moderate Problem
5-10%	Trouble
10-20%	Severe Trouble
> 20%	Very Severe Trouble

Table 2 can be combined with other factors such as the probability of ground wetting to occur on-site and the extent or depth of potential collapsible soil zone to evaluate the potential hazard by collapsible soil at a specific site. A hazard ranking system associated with collapsible soil as developed by Hunt (1984) is presented in Table 3, Collapsible Soil Hazard Ranking System.

Table 3
Collapsible Soil Hazard Ranking System

Degree of Hazard	Definition of Hazard
No Hazard	No hazard exists where the potential collapse magnitudes are non-existent under any condition of ground wetting.
Low Hazard	Low hazards exist where the potential collapse magnitudes are small (CP values 0-1%) and tolerable or the probability of significant ground wetting is low.
Moderate Hazard	Moderate hazards exist where the potential collapse magnitudes are undesirable (CP values 1-5%) or the probability of substantial ground wetting is low, or the occurrence of the collapsible unit is limited.
High Hazard	High hazard exist where potential collapse magnitudes are undesirably high (CP values 5-20%) and the probability of occurrence is high.

The project site is located in a geologic environment where the potential for collapsible soil exists. The results of collapse potential tests performed on three selected samples from different depths throughout the project site and above the groundwater table indicated a range of collapse potential on the order of 0 to 1 percent at applied vertical stresses of 1,000 to 2,000 psf. It is our opinion that the site soils have a low potential for collapse as the majority of site soils are below the groundwater table and testing indicates soils which are above the groundwater table have a low collapse potential.

3.5 Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume change (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from rainfall, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors, and may cause unacceptable settlement or heave of structures, concrete slabs supported-on-grade, or pavements supported over these materials. Depending on the extent and location below finished subgrade, expansive soils can have a detrimental effect on structures. Based on our laboratory testing, the expansion potential of the onsite soils is typically “low” as defined by ASTM D 4829.

3.6 Corrosivity

One sample of the near-surface soil within the proposed site area was tested for potential to corrosion of concrete and ferrous metals. The tests were conducted in general accordance with the ASTM test methods to evaluate pH, resistivity, and water-soluble sulfate and chloride content. The test results are presented in Appendix B. These tests should be considered as only an indicator of corrosivity for the sample tested. Other earth materials found on site may be more, less, or of a similar corrosive nature. Water-soluble sulfates in soil can react adversely with concrete. ACI 318 provides the relationship between corrosivity to concrete and sulfate concentration, presented in the table below:

Table 4
Sulfate Corrosion Correlations

Water-Soluble Sulfate in Soil (ppm)	Corrosivity to Concrete
0-1,000	Negligible
1,000 – 2,000	Moderate
2,000 – 20,000	Severe
Over 20,000	Very Severe

In general, the lower the pH (the more acidic the environment), the higher the soil corrosivity will be with respect to ferrous structures and utilities. As soil pH increases above 7 (the neutral value), the soil is increasingly more alkaline and less corrosive to buried steel structures, due to protective surface films, which form on steel in high pH environments. A pH between 5 and 8.5 is generally considered relatively passive from a corrosion standpoint. High chloride levels tend to reduce soil resistivity and break down otherwise protective surface deposits, which can result in corrosion of buried steel or reinforced concrete structures. Soil resistivity is a measure of how easily electrical current flows through soils and is the most influential factor. Based on the findings of studies presented in ASTM STP 1013 titled "Effects of Soil Characteristics on Corrosion" (February, 1989), the approximate relationship between soil resistivity and soil corrosivity was developed as shown in Table 5.

Table 5
Resistivity Corrosion Correlations

Soil Resistivity (Ohm-cm)	Corrosivity to Ferrous Metals
0 to 900	Very Severely Corrosive
900 to 2,300	Severely Corrosive
2,300 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
10,000 to >100,000	Very Mildly Corrosive

Test results (presented in Appendix B) show a pH value of 8.1, chloride content of 2,360 ppm, sulfate content of 2,740 ppm, and minimum resistivity of 178 Ohm-cm. Additionally, evidence of sulfate attack was seen in the surrounding sidewalks adjacent to the site. Although Earth Systems does not practice corrosion engineering, the corrosion values from the soil tested are normally considered as being very severely corrosive to buried metals and as possessing a "severe" exposure to sulfate attack for concrete as defined in American Concrete Institute (ACI) 318, Section 4.3. The above values can potentially change based on several factors, such as importing soil from another job site and the quality of construction water used during grading and subsequent landscape irrigation. As such, we recommend an engineer competent in corrosion mitigation review these results and design corrosion protection appropriately.

3.7 Geologic Hazards

Geologic hazards that may affect the region include primary seismic hazards (ground shaking and surface fault rupture), secondary seismic hazards (soil liquefaction, ground subsidence, tsunamis, and seiches), and other hazards (slope instability, erosion potential, and flooding). A discussion follows on the hazards specific to this site.

3.7.1 Primary Seismic Hazards

Seismic Sources: Several active faults or seismic zones lie within 132 miles of the project site as shown on Table 1 in Appendix A. The primary seismic hazard to the site is weak to moderate ground shaking from earthquakes along the San Andreas fault located southwest of the project. The Mean Magnitude Earthquake listed is from published geologic information available for each fault (CGS, 2008).

Surface Fault Rupture: The project site does not lie within a currently delineated State of California, *Alquist-Priolo* Earthquake Fault Zone (Bryant and Hart, 2007) or Riverside County designated fault zone. There are no well-delineated active fault lines through the Palo Verde Valley region as shown on California Geological Survey [CGS] maps (Jennings, 1994). No active faults are mapped within the project limits. Based upon a review of Google Earth aerial photographs, no obvious air photograph lineaments were noted that would be suggestive of active fault rupture.

On-site reconnaissance revealed a level disturbed surface. Much of the site area has been modified by agricultural activities. An aerial photograph review was performed to further review the potential of active faulting in the site vicinity. Using Google Earth web photographic resources (1994-2011), the sites appear to be extremely uniform with no obvious natural topographic features suggestive of active faulting. Some remnants of meandering river patterns are present east of the site. Anthropic lineaments pertain to plow patterns, roadways, and power lines.

Therefore, due to the lack of defined fault related photographic lineaments, the presence of a uniform flood plain surface, and absence of previous mapped faults in the site vicinity, it is our professional opinion that the potential for active faulting at this project site is very low.

Known active and potentially active faults in the site vicinity are listed in Table 1 of Appendix A. The San Andreas fault has the lowest return interval and highest slip rate of proximal faults. Thus, it is our professional opinion that the San Andreas is the closest significant fault

Historic Seismicity: The project site is in an area of relatively low historic seismic activity. Approximately 35 magnitude 5.5 or greater earthquakes have occurred within 100 miles of the project since 1872. Most of the historic earthquake epicenters are greater than 50 miles from the project site. Table 2 in Appendix A present's historical earthquake information.

Seismic Risk: While accurate earthquake predictions are not possible, various agencies have conducted statistical risk analyses. In 2002 and 2008, the California Geological Survey [CGS] and the United States Geological Survey [USGS] completed of probabilistic seismic hazard maps. We have used these maps in our evaluation of the seismic risk at the site. The recent Working Group of California Earthquake Probabilities (WGCEP, 2008) estimated a 59% conditional probability that a magnitude 6.7 or greater earthquake may occur between 2008 and 2038 along the southern segment of the San Andreas fault.

The primary seismic risk at the site is a potential earthquake along segments of the San Andreas fault zone that are approximately 65 miles southwest of the site and are considered as fault Type A per the CGS. Geologists believe that the San Andreas fault has characteristic earthquakes that result from rupture of each fault segment. The estimated characteristic earthquake is magnitude 7.7 for the Southern Segment of the fault (USGS, 2002). This segment has the longest elapsed time since rupture of any part of the San Andreas fault. The last rupture occurred about 1680 AD, based on dating by the USGS near Indio (WGCEP, 2008). This segment has also ruptured on about 1020, 1300, and 1450 AD, with an average recurrence interval of about 220 years. The San Andreas fault may rupture in multiple segments, producing a higher magnitude earthquake. Recent paleoseismic studies suggest that the San Bernardino Mountain Segment to the north and the Coachella Segment may have ruptured together in 1450 and 1690 AD (WGCEP, 1995).

3.7.2 Secondary Hazards

Secondary seismic hazards related to ground shaking include soil liquefaction, seismic settlement, tsunamis, and seiches.

Soil Liquefaction and Lateral Spreading: The site is within a "very high" liquefaction zone as identified by Riverside County. Liquefaction is the loss of soil strength from sudden shock (usually earthquake shaking), causing the soil to become a fluid mass. Lateral spreading is the movement of a soil on a liquefied or seismically softened zone of soil. In general, for the effects of liquefaction to be manifested at the surface, groundwater levels must be within 50 feet of the ground surface and the soils within the saturated zone must also be susceptible to liquefaction. Current groundwater conditions are shallow in the site area currently and historically at approximately 8 feet below the existing ground surface. Based on the soil conditions observed and anticipated seismic shaking, we believe that the potential for liquefaction of the underlying soils at the site is considered very high. The potential for liquefaction induced lateral spreading of the proposed fill pad slopes is considered low as no free-face or sloping ground conditions exist adjacent to the proposed site.

Dry seismic (dynamic) settlement is often caused by loose to medium dense granular soils above the water table being consolidated due to soil particle redistribution into a more compact state during ground shaking. Due to the loose, unconsolidated nature of the soils above the groundwater table, the potential for dry seismic settlement exists at the site.

We have used the data obtained from our borings to evaluate the potential for dry seismic settlement and liquefaction induced settlement at the site. We estimated seismically induced settlements in general accordance with methods developed by Tokimatsu and Seed (1987), the 1996 NCEER and 1998 NCEER/NSF workshops on liquefaction, and considered information provided in *Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction Hazards in California, published by Southern California Earthquake Center (SCEC)*, dated March 1999 and *Guidelines for Analyzing and Mitigating Seismic Hazards in California,* Special Publication 117A, published by California Geological Society (CGS), 2008. Our analysis incorporated multi-directional shaking and used a Design Earthquake ground motion of 0.13g (S_{DS}/2.5 ground acceleration) associated with a magnitude 8.2 earthquake. We used a groundwater depth of 8 feet.

We evaluated our deep borings at the site (borings B-7 and B-8). The results of our analyses indicate that isolated layers of soil liquefaction will occur within the observed alluvial soils at depths on the order of 12 to 28 feet and 37 to 50 feet below the ground surface within Boring B-7 and depths on the order of 17 to 28 feet and 37 to 50 feet below the ground surface within boring B-8. Total estimated liquefaction-induced settlement of the total soil columns is on the order of 1.7 to 4.8 inches. The potential for differential settlement is estimated to be on the order of 3 inches over a distance of 40 feet (typical foundation distance, SP117A). The potential for seismically induced dry settlement of soils above the groundwater table was calculated to be negligible. Due to the depth of the liquefiable soils below the proposed finish grades, it is our opinion that the potential for complete loss of foundation bearing support from liquefied soils is low; however, it is also our opinion that the potential for sand boil formation to relieve subsurface pore-water pressures generated during a seismic event is moderate. Tanks or buoyant structures founded below grade may be subject to hydrostatic forces during a seismic event. The recommended remedial grading presented in subsequent sections of this report has been provided to reduce potential for structure distress should liquefaction of these soils occur.

The total seismically induced settlement is exclusive and independent of any static settlement that may occur from foundation loads. The potential for total and differential settlements is addressed in a later Section of this report. The potential for static differential settlements of native soils and fill placed during the anticipated grading is addressed in a later section of this report.

Tsunamis and Seiches: The site is far inland, and there are no water storage reservoirs on or near the site, so the hazards from tsunamis and seiches are nil.

3.7.3 Other Geologic Hazards

Slope Instability: The site is relatively level and there are no significant slopes on or adjacent to the site. Therefore, the potential for slope instability, landslides or debris flows is considered nil for permanent slope conditions.

Erosion Potential: The project is located in an area where seasonal rainfall and runoff can be intense. Shallow exposed soils are moderately to highly susceptible to erosion.

Flooding: The project site is within an “undetermined” FEMA flood risk zone. The project site is in an area where sheet flooding and erosion could occur. Appropriate project design, construction, and maintenance can minimize the sheet flooding potential.

Section 4
CONCLUSIONS

The following is a summary of our conclusions and professional opinions based on the data obtained from a review of selected technical literature and the site evaluation.

General:

- From a geotechnical perspective, the site is suitable for the proposed development, provided the recommendations in this report are followed in the design and construction of this project
- The primary geologic hazard relative to site development is moderate ground shaking and associated liquefaction from earthquakes originating on local faults. In our opinion, a major seismic event originating on regional segments of the San Andreas fault zones will be the most likely cause of significant earthquake activity at the site within the estimated design life of the proposed facility.
- We consider the primary geotechnical constraint for development of this site, as identified by our study, to be the potential for liquefaction induced ground settlement. It is our opinion that to construct the proposed facility, site soil improvement techniques and a specialized foundation system will be required to reduce the potential distress to the proposed structure should liquefaction occur. The recommendations presented are intended to reduce the magnitude and severity of potential liquefaction induced differential settlement distress to the proposed restroom building, LCNG tank pad, and above ground diesel tank pad, such that the estimated ground settlement presented within can be accommodated in structural design.
- The recommendations presented within do not address post-earthquake performance in regard to flatwork, site perimeter walls, basins, utilities, etc. It is our opinion that it is not practically feasible to mitigate or reduce the potential for the occurrence of liquefaction across the whole site due to the shallow nature of the groundwater and the susceptible nature of the site soils. The manifestation and effect of liquefaction may generally affect the flatwork, site perimeter walls, basin, utilities, etc. through differential settlement of the liquefied soils after seismic shaking and/or through buoyant forces due to the release of pore water pressure (manifested on the surface as sand boils). These effects may cause localized distress to the portions of the site where liquefaction occurs. It is our opinion that it may not be economically feasible or cost effective to implement engineering measures to attempt to reduce the potential effects of liquefaction. It is our opinion that the effects of liquefaction and related distress will most likely require repair to portions of the site after a major seismic event. The extent of liquefaction induced distress is difficult to quantify based upon the limits of this study, but may require replacement or re-leveling. If the site is designated as part of an essential service, consideration should be given to performing further study to estimate potential impacts to the proposed site and the possibility to reduce the impact of liquefaction. Other measures may include performing the indicated structure overexcavation for the tank and restroom pads across the whole site.

- The underlying geologic condition for seismic design is Site Class F due to liquefaction potentials. A qualified professional should design any permanent structure constructed on the site. The *minimum* seismic design should comply with the 2010 edition of the California Building Code.
- Based upon criteria presented in *SP117A, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California,* the foundations at the site are not considered susceptible to loss of bearing support due to the depth of liquefaction below the proposed finished grades.
- The upper soils were found to be relatively non-uniform silty sands, clays, and silts which are unsuitable in their present condition to support structures, fill, and hardscape. The soils within the building and structural areas will require moisture conditioning, over-excavation, and recompaction to improve bearing capacity and reduce the potential for differential settlement. Soils can be readily cut by normal grading equipment.
- Other geologic hazard potentials, including fault rupture, tsunamis, seiches and slope instability are considered low to nil on this site.
- Site soils should be reviewed by a corrosion engineer, see Section 3.6.
- Tanks or buoyant structures founded below grade may be subject to hydrostatic forces during a seismic event.

Section 5
RECOMMENDATIONS

5.1 Site Development – Grading for Building Structures

A representative of Earth Systems should observe site clearing, grading, and the bottoms of excavations before placing fill. Local variations in soil conditions may warrant increasing the depth of recompaction and over-excavation.

Clearing and Grubbing: At the start of site grading, existing vegetation, trees, large roots, pavement, foundations, irrigation systems, non-engineered fill, construction debris, trash, and underground utilities should be removed from the proposed building pad and improvement areas. Areas disturbed during demolition and clearing should be properly backfilled and compacted as described below.

Septic systems, leach fields, drywells, undocumented fill, and buried utilities may be located in the vicinity of the proposed structures and within other areas of the project site. As part of the demolition plan for the project, it is recommended these structures be located and identified for proper abandonment. All buried structures which are removed should have the resultant excavation backfilled with soil compacted as engineered fill described herein or with a minimum 2-sack sand slurry approved by the project geotechnical engineer. Abandoned utilities should be removed entirely, or pressure-filled with concrete or grout and be capped. Buried utilities should not extend through building lines.

Subsequent to stripping and grubbing operations, areas to receive fill should be stripped of loose or soft earth materials until a uniform, firm subgrade is exposed, as evaluated by the geotechnical engineer or geologist. Prior to the placement of fill or subsequent to cut, the existing surface soils within the building pads and improvement areas should be over-excavated as follows:

Building and Tank Pad Preparation: Because of the relatively non-uniform and under-compacted nature of the site soils as well as the liquefaction potential, we recommend recompaction of soils in building areas. We have combined three accepted methods of reducing localized differential settlement (reinforced foundation and soil densification, and gravel bed with vent pipes to reduce hydrostatic pressure) which are recommended in SP117A and *Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California*, Martin and Lew, 1999. The mat slab and geogrid reinforced soil mat (densification) system presented in the project soils report for this site are recommended as measures to increase the soil bridging (membrane effect) such that point differential settlement which may occur at depth due to liquefaction is further distributed and attenuated within the foundation and slab area. The gravel and vent pipes are recommended to reduce the potential for the formation of sand boils.

We recommend the overexcavation for the restroom and tank pad, and above ground diesel tank pad be performed as one excavation operation (if possible). The existing surface soils within the building pad and foundation areas should be over-excavated a minimum of 7 feet below existing grade. The over-excavation should extend for 7 feet beyond the outer edge of exterior footings or mat slab, where possible. The bottom of the sub-excavation should be scarified, moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of one foot. Overexcavation of 7 feet will place the excavation bottom in the near vicinity of groundwater.

Where compaction of the resultant excavation bottom is difficult or not achievable due the near vicinity of groundwater, this recommendation may be reviewed and revised by the project geotechnical engineer. Alternative techniques to stabilize the bottom may be required (such as placing gravel and punching it into the soft soil surface prior to placement of geogrid).

Three layers of tri-axial geo-grid (Tensar TX160 or equivalent) should then be placed within the building pad remedial grading. One layer placed at the base of the over-excavation (after the sub excavation has been moisture conditioned and compacted), and then at one-foot increments as the fill is placed (i.e. at 7, 6, and 5 feet below grade), i.e. one layer of Tensar tri-axial geogrid should then be placed on the excavation bottom, then one foot of fill should then be placed and compacted to at least 90% relative compaction (ASTM D 1557), then one layer of Tensar tri-axial geogrid should then be placed, then one foot of fill should then be placed and compacted to at least 90% relative compaction (ASTM D 1557), then the final layer of Tensar tri-axial geogrid should then be placed, then one foot of fill should then be placed and compacted to at least 90% relative compaction (ASTM D 1557). The resultant excavation should then be covered with a filter fabric (Mirafi 140N) overlain by 18 inches of 1 to 2-inch diameter crushed aggregate. The aggregate should be lightly moistened and tamped with heavy vibratory equipment into place using 6-9 inch thick lifts to induce consolidation. The aggregate layer should be enveloped on the top, sides and bottom with the filter fabric (i.e. burrito wrapped). The filter fabric should be overlapped on top by at least 3 feet. At least 1-foot of fill should then be placed to the mat foundation subgrade bottom elevation (see the following paragraph for vent installation recommendations which should partially occur prior to backfilling). The mat subgrade bottom elevation should be designed such that this minimum thickness of fill can be accommodated, which may require designing the mat foundation finish surface elevation to be above grade. Placement of underground utilities should take the geogrid location into consideration, such that damage to the grid is not allowed during subsequent trench excavations and placement of piping.

A minimum of 6 uniformly distributed vertical vent pipes consisting of 6-inch diameter Schedule 80 PVC pipe should be placed around the tank and restroom mat and extend from the ground surface into the middle of the gravel layer. The vent piping should be cutoff approximately 18 inches above the finished surface, covered with a top cap that is open to the atmosphere yet stops rainwater entry, and covered with a screen to prevent rodent entry. The vent piping should be protected on all four sides with bollards or concrete encasement. If the pipes are concrete encased, the top of concrete should be below the top of the pipe to limit water runoff entry. The vent piping is intended to relieve hydrostatic pressures in the event of liquefaction. In no event should the pipes be capped or encased in boxes such that water outflow would be inhibited during a seismic event.

Auxiliary Structures Subgrade Preparation: Auxiliary structures such as perimeter walls and retaining walls, should be over-excavated a minimum of 2 feet below the bottom of the foundation or existing grade, whichever is lower. The over-excavation should extend for 2 feet beyond the outer edge of exterior footings, where possible. The bottom of the sub-excavation should be scarified, moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of one-foot.

Lightly Loaded Flatwork, Such As Sidewalks, Trash Enclosure Pads, etc.: These areas should be over-excavated to a minimum depth of 2 feet below existing grade or finish grade (whichever is lower). The over-excavation should extend horizontally for 2 feet beyond the outer pad edges, where possible. Fill compacted to a minimum 90% compaction relative to ASTM D 1557 should be placed to finished grade.

Pavement Area Preparation: In street, drive, and permanent parking areas, the subgrade should be over-excavated, scarified, moisture conditioned, and compacted to at least 90% relative compaction (ASTM D 1557) for a depth of three feet below existing grade or finish grade (whichever is deeper), with the upper 1 foot compacted to at least 95% relative compaction. Compacted fill should be placed to finish subgrade elevation. Compaction should be verified by testing.

All over-excavations should extend to a depth where the project geologist, engineer or his representative has deemed the exposed soils as being suitable for receiving compacted fill. The materials exposed at the bottom of excavations should be observed by a geotechnical engineer or geologist from our office prior to the placement of any compacted fill soils. Additional removals may be required as a result of observation and/or testing of the exposed subgrade subsequent to the required over-excavation.

If excavation is performed in the near vicinity of the groundwater (i.e. soils above, but near the groundwater elevation), increased moisture content and unstable soils should be anticipated.

Engineered Fill Soils: The native soil is suitable for use as engineered fill and utility trench backfill provided it is free of significant organic or deleterious matter, and oversize rock. Within areas to receive foundations and slabs-on-grade the fill should be "very low" to "low" in expansion potential.

All fill should be placed in maximum 8-inch lifts (loose thickness) and compacted to at least 90 percent relative compaction in general accordance with ASTM D 1557 (current edition). In parking and drive areas the upper one foot of subgrade and aggregate base should be compacted to a minimum of 95 percent relative compaction. Compaction should be verified by testing. In general, rocks larger than 6 inches in greatest dimension should be removed from fill or backfill material.

All soils should be moisture conditioned prior to application of compactive effort. Moisture conditioning of soils refers to adjusting the soil moisture to or just above optimum moisture content. If the soils are overly moist so that instability occurs, or if the minimum recommended compaction cannot be readily achieved, it may be necessary to aerate to dry the soil to optimum moisture content or use other means to address soft soils.

A program of compaction testing, including frequency and method of test, should be developed by the project geotechnical engineer at the time of grading. Acceptable methods of test may include Nuclear methods such as those outlined in ASTM D 6938 (Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods) or correlated hand-probing.

Shrinkage: The shrinkage factor for earthwork is expected to range from -6 to 27 percent for the upper excavated or scarified *site* soils (negative shrinkage is bulking). This estimate is based on compactive effort to achieve an average relative compaction of about 92 percent.

Based upon 29 in-place densities evaluated, the average computed shrinkage is 15% with a standard deviation of 7%. Subsidence is estimated to be less than 0.2 feet. Shrinkage and subsidence are highly dependent on and may vary with contractor methods for compaction. Losses from site clearing, oversize material, and removal of existing site improvements may affect earthwork quantity calculations and should be considered.

5.2 Excavations, and Utilities

Excavations should be made in accordance with OSHA requirements. Using the OSHA standards and general soil information obtained from the field exploration, classification of the near surface on-site soils will likely be characterized as Type C. Actual classification of site specific soil type per OSHA specifications as they pertain to trench safety should be based on real-time observations and determinations of exposed soils by the contractors *Competent Person* (as defined by OSHA) during grading and trenching operations. Due to the cohesionless site soil encountered to depth and shallow groundwater, caving and running surficial soils should be anticipated.

Our site exploration and knowledge of the general area indicates there is a moderate potential for caving and slaking of site excavations (overexcavation areas, utilities, footings, etc.). Where excavations over 4 feet deep are planned lateral bracing or appropriate cut slopes of 1½:1 (horizontal/vertical) should be provided. No surcharge loads from stockpiled soils or construction materials should be allowed within a horizontal distance measured from the top of the excavation slope and equal to the depth of the excavation. Soils are susceptible to caving such that shallower excavated slopes may be required for site safety. Based upon the currently proposed elevations and the groundwater levels encountered during our field exploration, groundwater may be encountered during construction above or in the near vicinity excavations for the site. As such, soils in the vicinity of groundwater may have increased moisture content and be unstable.

Excavations which parallel structures, pavements, or other flatwork, should be planned so that they do not extend into a plane having a downward slope of 1.5:1 (horizontal: vertical) from the bottom edge of the footings, pavements, or flatwork. Shoring or other excavation techniques may be required where these recommendations cannot be satisfied due to space limitations or foundation layout. Where overexcavation will be performed adjacent to existing structures, ABC slot cutting techniques may be used. The width of the slot cuts will depend on the soils encountered at the point of excavation (slot cut widths are generally no greater than 5 to 8 feet).

Shoring: Shoring may be required where soil conditions, space or other restrictions do not allow a sloped excavation. A braced or cantilevered shoring system may be used.

A temporary cantilevered shoring system should be designed to resist an active earth pressure equivalent to a fluid weighing 45 pounds per cubic foot (pcf). Shoring below the groundwater table should be designed to resist an active earth pressure equivalent to a fluid weighing 25 pounds per cubic foot (pcf) and should include water pressure. Braced or restrained excavations above the groundwater table should be designed to resist a uniform horizontal equivalent soil pressure of 65 pounds per cubic foot (pcf). Braced or restrained shoring below the groundwater table should be designed to resist an active earth pressure equivalent to a fluid weighing 35 pounds per cubic foot (pcf) and should include water pressure. The values provided above assume a level ground surface adjacent to the top of the shoring and do not include a factor of safety.

Fifty percent of an aerial surcharge placed adjacent to the shoring may be assumed to act as a uniform horizontal pressure against the shoring. Special cases such as combinations of slopes and shoring or other surcharge loads may require an increase in the design values recommended above. These conditions should be evaluated by the project geotechnical engineer on a case-by-case basis. The wall pressures above the groundwater do not include hydrostatic pressures; it is assumed that drainage will be provided. If drainage is not provided, shoring extending below the groundwater level should be evaluated on a case-by-case basis.

Cantilevered shoring must extend to a sufficient depth below the excavation bottom to provide the required lateral resistance. We recommend required embedment depths be determined using methods for evaluating sheet pile walls and based on the principles of force and moment equilibrium. For this method, the allowable passive pressure against shoring, which extends below the level of excavation may be assumed to be equivalent to a fluid weighing 250 pcf. Additionally, we recommend a factor of safety of at least 1.2 be applied to the calculated embedment depth and that passive pressure be limited to 2,000 psf.

The contractor should be responsible for the structural design and safety of all temporary shoring systems. The contractor should carefully review the boring and test pits logs in this report, and perform their own assessment of potential construction difficulties, and methods should be selected accordingly. Shoring should be sealed to prevent the piping of soil material and potential soil loss conditions which can cause settlement. The method of excavation and support is ultimately left to the contractor with guidance and restrictions provided by the designer and owner. We recommend that existing structures be monitored for both vertical and horizontal movement, especially if vibratory compaction techniques are utilized.

A representative from our firm should be present during all site demolition, and clearing and grading operations to monitor site conditions; substantiate proper use of materials; evaluate compaction operations; and verify that the recommendations contained herein are met.

Utility Trenches: Backfill of utilities within roads or public right-of-ways should be placed in conformance with the requirements of the governing agency (water district, public works department, etc.). Utility trench backfill within private property should be placed in conformance with the provisions of this report. In general, service lines extending inside of property may be backfilled with native soils compacted to a minimum of 90% relative compaction per ASTM D 1557. Backfill operations should be observed and tested to monitor compliance with these recommendations. The trench bottom should be in a firm condition prior to placing pipe, bedding, or fill.

Under pavement sections, the upper 12 inches of trench backfill soil below the pavement section should be compacted to at least 95 percent relative compaction (ASTM D 1557). Backfill materials should be brought up at substantially the same rate on both sides of the pipe or conduit. Reduction of the lift thickness may be necessary to achieve the above recommended compaction. Mechanical compaction is recommended; ponding or jetting should be avoided, especially in areas supporting structural loads or beneath concrete slabs supported on-grade, pavements, or other improvements.

In general, coarse-grained sand and/or gap graded gravel (i.e. ¾-inch rock or pea-gravel, etc.) should not be used for pipe/conduit or trench zone backfill due to the potential for soil migration into the relatively large void spaces present in this type of material and water seepage along trenches backfilled with coarse-grained sand and/or gravel. Loss of soil may cause damaging settlement. NOTE: Rocks greater than 3 inches in diameter should not be incorporated within utility trench backfill.

Utilities connections which tie into the tank pads or restroom structure should be flexible and designed to accommodate at least 3 inches of vertical offset at the transition from the overexcavated and remediated pads to other areas of the site.

5.3 Temporary Dewatering

Based upon the currently proposed elevations and the groundwater levels encountered during our field exploration, groundwater may be encountered during construction above or in the near vicinity excavations for the site.

The contractor may require a dewatering plan for excavation and construction in the event that dewatering is required. The goal of the plan should be to identify an effective means of temporarily removing water from the trench excavation. As such, the plan should include identifying groundwater elevations relative to excavation or construction elevations, the horizontal and vertical permeability of soils needing to be dewatered, the area and volume of material needing to be dewatered, and the appropriate means to do so. Since temporary dewatering will impact and be dependent on construction methods and scheduling, we recommend the contractor be solely responsible for the design, installation, maintenance and performance of all temporary dewatering systems. The following suggestions are designed to aid the contractor in preparing an acceptable dewatering plan.

Prior to initiating any dewatering operations, the contractor should conduct at least the following assessments.

- Groundwater levels can fluctuate depending on rainfall, runoff conditions, or other factors. Therefore, water levels presented in this report may not be representative of those encountered at the time of construction.
- Identify specific soil types and their associated vertical and horizontal permeability.
- Identify depth of dewatering based on soil types and depth of construction.
- Identify dewatering methods suitable to soil types and excavation type and depth.

Given the type and setting of the project, the contractor may also need to accommodate for the following logistical issues.

- Discharge: Water removed from the excavations needs to be discharged remotely to avoid reinfiltration into the excavation. Water discharge should follow all local, state, and federal regulatory laws.
- Operations: Active construction and excavation sites often damage dewatering well heads, power lines, discharge lines and collection lines. As such, the final dewatering system needs to be designed and operated for this type of environment.
- Settlement: Dewatering may cause settlement of surrounding structures in the near vicinity of groundwater drawdown. We recommend structures be monitored for potential movement and the contractor have a plan for minimizing settlement occurrence.

Depending on the depth of excavation below groundwater, soil conditions encountered along the excavation face and slope inclination, caving or sloughing of excavation slopes is possible within the vicinity of a dewatering system.

Sloughing or caving of excavation slopes could endanger personnel working within or adjacent to the excavation as well as nearby equipment, structures, or other existing improvements. The contractor should be aware of the potential for caving and take appropriate precautions to ensure the safety of site personnel as well as the integrity of the excavation slopes and any existing nearby structures or other improvements.

5.4 Foundations

In our professional opinion, foundations for the tank and restroom structures proposed (as presented within) should be supported on mat foundations bearing in properly prepared and compacted soils placed as recommended in Section 5.1. The recommendations that follow are based on "low" expansion category soils in the upper 7 feet of subgrade. During remedial grading of building pads, the soil expansion potential should be verified and foundation recommendations confirmed or modified, based on the site specific expansion index at each building site.

Foundation design is the responsibility of the Structural Engineer, considering the structural loading and the geotechnical parameters given in this report. A representative of Earth Systems should observe foundation excavations before placement of reinforcing steel or concrete. Loose soil or construction debris should be removed from footing excavations before placement of concrete.

Bearing Capacity - Foundations for Buildings and Tank Pads: A minimum footing depth of 18 inches below lowest adjacent grade should be maintained (lowest adjacent = lowest grade within 2 feet laterally). Allowable soil bearing pressures are given below for mat foundations bearing on recompacted soils as described in Section 5.1. Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected). We utilized a factor-of-safety of 3.0 for determining allowable bearing values.

- Mat foundations, 36-inch minimum thickness and 18-inch minimum below grade:

  1,000 psf for dead plus design live loads.

  Allowable increases of 500 psf for each additional 0.5-foot of footing depth may be used up to a maximum value of 2,500 psf.

Bearing Capacity – Retaining Walls and Perimeter Walls: A minimum footing depth of 18 inches below lowest adjacent grade should be maintained (lowest adjacent = lowest grade within 2 feet laterally). Allowable soil bearing pressures are given below for foundations bearing on recompacted soils as described in Section 5.1. Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected). We utilized a factor-of-safety of 3.0 for determining allowable bearing values.

- Continuous wall foundations, 12-inch minimum width and 18-inch minimum below grade:

  1,500 psf for dead plus design live loads.

  Allowable increases of 250 psf for each additional 0.5-foot of footing depth may be used up to a maximum value of 3,000 psf.

- Isolated pad foundations, 2 x 2-foot minimum in plan and 18-inch minimum below grade:

  1,500 psf for dead plus design live loads.

  Allowable increases of 250 psf for each additional 0.5-foot of footing depth may be used up to a maximum value of 3,000 psf.

An average modulus of subgrade reaction, k, of 100 pounds per cubic inch (pci) can be used to design footings and slabs founded upon compacted fill. ACI Section 4.3, Table 4.3.1 should be followed for recommended cement type, water cement ratio, and compressive strength for severe exposure conditions.

Minimum Foundation Reinforcement: Minimum reinforcement for continuous footings should be four No. 4 steel reinforcing bars, two placed near the top and two placed near the bottom of the footing. This reinforcing is not intended to supersede any additional structural requirements provided by the structural engineer.

Bearing Capacity and Passive Pressure – Wind and Seismic Increases: A one-third (⅓) increase in the bearing and passive pressures may be used when calculating resistance to wind or seismic loads. The allowable bearing values indicated are based on the structure types described in this report. If the structures are different from that described, the geotechnical engineer must reevaluate the allowable bearing values and the grading requirements.

5.4.1 Estimated Settlements

Total static settlement of the foundation will vary depending on the plan dimensions of the foundation and the actual load supported. Based upon the foundation dimensions presented within, the assumed maximum bearing pressures provided, and assuming the site is prepared as recommended within this report, it is our opinion that estimated total static settlement of the proposed foundations should be less than 1 inch.

Differential mat settlement (expressed as mat rotation) should be less than ½ inch, expressed in a post-construction angular distortion ratio of 1:480 or less. Differential static settlement of retaining wall and perimeter wall foundations should be less than ¾ inch, expressed in a post-construction angular distortion ratio of 1:480 or less. Outside of tank slab and restroom mat slab areas, the total estimated seismic-induced settlement of the total soil columns is on the order of 1.7 to 4.8 inches. The potential for differential settlement is estimated to be on the order of 3 inches over a distance of 40 feet (typical foundation distance, SP117A). Due to the granular nature of the site soils, the total static settlement is expected to occur during and shortly after construction.

5.5 Slabs-on-Grade

Subgrade: Concrete slabs-on-grade and flatwork should be supported by compacted soil placed in accordance with Section 5.1 of this report.

Vapor Retarder: In areas of moisture-sensitive floor coverings or exposed interior slabs, an appropriate vapor retarder should be installed to reduce moisture transmission from the subgrade soil to the slab. For these areas, a vapor retarder (minimum 10-mil thickness) should underlie the floor slabs. If a Class A vapor retarder (ASTM E 1745) is specified, the retarder can be placed directly on non expansive soil and the retarder should be covered with a minimum of 2 inches of *clean* sand.

If a less durable vapor retarder is specified (i.e. ASTM E 1745, Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as well or poorly-graded sand (ASTM D 2488) of which less than 3% passes the No. 200 sieve. The site soils do not fulfill the criteria to be considered clean sand. The sand should be lightly moistened just prior to placing the concrete. Low-slump concrete should be used to help reduce the potential for concrete shrinkage. The effectiveness of the membrane is dependent upon its quality, the method of overlapping, its protection during construction, and the successful sealing of the membrane around utility lines and at joints. Capillary breaks (if any) should consist of a minimum of 4 inches of open/gap-graded gravel.

The following minimum slab recommendations are intended to address geotechnical concerns such as potential variations of the subgrade and are not to be construed as superseding any structural design. The design engineer and/or project architect should ensure compliance with SB800 with regards to moisture and moisture vapor.

Slab Thickness and Reinforcement: Slab thickness and reinforcement of slabs-on-grade are contingent on the recommendations of the structural engineer or architect and the expansion index of the supporting soil. Based upon our findings, a modulus of subgrade reaction of approximately 100 pounds per cubic inch can be used in concrete slab design for the expected compacted subgrade. ACI Section 4.3, Table 4.3.1 should be followed for recommended cement type, water cement ratio, and compressive strength for severe exposure conditions.

Concrete slabs and flatwork should be a minimum of 4 inches thick (actual, not nominal). We suggest that the concrete slabs be reinforced with a minimum of No. 3 rebar at 18-inch centers, both horizontal directions, placed on positive spacers at slab mid-height to resist potential shrinkage cracking. Concrete floor slabs may either be monolithically placed with the foundations or doweled after footing placement.

The thickness and reinforcing given are not intended to supersede any structural requirements provided by the structural engineer. The project architect or geotechnical engineer should continually observe all reinforcing steel in slabs during placement of concrete to check for proper location within the slab.

Control Joints: Control joints should be provided in all concrete slabs-on-grade at a maximum spacing of 36 times the slab thickness (12 feet maximum on-center, each way) as recommended by American Concrete Institute [ACI] guidelines. All joints should form approximately square patterns to reduce the potential for randomly oriented shrinkage cracks. Control joints in the slabs should be tooled at the time of the concrete placement or saw cut (¼ of slab depth) as soon as practical but not more than 8 hours from concrete placement.

Construction (cold) joints should consist of thickened butt joints with ½-inch dowels at 18 inches on center or a thickened keyed-joint to resist vertical deflection at the joint. All control joints in exterior flatwork should be sealed to reduce the potential of moisture or foreign material intrusion. These procedures will reduce the potential for randomly oriented cracks, but may not prevent them from occurring.

Curing and Quality Control: The contractor should take precautions to reduce the potential of curling of slabs in this arid desert region using proper batching, placement, and curing methods. Curing is highly affected by temperature, wind, and humidity.

Quality control procedures *may* be used, including trial batch mix designs, batch plant inspection, and on-site special inspection and testing. Curing should be in accordance with ACI recommendations contained in ACI 211, 304, 305, 308, 309, and 318.

5.6 Retaining Walls and Lateral Earth Pressures

Retaining Walls:

- Retaining walls should be designed for an active soil pressure equivalent to a fluid density of 40 pcf. The active lateral earth pressures are for horizontal (level) backfills using the on-site native soils on walls that are free to rotate at least 0.1% of the wall height. Walls, which are restrained against movement or rotation at the top, should be designed for an at-rest equivalent fluid pressure of 60 pcf. The lateral earth pressure values for level backfill are provided for walls backfilled with drainage materials and existing on-site soils which are above the groundwater table. The geotechnical engineer should be consulted on a case-by-case basis for walls designed to be below the groundwater table.
- In addition to the active or at rest soil pressure, the proposed wall structures may be designed to include forces from dynamic (seismic) earth pressure. Dynamic earth pressures should be estimated by the structural engineer using methods such as the Mononobe-Okabe method (Mononobe and Matsuo, 1929), Seed and Whitman (1970), or other suitable technique. Dynamic pressures are additive to active earth pressure. Walls retaining less than 12 feet of soil or walls designed using at-rest pressures need not consider this increased pressure (reference: *Seismic Earth Pressures on Deep Building Basements*, M. Lew, et al, 2010 Structural Engineers Association of California Convention proceedings).
- Retaining wall foundations should be placed upon compacted fill described in Section 5.1.
- A backdrain or an equivalent system of backfill drainage should be incorporated into the retaining wall design, whereby the collected water is conveyed to an approved point of discharge. Design should be in accordance with Section 1805.4.2 and 1805.4.3 of the 2010 California Building Code. Drain rock should be wrapped in filter fabric such as Mirafi 140N as a minimum. Backfill immediately behind the retaining structure should be a free-draining granular. Waterproofing should be according to the designer's specifications. Water should not be allowed to pond or infiltrate near the top of the wall. To accomplish this, the final backfill grade should be such that water is diverted away from the retaining wall.
- Compaction on the retained side of the wall within a horizontal distance equal to one wall height (to a maximum of 6 feet) should be performed by hand-operated or other lightweight compaction equipment (90% compaction relative to ASTM D 1557 at near optimum moisture content). This is intended to reduce potential locked-in lateral pressures caused by compaction with heavy grading equipment or dislodging modular block type walls.

- The above recommended values do not include compaction or truck-induced wall pressures. Care must be taken during the compaction operation not to overstress the wall. Heavy construction equipment should be maintained a distance of at least 3 feet away from the walls while the backfill soils are placed. Upward sloping backfill or rock, or surcharge loads from nearby footings can create larger lateral pressures. Should any walls be considered for retaining sloped backfill (or rock) or placed next to foundations, our office should be contacted for recommended design parameters. Surcharge loads should be considered if they exist within a zone between the face of the wall and a plane projected 45 degrees upward from the base of the wall. The increase in lateral earth pressure should be taken as 35% of the surcharge load within this zone and applied to the backside of the wall as a distributed load. Retaining walls subjected to traffic loads should include a uniform surcharge load equivalent to at least 2 feet of native soil (130 pcf unit weight). Retaining walls should be designed with a minimum factor of safety of 1.5.

Frictional and Lateral Coefficients:

- Resistance to lateral loads (including those due to wind or seismic forces) may be provided by frictional resistance between the bottom of concrete foundations and the underlying soil, and by passive soil pressure against the foundations. An allowable coefficient of friction of 0.30 may be used between cast-in-place concrete foundations and slabs and the underlying soil. An allowable coefficient of friction of 0.25 may be used between pre-cast or formed concrete foundations and slabs and the underlying soil
- Allowable passive pressure may be taken as equivalent to the pressure exerted by a fluid weighing 250 pounds per cubic foot (pcf). Vertical uplift resistance may consider a soil unit weight of 105 pounds per cubic foot. The upper 1 foot of soil should not be considered when calculating passive pressure unless confined by overlying asphalt concrete pavement or Portland cement concrete slab. The soils pressures presented have considered onsite fill soils. Testing or observation should be performed during grading by the soils engineer or his representative to confirm or revise the presented values.
- Passive resistance for thrust blocks bearing against firm natural soil or properly compacted backfill can be calculated using an equivalent fluid pressure of 250 pcf. The maximum passive resistance should not exceed 1,500 psf.
- Friction and soil pressure values (resistance) presented above are considered to have a factor of safety of 1.5 in relation to ultimate values (factor of safety = 1). The above values are not permitted to be increased by 1/3 due to short term loads such as wind or seismic forces.
- Construction employing poles or posts (i.e. lamp posts) may utilize design methods presented in Section 1807.3 of the CBC for sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM, and GC) material class. Groundwater at 8 feet should be considered in the design.

- The passive resistance of the subsurface soils will diminish or be non-existent if trench sidewalls slough, cave, or are over widened during or following excavations. If this condition is encountered, our firm should be notified to review the condition and provide remedial recommendations, if warranted.

5.7 Slope Construction

Onsite slope construction is anticipated to be minimal (less than 5 feet in height, if any). Slopes should be constructed such that fully compacted soil is exposed at the surface. Such methods may include overfilling during construction and cutting back to expose a fully compacted soil, or track-walking or grid-rolling. Compacted fill should be placed at near optimum moisture content and compacted to a minimum 90% of the maximum dry unit weight, as measured in relation to ASTM D 1557 test procedures. The exposed face of any cut or fill slope (upper 12 inches) should have a minimum relative density of 90 percent of the maximum dry unit weight, as measured in relation to ASTM D 1557 test procedures, and be compacted at near optimum moisture content. Basin slopes should be constructed no steeper than 3:1 (horizontal:vertical). We recommend that basin bottom soils be left in a natural, un-worked, uncompacted state subsequent to construction to allow for infiltration. Compacted soils significantly reduce infiltration rates.

5.7.1 Surficial Slope Failures

All slopes will be exposed to weathering, resulting in decomposition of surficial earth materials, thus potentially reducing shear strength properties of the surficial soils. In addition, these slopes become increasingly susceptible to rodent burrowing. As these slopes deteriorate, they can be expected to become susceptible to surficial instability such as soil slumps, erosion, soil creep, and debris flows. Development areas immediately adjacent to ascending or descending slopes should address future surficial sloughing of soil material. Such measures may include debris fences, catchment areas or walls, ditches, soil planting or other techniques to contain soil material away from developed areas.

Operation and maintenance inspections should be done after a significant rainfall event and on a time-based criteria (annually or less) to evaluate distress such as erosion, slope condition, rodent infestation burrows, etc. Inspections should be recorded and photographs taken to document current conditions. The repair procedure should outline a plan for fixing and maintaining surficial slope failures, erosional areas, gullies, animal burrows, etc. Repair methods could consist of excavating and infilling with compacted soil erosional features, track walking the slope faces with heavy equipment, as determined by the type and size of repair. These repairs should be performed in a prompt manner after their occurrence. Existing slope inclinations should be maintained and a maintenance program should include identifying areas where slopes begin to steepen.

5.8 Seismic Design Criteria

This site maybe subject to moderate ground shaking due to potential fault movements along regional faults. A *site response analysis is typically required for liquefiable sites meeting the definition of site class F;* however, we have classified this site as Site Class D as allowed in ASCE 7-05 Section 11.4.7.

This section permits the determination of a site class in accordance with Section 20.3, with the corresponding values of Fa and Fv determined from Tables 11.4-1 and 11.4.2, such that a site-response analysis is not required to determine the spectral accelerations for liquefiable soils if the structure being designed has a fundamental period of vibration equal to or less than 0.5 seconds and the foundation soils are not subject to bearing failure from liquefaction. The site soils in the tank and restroom areas are not subject to liquefaction induced bearing failure if the grading recommendations presented within are adhered to. Additionally, we understand based upon discussion with the structural engineer (Tom Mitchell, June 14, 2012) that the tank structure period is less than 0.5 seconds. As such, the *minimum* seismic design should comply with the 2010 edition of the CBC using the seismic coefficients given in the table below.

2010 CBC (ASCE 7-05) Seismic Parameters

Site Class:	D
Maximum Considered Earthquake [MCE] Ground Motion	
Short Period Spectral Response S_s:	0.314 g
1 second Spectral Response, S_1:	0.190 g
Site Coefficient, F_a:	1.549
Site Coefficient, F_v:	2.039
Design Earthquake Ground Motion	
Short Period Spectral Response, S_{DS}	0.324 g
1 second Spectral Response, S_{D1}	0.258 g

The intent of the CBC lateral force requirements is to provide a structural design that will resist collapse to provide reasonable life safety from a major earthquake, but may experience some structural and nonstructural damage.

A fundamental tenet of seismic design is that inelastic yielding is allowed to adapt to the seismic demand on the structure. In other words, *damage is allowed*. The CBC lateral force requirements should be considered a *minimum* design. The owner and the designer may evaluate the level of risk and performance that is acceptable. Performance based criteria could be set in the design. The design engineer should exercise special care so that all components of the design are fully met with attention to providing a continuous load path. An adequate quality assurance and control program is urged during project construction to verify that the design plans and good construction practices are followed.

5.9 Streets and Driveways

Pavement structural sections for associated parking and drive areas including recommendations for standard and heavy duty asphalt concrete and Portland cement concrete are provided below.

Pavement Area Preparation: In onsite drive, and parking areas, the subgrade should be overexcavated as recommended in Section 5.1 and below, moisture conditioned, and compacted. Compaction should be verified by testing.

Truck Driveways

The pavement section presented in the following Table 6 is for 18-wheel semi-trailer type traffic which is expected to enter and exit the site, and is based on R-value testing and current Caltrans design procedures.

Site soils in the influence zone for paving and flatwork are clayey in nature and provide minimal pavement support based upon R-Value testing conditions. Truck traffic information provided by Mr. Ulrich Sauerbrey on June 19, 2012, estimated that the peak daily truck traffic over the design life of the station will be 200 vehicles. As such, considering a typical 80,000 lb truck load, 18-wheel configuration, and a design life of 20 years (servicing traffic over 7 days per week, 52 weeks per year), we estimate an Equivalent Single Axle Load (ESAL) for the site of 3,400,000 which correlates to a Traffic Index (TI) of 10.5, which was used to facilitate the design of asphalt concrete pavements for drive areas and offsite street improvements. The TI's assumed below should be reviewed by the project Civil Engineer to evaluate the suitability for this project. All design should be based upon an appropriately selected traffic index. Changes in the traffic indices will affect the corresponding pavement section.

Table 6
Preliminary Flexible Pavement Section Recommendations

R-Value Subgrade Soils - 10 (tested) Design Method – CALTRANS

Traffic Index (Assumed)	Pavement Use	Flexible Pavements	
		Asphaltic Concrete Thickness (inches)	Aggregate Base Thickness (inches)
10.5	Semi-Trailer Drives	8.5	19

Conventional, rigid pavements, i.e. Portland cement concrete (PCC) pavements, are recommended in areas that will be subject to relatively high static wheel loads and/or heavy vehicle loading and unloading and turning areas (i.e. truck/bus lanes). The pavement section below is based upon the *Guide for Construction of Concrete Parking Lots, ACI 330R*, and the assumptions outlined below.

Table 7
Preliminary Portland Cement Concrete Pavement Sections

Area	Minimum Pavement PCC Thickness (inches)	Minimum Aggregate Base Thickness (inches)	Minimum 28 Day Flexural Strength (psi)	Concrete Compressive Strength (psi)
Truck Access Areas (Traffic Category D, ADTT =200)	8.0	4.0	575	3,750

Modulus of Subgrade Reaction drive area fill, k = 100 pci

Should the actual traffic category vary from those assumed and listed above, these sections should be modified. All above recommended preliminary pavement sections are contingent on the following recommendations being implemented during construction:

- The upper 12 inches of subgrade soils beneath the asphalt concrete and conventional PCC pavement section should be compacted to a minimum of 95% relative compaction (ASTM D 1557).
- Subgrade soils and aggregate base should be in a stable, non-pumping condition at the time of placement and compaction. Exposed subgrades should be proof-rolled to verify the absence of soft or unstable zones.
- Subgrade soils should be compacted at or slightly over optimum moisture content.
- Aggregate base materials should be compacted at near optimum moisture content to at least 95% relative compaction (ASTM D 1557) and should conform to Caltrans Class II criteria.
- All concrete curbs separating pavement from landscaped areas should extend at least 6 inches into the subgrade soils to reduce the potential for movement of moisture into the aggregate base layer (this reduces the risk of pavement failures due to subsurface water originating from landscaped areas). The curbing acts as a moisture cut-off barrier.
- Concrete pavements should be constructed with transverse joints at maximum spacing of 12 feet. A thickened edge should be used where possible and, as a minimum, where concrete pavements abut asphalt pavements. The thickened edge should be 1.2 times the thickness of the pavement (10 inches for an 8-inch pavement), and should taper back to the pavement thickness over a horizontal distance on the order of 3 feet.
- All longitudinal or transverse control joints should be constructed by hand forming or placing a pre-molded filler such as "zip strips." Expansion joints should be used to isolate fixed objects abutting or within the pavement area. The expansion joint should extend the full depth of the pavement. Joints should run continuously and extend through integral curbs and thickened edges. We recommend that joint layout be adjusted to coincide with the corners of objects and structures. In addition, the following is recommended for concrete pavements:
    1. Slope pavement at least ½ percent to provide drainage;
    2. Provide rough surface texture for traction;
    3. Cure concrete with curing compound or keep continuously moist for a minimum of seven days;
    4. Keep all traffic off concrete until compressive strength exceeds 2,000 pounds per square inch (truck traffic should be limited until the concrete meets the design strength (3,750 psi); and
    5. Due to potential low expansive soils, all construction joints should be keyed or slip dowels should be used on 24-inch centers to strengthen control and construction joints. Dowels placed within dowel baskets should be incorporated into the concrete at each saw-cut control joint (i.e. dowel baskets and dowels are set in place prior to placement of concrete).
- Subgrade soils and base materials should be in a stable, <u>non-pumping</u> condition at the time of placement and compaction.

- Asphalt concrete paving and placement methods should conform to the Caltrans or the Standard Specification for Public Works referred to in the ("Green Book").
- Concrete placement and curing should, at a minimum, be in accordance with the American Concrete Institute (ACI) recommendations contained in ACI 211, 304, 305, 308, 309, and 318.
- Within the structural pavement section areas, positive drainage (both surface and subsurface) should be provided. In no instance should water be allowed to pond on the pavement. Roadway performance depends greatly on how well runoff water drains from the site. This drainage should be maintained both during construction and over the entire life of the project.
- Proper methods, such as hot-sealing or caulking, should be employed to limit water infiltration into the pavement base course and/or subgrade at construction/expansion joints and/or between existing and reconstructed asphalt concrete sections (if any). Water infiltration could lead to premature pavement failure.
- To reduce the potential for detrimental settlement, excess soil material, and/or fill material removed during any footing or utility trench excavation, should not be spread or placed over compacted finished grade soils unless subsequently compacted to at least 95% of the maximum dry unit weight, as evaluated by ASTM D 1557 test procedure, at near optimum moisture content, if placed under areas designated for pavement.
- Asphaltic concrete should be Caltrans, ½-in. or ¾-in. maximum-medium grading or as dictated by Riverside County guidelines and compacted to a minimum of 95% of the 75-blow Marshall density (ASTM D 1559) or equivalent.
- Where new roadways will be installed against existing roadways, the repaired asphalt concrete pavement section should be designed and constructed to have at least the pavement and aggregate base section as the original pavement section thickness (for both AC and base) or upon the newly calculated pavement sections presented within, whichever is greater.

The appropriate pavement design section depends primarily on the shear strength of the subgrade soil exposed after grading and anticipated traffic over the useful life of the pavement. R-value testing should be performed during grading to verify and/or modify the preliminary pavement sections presented within this report. Pavement designs assume that heavy construction traffic will not be allowed on base cap or finished pavement sections.

Existing Asphalt Concrete: Our borings placed within the existing Willow and West Wells Street measured the existing asphalt concrete and aggregate base thickness. Additionally, we performed a visual evaluation of the existing asphalt concrete. Table 8 below presents the measured thickness and location.

Table 8
Existing Pavement Section at Exploration Location

Boring	Roadway Location	Measured Asphalt Concrete Thickness (in)	Measured Aggregate Base Thickness (in)
B-1	West Edge of Willow Street	4½	5
B-2	East Edge of Willow Street at Turning Radius	4½	4½
B-3	East Edge of Willow Street at Turn Radius off W. 14th Avenue	4½	4½
B-4	South Edge of West Wells Street at Existing Arco Facility	4½	20
B-5	North Edge of West Wells Street at Turning Radius Exit	4½	5
B-6	Center of West Wells Street	4½	4½

Our evaluation considered that Willow Street (bounded by 14th Avenue) and West Wells Street (bounded by South Lovekin Boulevard) will be used for access to the LCNG site by heavy 18-wheel type truck traffic. Truck traffic information provided by Mr. Ulrich Sauerbrey on June 19, 2012, estimated that the peak daily truck traffic over the design life of the station will be 200 vehicles; however, for the first couple years, truck traffic is projected to be 50 to 100 vehicles per day.

In general, the asphalt concrete between the boundaries mentioned above is moderately to severely degraded. Some rutting is present indicating forms of subgrade failure; however, due to the lack of water infiltration (lack of rainfall or runoff) the rutted areas are minor. Typically within the travelled way, the asphalt concrete exhibits "alligator" hexagonal type cracking which has well defined blocks and spalling at the edges. In general, the blocks are 3 to 6 inches in width. There is significant soil and debris intrusion into the separations between the spalled edges (most likely from windblown sand). At minor locations, separation between asphalt lifts has occurred. In less travelled areas, the cracking is less pronounced; however, the asphalt exhibits moderate to severe oil loss and hardening. These types of failures are generally caused by high temperature, intense sun which causes oxidation and oil loss which leads to hardening and embrittlement. Plates 3 through 6 present example roadway pictures.

It is our opinion that roadway repair options are limited, short of removal and replacement. We have been requested to provide discussion on the suitability of the existing section to support the anticipated truck loading (truck type/loading and number of truck trips as discussed above). We understand that Willow Street and West Wells Streets are not proposed to be rehabilitated or reconstructed until 1 or 2 years after construction of the LCNG facility. In general, it is our opinion that the roadway will continue to deteriorate in its present form. The alligator cracking is severe; however, loss of subgrade support was minor. As roadways near these life stages, deterioration increases at a more pronounced rate, especially with increased traffic and load, such that cracking of brittle asphalt is increased. Typically, with the introduction of water, this allows water intrusion, which then causes subgrade and aggregate base failure and rutting, potholes, and roadway asphalt block loss. Blythe, however, is a desert climate with intense sun and high average temperatures throughout a majority of the year. Rainfall averages 4 inches, typically spread equally throughout each month, and occurring in short sporadic events (www.cityofblythe.ca.gov). As such, this type of failure is less likely, as evidenced by the general lack of rutting in the roadway, despite ongoing traffic loading and moderate to severe cracking.

In regard to pavement section to resist deterioration from traffic loads, Willow Street and West Wells do not have an adequate section to provide long term support for the anticipated Traffic Index. Due to the possible time delay between constructing the LCNG facility and reconstructing/rehabilitating the roadways, we recommend West Wells and Willow Streets be monitored for further degradation. For the current roadway condition and lack of water intrusion, roadways typically do not fail catastrophically, especially on low speed roadways such as Willow Street and West Wells. Due to an inadequate pavement section and clayey subgrade soils, the roadway may experience depressions and distortions. Where ruts, potholes, depressions, and distortions begin to develop, they should be promptly repaired such that accelerated roadway distress is limited until the roadway is replaced.

5.10 Site Drainage and Maintenance

Positive drainage in native soils should be maintained away from the structures (5% for 5 feet minimum) to prevent ponding and subsequent saturation of the foundation soils. Gutters and downspouts in conjunction with a 2% paved or hardscape grade should be considered as a means to convey water away from foundations if increased fall is not provided.

Drainage should be maintained for paved areas. Water should not pond on or near paved areas or foundations. The following recommendations are provided in regard to site drainage and structure performance:

- In no instance should water be allowed to flow or pond against structures, slabs or foundations or flow over unprotected slope faces. Adequate provisions should be employed to control and limit moisture changes in the subgrade beneath foundations or structures to reduce the potential for soil saturation. Landscape borders should not act as traps for water within landscape areas. Potential sources of water such as piping, drains, broken sprinklers, etc, should be frequently examined for leakage or plugging. Any such leakage or plugging should be immediately repaired.

- It is highly recommended that landscape irrigation or other sources of water be collected and conducted to an approved drainage device. Landscaping and drainage grades should be lowered and sloped such that water drains to appropriate collection and disposal areas. All runoff water should be controlled, collected, and drained into proper drain outlets. Control methods may include curbing, ribbon gutters, 'V' ditches, or other suitable containment and redirection devices.

- The proposed retention/infiltration pond should not be based in fine grained soils. Excavation should extend through any fine grained soils encountered and extend into the site sandy soils. The site soils within the proposed retention basin area consisted of interbedded silty sand (SM), Silty Clay (CL) and Sandy Silt (ML) soils. Typically, the sandy soils (SM) which may have the potential to infiltrate water were observed at depths of approximately 2 to 4½ feet below the existing grades. Above these depths soils were clayey and not suitable to infiltrate water. Below these approximate depths, soils were silty and clayey (not suitable to infiltrate water) to a depth of approximately 9½ feet where sandy (SP) soils were encountered. At a depth of 8 feet, groundwater was encountered. As such, there appears to be a very narrow range of depth where water in a retention basin could infiltrate (laterally in the SM type soils as water may perch on the lower silt and clay layers), see the *Double Ring Infiltration Test Exploratory Log* in Appendix A for a depiction of the soil strata at the test location. The subgrade soils should be evaluated by the project geotechnical engineer or his representative to confirm or modify the basin recommendations provided.

- Maintenance of drainage systems and infiltration structures can be the most critical element in determining the success of a design. They must be protected and maintained from sediment-laden water both during and after construction to prevent clogging of the surficial soils any filter medium. The potential for clogging can be reduced by pre-treating structure inflow through the installation of maintainable forebays, biofilters, or sedimentation chambers. In addition, sediment, leaves, and debris must be removed from inlets and traps on a regular basis. Since these and other factors (such as varying soil conditions) may affect the rate of water infiltration, it is imperative to apply a conservative factor of safety [FOS] to the unfactored Basic Percolation/Infiltration Rates presented within to provide a reliable basis for design. In order to account not only for the unknown factors above but also for changes of conditions during the use of the structures such as potential clogging effects due to washing in of soil fines, a FOS between 3 and 12 should be applied to lower the presented infiltration rates.

  We suggest a FOS of at least 5 be applied for design due to the potential for soil clogging, soil variation, and dirty water effects; however, the factor of safety should be selected by the project drainage engineer and may be dependent on agency guidelines and the presence of filters and sedimentation structures. If these measures are provided, the factor of safety can be reduced.

- The drainage pattern should be established at the time of final grading and maintained throughout the life of the project. Additionally, drainage structures should be maintained (including the de-clogging of piping, basin bottom scarification, etc.) throughout their design life.

Maintenance of these structures should be incorporated into the facility operation and maintenance manual. Structural performance is dependent on many drainage-related factors such as landscaping, irrigation, lateral drainage patterns and other improvements.

- It is expected that basin soils will be graded with heavy, construction grade earth moving equipment which can compact soils during grading. Compacted soils have a reduced inability to infiltrate water. As such, we recommend leaving basin bottom soils in a native, undisturbed or scarified condition to maintain infiltration rates.

Section 6
LIMITATIONS AND ADDITIONAL SERVICES

6.1 Uniformity of Conditions and Limitations

Our findings and recommendations in this report are based on selected points of field exploration, laboratory testing, and our understanding of the proposed project. Furthermore, our findings and recommendations are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil or groundwater conditions could exist between and beyond the exploration points. The nature and extent of these variations may not become evident until construction. Variations in soil or groundwater may require additional studies, consultation, and possible revisions to our recommendations.

The planning and construction process is an integral design component with respect to the geotechnical aspects of this project. Because geotechnical engineering is an inexact science due to the variability of natural processes and because we sample only a small portion of the soil and material affecting the performance of the proposed structure, unanticipated or changed conditions can be disclosed during demolition and construction. Proper geotechnical observation and testing during construction is imperative to allow the geotechnical engineer the opportunity to verify assumptions made during the design process and to verify that our geotechnical recommendations have been properly interpreted and implemented during construction. Therefore, we recommend that Earth Systems be retained during the construction of the proposed improvements to observe compliance with the design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this commission. If we are not accorded the privilege of performing this review, we can assume no responsibility for misinterpretation of our recommendations. The above services can be provided in accordance with our current Fee Schedule.

Our evaluation of subsurface conditions at the site has considered subgrade soil and groundwater conditions present at the time of our study. The influence(s) of post-construction changes to these conditions such as introduction or removal of water into or from the subsurface will likely influence future performance of the proposed project. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions due to the limitation of data from field studies. The availability and broadening of knowledge and professional standards applicable to engineering services are continually evolving. As such, our services are intended to provide the Client with a source of professional advice, opinions and recommendations based on the information available as applicable to the project location, time of our services, and scope. If the scope of the proposed construction changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing by Earth Systems.

Findings of this report are valid as of the issued date of the report. However, changes in conditions of a property can occur with passage of time, whether they are from natural processes or works of man, on this or adjoining properties. In addition, changes in applicable standards occur, whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of one year.

This report is issued with the understanding that the owner or the owner's representative has the responsibility to bring the information and recommendations contained herein to the attention of the architect and engineers for the project so that they are incorporated into the plans and specifications for the project. The owner or the owner's representative also has the responsibility to verify that the general contractor and all subcontractors follow such recommendations. It is further understood that the owner or the owner's representative is responsible for submittal of this report to the appropriate governing agencies.

As the Geotechnical Engineer of Record for this project, Earth Systems has striven to provide our services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee, express or implied, is made. This report was prepared for the exclusive use of the Client and the Client's authorized agents.

Earth Systems should be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If Earth Systems is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation of our recommendations. The owner or the owner's representative has the responsibility to provide the final plans requiring review to Earth Systems' attention so that we may perform our review.

Any party other than the client who wishes to use this report shall notify Earth Systems of such intended use. Based on the intended use of the report, Earth Systems may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Earth Systems from any liability resulting from the use of this report by any unauthorized party.

Although available through Earth Systems, the current scope of our services does not include an environmental assessment or an investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

6.2 Additional Services

This report is based on the assumption that a program of client consultation, construction monitoring, and testing will be performed during the final design and construction phases to check compliance with these recommendations. Maintaining Earth Systems as the geotechnical consultant from beginning to end of the project will provide continuity of services. *The geotechnical engineering firm providing tests and observations shall assume the responsibility of Geotechnical Engineer of Record.*

Construction monitoring and testing would be additional services provided by our firm. The costs of these services are not included in our present fee arrangements, but can be obtained from our office. The recommended review, tests, and observations include, but are not necessarily limited to the following:

- Consultation during the final design stages of the project.
- A review of the building and grading plans to observe that recommendations of our report have been properly implemented into the design.
- Observation and testing during site preparation, grading, and placement of engineered fill.
- Special Inspection for concrete, masonry, steel during construction.
- Consultation as needed during construction.

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Aerial Photographs:

Google Earth

1994-2011

APPENDIX A

Plate 1 – Site Location
Plate 2– Boring and Test Location Map
Plates 3 through 6 – Willow and West Wells Street Photos
Terms and Symbols Used on Boring Logs
Soil Classification System
Boring and Trench Logs
Site Class (2)
Seismic Settlement Calculation (2)
Table 1 – Fault Parameters
Table 2 – Historic Earthquakes

Reference: USGS Blythe, CA-AZ Quadrangle, 2012

LEGEND

Approximate Scale: 1" = 3,450’

0 3,450’ 6,900’

Plate 1
Site Location

Proposed Willow Street LCNG Refueling Station
NEC 14th Avenue & Willow Street
Blythe, Riverside County, California

Earth Systems Southwest

06/21/2012 | File No.: 12068-01

Reference: GoogleEarth Satellite Image, 11/29/2004.

LEGEND

- **B-10** Approximate Boring Locations
- **P-2** Approximate Percolation Test Location
- **T-1** Approximate Trench Location

Approximate Scale: 1" = 170'

0 170' 240'

N

Plate 2
Boring and Test Locations

Proposed Willow Street LCNG Refueling Station
NEC 14th Avenue & Willow Street
Blythe, Riverside County, California

Earth Systems Southwest

06/21/2012 | File No.: 12068-01

West Wells Street looking west

Plate 3
West Wells Street Photo

Proposed Willow Street LCNG Refueling Station
NEC 14th Avenue & Willow Street
Blythe, Riverside County, California

Earth Systems Southwest

06/21/2012	File No.: 12068-01

West Wells Street looking east

Plate 4
West Wells Street Photo

Proposed Willow Street LCNG Refueling Station
NEC 14th Avenue & Willow Street
Blythe, Riverside County, California

Earth Systems Southwest

06/21/2012	File No.: 12068-01

West Wells Street looking east

Plate 5
West Wells Street Photo

Proposed Willow Street LCNG Refueling Station
NEC 14th Avenue & Willow Street
Blythe, Riverside County, California

Earth Systems Southwest

06/21/2012	File No.: 12068-01

Willow Street looking north

Plate 6
Willow Street Photo

Proposed Willow Street LCNG Refueling Station
NEC 14th Avenue & Willow Street
Blythe, Riverside County, California

Earth Systems Southwest

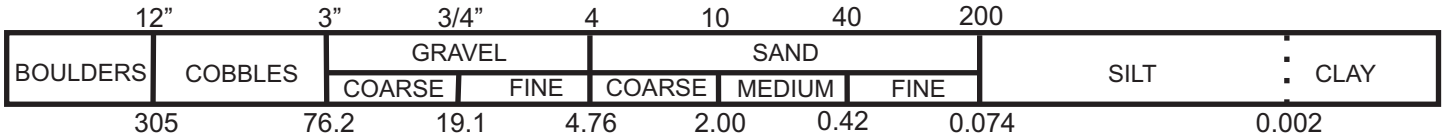
06/21/2012 | File No.: 12068-01

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on ASTM Designations D 2487 and D 2488 (Unified Soil Classification System). Information on each boring log is a compilation of subsurface conditions obtained from the field as well as from laboratory testing of selected samples. The indicated boundaries between strata on the boring logs are approximate only and may be transitional.

SOIL GRAIN SIZE

U.S. STANDARD SIEVE



SOIL GRAIN SIZE IN MILLIMETERS

RELATIVE DENSITY OF GRANULAR SOILS (GRAVELS, SANDS, AND NON-PLASTIC SILTS)

Very Loose	*N=0-4	RD=0-30	Easily push a 1/2-inch reinforcing rod by hand
Loose	N=5-10	RD=30-50	Push a 1/2-inch reinforcing rod by hand
Medium Dense	N=11-30	RD=50-70	Easily drive a 1/2-inch reinforcing rod with hammer
Dense	N=31-50	RD=70-90	Drive a 1/2-inch reinforcing rod 1 foot with difficulty by a hammer
Very Dense	N>50	RD=90-100	Drive a 1/2-inch reinforcing rod a few inches with hammer

*N=Blows per foot in the Standard Penetration Test at 60% theoretical energy. For the 3-inch diameter Modified California sampler, 140-pound weight, multiply the blow count by 0.63 (about 2/3) to estimate N. If automatic hammer is used, multiply a factor of 1.3 to 1.5 to estimate N. RD=Relative Density (%). C=Undrained shear strength (cohesion).

CONSISTENCY OF COHESIVE SOILS (CLAY OR CLAYEY SOILS)

Very Soft	*N=0-1	*C=0-250 psf	Squeezes between fingers
Soft	N=2-4	C=250-500 psf	Easily molded by finger pressure
Medium Stiff	N=5-8	C=500-1000 psf	Molded by strong finger pressure
Stiff	N=9-15	C=1000-2000 psf	Dented by strong finger pressure
Very Stiff	N=16-30	C=2000-4000 psf	Dented slightly by finger pressure
Hard	N>30	C>4000	Dented slightly by a pencil point or thumbnail

MOISTURE DENSITY

Moisture Condition: An observational term; dry, damp, moist, wet, saturated.
Moisture Content: The weight of water in a sample divided by the weight of dry soil in the soil sample expressed as a percentage.
Dry Density: The pounds of dry soil in a cubic foot.

MOISTURE CONDITION

Dry.....Absence of moisture, dusty, dry to the touch
Damp.....Slight indication of moisture
Moist.....Color change with short period of air exposure (granular soil)
Below optimum moisture content (cohesive soil)
Wet.....High degree of saturation by visual and touch (granular soil)
Above optimum moisture content (cohesive soil)
Saturated.....Free surface water

PLASTICITY

DESCRIPTION	FIELD TEST
Nonplastic	A 1/8 in. (3-mm) thread cannot be rolled at any moisture content.
Low	The thread can barely be rolled.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit.
High	The thread can be rerolled several times after reaching the plastic limit.

GROUNDWATER LEVEL

Water Level (measured or after drilling)

Water Level (during drilling)

RELATIVE PROPORTIONS

Trace.....minor amount (<5%)
with/some.....significant amount
modifier/and...sufficient amount to influence material behavior (Typically >30%)

LOG KEY SYMBOLS

Bulk, Bag or Grab Sample

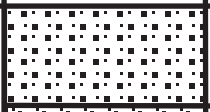
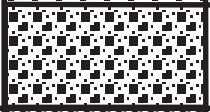
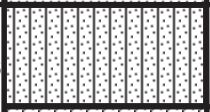
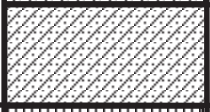
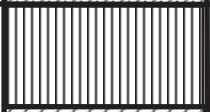
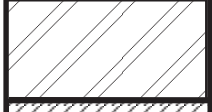
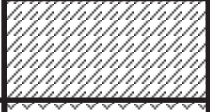
Standard Penetration Split Spoon Sampler (2” outside diameter)

Modified California Sampler (3” outside diameter)

No Recovery

Terms and Symbols used on Logs

Earth Systems Southwest

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	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 < 5% 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 > 12% 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 No. 4 sieve	CLEAN SAND (Little or no fines) < 5%		SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
		SAND WITH FINES (appreciable amount of fines) > 12%		SM	Silty sands, sand-silt mixtures
				SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS 50% or more 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 low 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
		LIQUID LIMIT GREATER THAN 50		MH	Inorganic silty, micaceous, or diatomaceous fine sand or silty soils
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS				PT	Peat, humus, swamp soils with high organic contents
VARIOUS SOILS AND MAN MADE MATERIALS					Fill Materials
MAN MADE MATERIALS					Asphalt and concrete

Soil Classification System

Earth Systems Southwest

Earth Systems
Southwest
79-811B Country Club Drive, Bermuda Dunes, CA 92203
Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-1

Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

Drilling Date: May 16, 2012
Drilling Method: 8" HSA
Drill Type: B61 w/autohammer
Logged By: Rich Howe

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS/Bedrock	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				AC			ASPHALT CONCRETE (AC): 4 1/2 inches
		4,4,4		BASE			AGGREGATE BASE (BASE): 5 inches
				CL			SILTY CLAY: brown, firm, moist, low to medium plasticity
		7,9,14		SM	100	14	SILTY SAND: reddish brown, medium dense, moist, fine grained sand
5		4,7,11			95	19	
10							
15							
20							
25							
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Total Depth 6 1/2 feet
No Refusal
No groundwater encountered
Backfilled with native, AC patched with commercial grade concrete mix with black dye

Earth Systems
Southwest
79-811B Country Club Drive, Bermuda Dunes, CA 92203
Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-2

Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

Drilling Date: May 16, 2012
Drilling Method: 8" HSA
Drill Type: B61 w/autohammer
Logged By: Rich Howe

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS/Bedrock	Dry Density (pcf)	Moisture Content (%)	Description
0				AC			ASPHALT CONCRETE (AC): 4 1/2 inches
		5,10,11		BASE	110	19	AGGREGATE BASE (BASE): 4 1/2 inches
				CL			SILTY CLAY: dark brown, stiff, moist, medium plasticity
		5,6,7		SM	93	8	SILTY SAND: yellow brown, loose, moist, fine grained sand
5		5,5,9		ML	96	24	SANDY SILT: brown, stiff, moist, slightly cohesive, non plastic, fine grained sand
10							
15							
20							
25							
30							

Total Depth 6 1/2 feet
No Refusal
No groundwater encountered
Backfilled with native, AC patched with commercial grade concrete mix with black dye

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Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-3

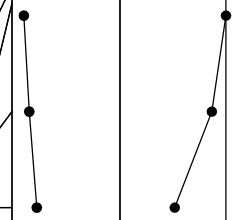
Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

Drilling Date: May 16, 2012
Drilling Method: 8" HSA
Drill Type: B61 w/autohammer
Logged By: Rich Howe

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS/Bedrock	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				AC			ASPHALT CONCRETE (AC): 4 1/2 inches
		5,5,6		BASE	122	17	AGGREGATE BASE (BASE): 4 1/2 inches
				ML			SANDY SILT: red brown, firm, moist, fine grained sand, low plasticity
		5,7,9		CL	109	12	SILTY CLAY: brown, stiff, moist, with fine grained sand
5		6,9,14		SP-SM	93	9	POORLY GRADED SAND WITH SILT: reddish brown, medium dense, moist, fine grained sand
10							
15							
20							
25							
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Total Depth 6 1/2 feet
No Refusal
No groundwater encountered
Backfilled with native, AC patched with commercial grade concrete mix with black dye

Earth Systems
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Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-4

Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

Drilling Date: May 16, 2012
Drilling Method: 8" HSA
Drill Type: B61 w/autohammer
Logged By: Rich Howe

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS/Bedrock	Dry Density (pcf)	Moisture Content (%)	Description
0				AC			ASPHALT CONCRETE (AC): 4 1/2 inches
				BASE		5	AGGREGATE BASE (BASE): 20 inches
				SM			SILTY SAND: brown, moist, fine grained sand, with aggregate base rock to 1/2"
		3,3,3		CL	95	26	SILTY CLAY: dark brown, soft, moist, medium plasticity
5		5,6,10		CL	90	30	CLAY: brown, stiff, moist, medium plasticity
10							
15							
20							
25							
30							

Graphic Trend
Blow Count Dry Density

Total Depth 6 1/2 feet
No Refusal
No groundwater encountered
Backfilled with native, AC patched with commercial grade concrete mix with black dye
Concern of utility line. Hand auger to 3 feet.

Earth Systems
Southwest
79-811B Country Club Drive, Bermuda Dunes, CA 92203
Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-5

Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

Drilling Date: May 16, 2012
Drilling Method: 8" HSA
Drill Type: B61 w/autohammer
Logged By: Rich Howe

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS/Bedrock	Dry Density (pcf)	Moisture Content (%)	Description
0				AC			ASPHALT CONCRETE (AC): 4 1/2 inches
		4,7,6		BASE	103	23	AGGREGATE BASE (BASE): 5 inches
				CL			SILTY CLAY: dark brown, firm, moist, low to medium plasticity
		7,10,13		ML/SM	97	5	SANDY SILT to SILTY SAND: brown, stiff (medium dense), slightly moist, fine grained sand
				SM			
5		6,7,9			102	11	SILTY SAND: reddish brown, loose, moist, fine grained sand
10							
15							
20							
25							
30							

Total Depth 6 1/2 feet
No Refusal
No groundwater encountered
Backfilled with native, AC patched with commercial grade concrete mix with black dye

Graphic Trend
Blow Count Dry Density

Earth Systems
Southwest
79-811B Country Club Drive, Bermuda Dunes, CA 92203
Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-6

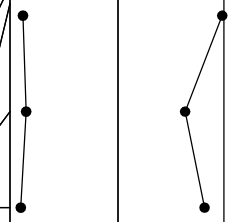
Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

Drilling Date: May 16, 2012
Drilling Method: 8" HSA
Drill Type: B61 w/autohammer
Logged By: Rich Howe

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS/Bedrock	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				AC			ASPHALT CONCRETE (AC): 4 1/2 inches
		5,5,7		BASE	107	21	AGGREGATE BASE (BASE): 4 1/2 inches
				CL			SILTY CLAY: brown, firm, moist, brown, low to medium plasticity
		6,7,8		SM/ML	98	10	SILTY SAND to SANDY SILT: brown to yellow brown, loose, moist, slightly cohesive, non plastic
5		4,5,5		CL	93	28	SILTY CLAY WITH SAND: brown, firm, moist, medium plasticity, fine grained sand
10							
15							
20							
25							
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Total Depth 6 1/2 feet
No Refusal
No groundwater encountered
Backfilled with native, AC patched with commercial grade concrete mix with black dye

Earth Systems
Southwest
79-811B Country Club Drive, Bermuda Dunes, CA 92203
Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-7

Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

Drilling Date: May 16, 2012
Drilling Method: 8" HSA
Drill Type: B61 w/autohammer
Logged By: Rich Howe

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS/Bedrock	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: reddish brown, loose, moist, fine grained sand, slightly clayey
		6,6,8			97	7	
5		4,5,8		SM/ML	101	22	SILTY SAND to SANDY SILT: brown, loose (firm), moist, fine grained sand, slightly cohesive, slightly plastic, clayey
		5,7,9			99	24	
10		4,6,8			98	25	
				SP-SM			POORLY GRADED SAND WITH SILT: reddish brown, loose, saturated, fine grained sand
15		4,4,4					NO RECOVERY (log by cutting), loose
20		2,2,2					NO RECOVERY (log by cutting), loose
25		3,4,6		SP-SM			POORLY GRADED SAND WITH SILT: reddish brown, medium dense, saturated, fine grained sand
30		13,19,21					very dense

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Earth Systems
Southwest
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Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-7
Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

Drilling Date: May 16, 2012
Drilling Method: 8" HSA
Drill Type: B61 w/autohammer
Logged By: Rich Howe

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS/Bedrock	Dry Density (pcf)	Moisture Content (%)	Description of Units
35	SPT	7,12,36					minor dark gray/black stringers, faint hydrocarbon odor
40	SPT	6,6,6					medium dense
45	SPT	5,6,7					1/2 inch diameter clay nodule in center of sampler, moderate hydrocarbon odor
				SP			POORLY GRADED SAND: brown, medium dense, saturated, fine grained sand
50	SPT	4,6,7					
55							Total Depth 51 1/2 feet No Refusal Groundwater at 8 feet Backfilled with cuttings
60							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Earth Systems
Southwest
79-811B Country Club Drive, Bermuda Dunes, CA92203
Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-8

Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

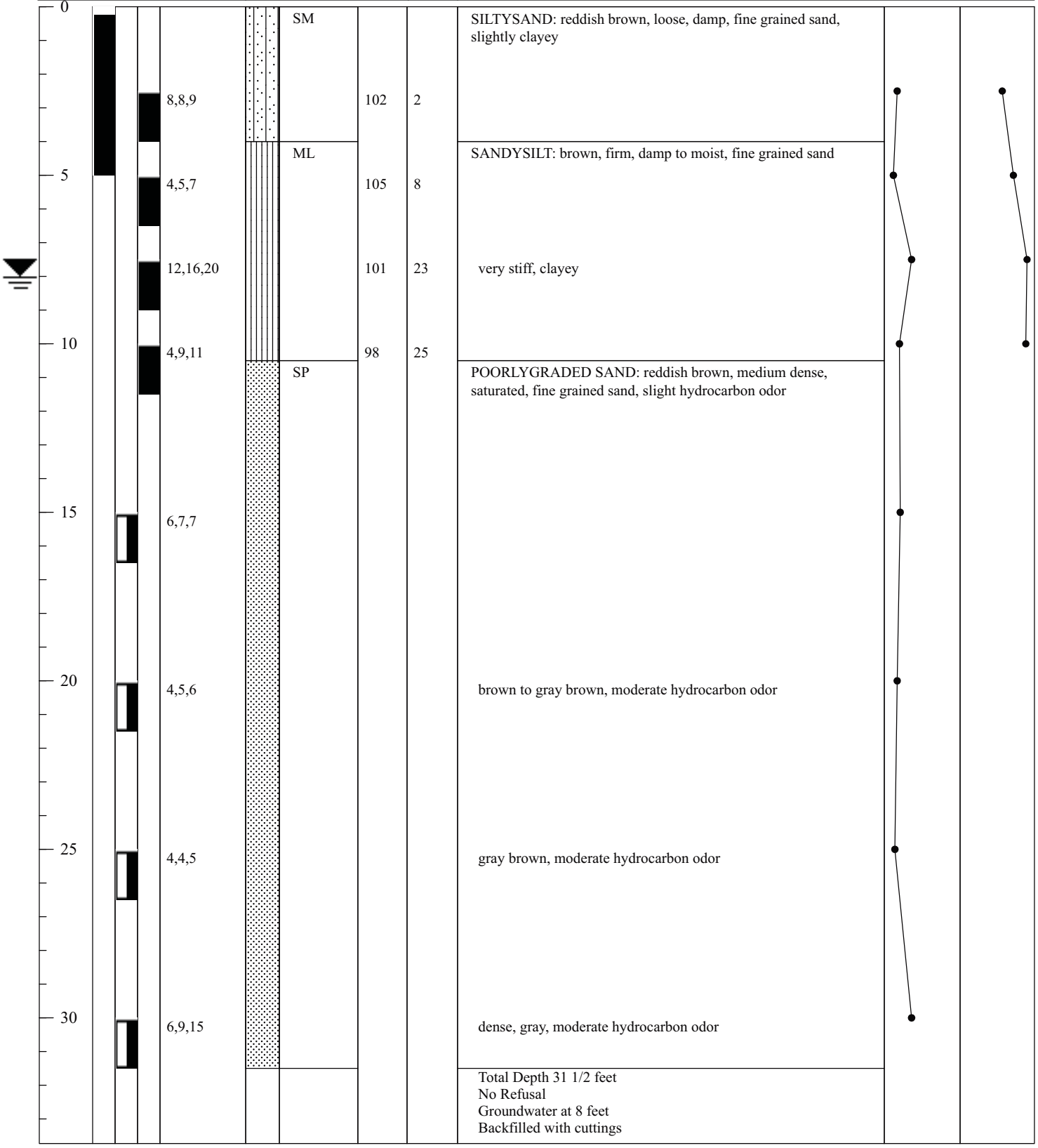
Drilling Date: May 16, 2012
Drilling Method: 8" HSA
DrillType: B61 w/autohammer
Logged By: Rich Howe

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

GraphicTrend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / SPT / MODCalif.)	Penetration Resistance (Blows/6")	USCS/Bedrock	DryDensity (pcf)	Moisture Content (%)	Description
0			SM			SILTYSAND: reddish brown, loose, damp, fine grained sand, slightly clayey
	MODCalif.	8,8,9		102	2	
			ML			SANDYSILT: brown, firm, damp to moist, fine grained sand
5	MODCalif.	4,5,7		105	8	
	MODCalif.	12,16,20		101	23	very stiff, clayey
10	MODCalif.	4,9,11		98	25	
			SP			POORLYGRADED SAND: reddish brown, medium dense, saturated, fine grained sand, slight hydrocarbon odor
15	MODCalif.	6,7,7				
20	MODCalif.	4,5,6				brown to gray brown, moderate hydrocarbon odor
25	MODCalif.	4,4,5				gray brown, moderate hydrocarbon odor
30	MODCalif.	6,9,15				dense, gray, moderate hydrocarbon odor
						Total Depth 31 1/2 feet No Refusal Groundwater at 8 feet Backfilled with cuttings



Earth Systems
Southwest
79-811B Country Club Drive, Bermuda Dunes, CA 92203
Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-9

Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

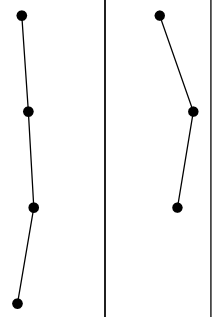
Drilling Date: May 16, 2012
Drilling Method: 8" HSA
Drill Type: B61 w/autohammer
Logged By: Rich Howe

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS/Bedrock	Dry Density (pcf)	Moisture Content (%)	Description
0				SM			SILTY SAND: reddish brown, medium dense, slightly moist, fine grained sand, slightly clayey
	MOD Calif.	7,9,14			97	4	
	MOD Calif.	7,12,17		SM/ML	108	11	SILTY SAND to SANDY SILT: yellow brown, medium dense/stiff, moist, fine grained sand, clayey
5	MOD Calif.	10,16,18		SM	98	13	SILTY SAND: reddish brown, medium dense, moist, fine grained sand
	MOD Calif.	8,9,10					NO RECOVERY
10							
15							
20							
25							Total Depth 8 feet No Refusal Groundwater at 8 feet Backfilled with cuttings
30							

Graphic Trend
Blow Count Dry Density



Earth Systems
Southwest
79-811B Country Club Drive, Bermuda Dunes, CA 92203
Phone (760) 345-1588 Fax (760) 345-7315

Boring No. B-10

Project Name: Willow Street LCNG Refueling Station
Project Number: 12068-01
Boring Location: See Plate 2

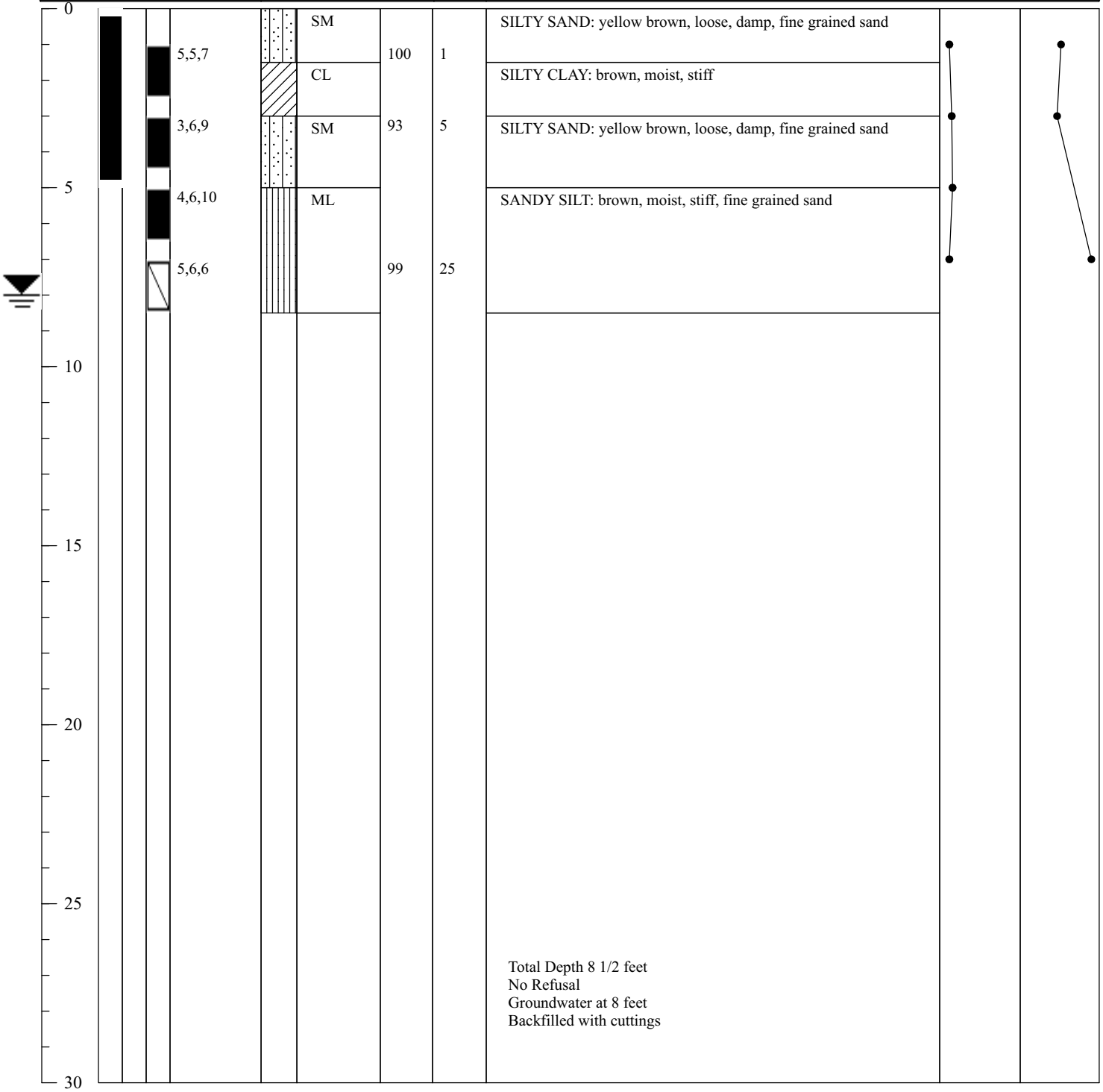
Drilling Date: May 16, 2012
Drilling Method: 8" HSA
Drill Type: B61 w/autohammer
Logged By: Rich Howe

Description of Units

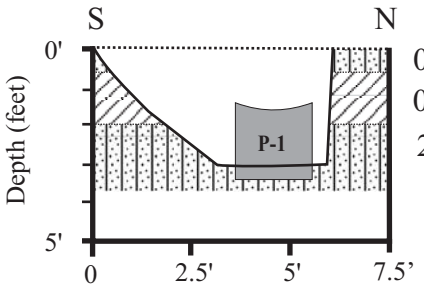
Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS/Bedrock	Dry Density (pcf)	Moisture Content (%)	Description
0				SM			SILTY SAND: yellow brown, loose, damp, fine grained sand
		5,5,7			100	1	
				CL			SILTY CLAY: brown, moist, stiff
		3,6,9		SM	93	5	SILTY SAND: yellow brown, loose, damp, fine grained sand
5		4,6,10		ML			SANDY SILT: brown, moist, stiff, fine grained sand
		5,6,6			99	25	
10							
15							
20							
25							Total Depth 8 1/2 feet No Refusal Groundwater at 8 feet Backfilled with cuttings
30							

Graphic Trend
Blow Count Dry Density



P-1



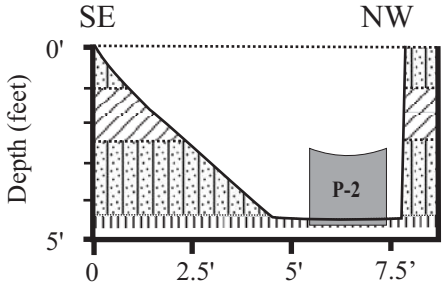
0-0.5’ SM: SILTY SAND, reddish brown, slightly moist, fine grained sand
0.5-2’ CL: SILTY CLAY, brown, moist, low to moderate plasticity
2-3’ SM: SILTY SAND, light reddish brown, slightly moist, fine grained sand

Double Ring Infiltration Test P-1 at 3’

Total Trench Depth 3 Feet

No groundwater encountered

P-2



0-1’ SM: SILTY SAND, reddish brown, slightly moist, fine grained sand
1-2.5’ CL: SILTY CLAY, brown, moist, low to moderate plasticity
2.5-4.5’ SM: SILTY SAND, light reddish brown, slightly moist, fine grained sand
4.5’ ML: SANDY SILT, brown, slightly moist, fine grained sand

Double Ring Infiltration Test P-2 at 4.5’

Total Trench Depth 4.5 Feet

No groundwater encountered

Horizontal and Vertical
Scale: 1" = 5’

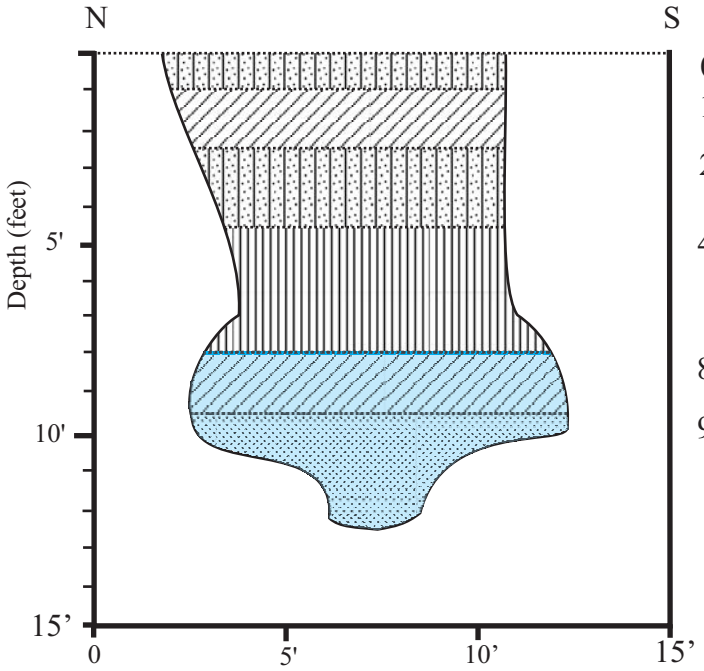
Reference: Field Sketch, ESSW (2012)

Double Ring Infiltration Test Trench Logs

Willow Street CLNG Refueling Station
Blythe, Riverside County, California

Earth Systems Southwest

06-15-2012 | File No.: 12068-01



T-1

0-1'	SM: SILTY SAND, reddish brown, slightly moist, fine grained sand
1-2.5'	CL: SILTY CLAY, brown, moist, low to moderate plasticity
2.5-4.5	SM: SILTY SAND, reddish brown, slightly moist, fine grained sand
4.5-8'	ML: SILT TO SANDY SILT, reddish brown to brown, fine grained sand, some 1-2" interbedded silty sand (SM) layers
8-9.5'	CL: SILTY CLAY, brown, wet, moderate plasticity
	Groundwater at 8'
9.5-12'	SP: SAND, reddish brown, wet, fine grained sand

Caving below 9.5'

Total Trench Depth 12 feet

Horizontal and Vertical
Scale: 1" = 5'

0 5' 10'

Reference: Field Sketch, ESSW (2012)

Double Ring Infiltration Test Exploratory Trench Log

Willow Street CLNG Refueling Station
Blythe, Riverside County, California

Earth Systems Southwest

05-xx-2012 | File No.: 12068-01

Boring No.	B-7	Project and Number	LCNG Blythe	12068-01
		ESSW Field Staff	R. Howe	
		Drilling Company	Whitcomb & WDC Drilling	
		Drilling Method	8" HSA	

Site Latitude (North)	Degrees	Minutes	Seconds	Decimal (deg.)
				0.0000

Site Longitude (West)	Degrees	Minutes	Seconds	Decimal (deg.)
				0.0000

Date Drilled
5/16/2012

Ave. SPT N-value (blows/ft)
11

Hammer Weight (lbs)
140

Ave. Shear Wave Velocity (ft/sec)**	
697	(Upper 50 feet)

Hammer Drop (inches)
30

Ave. Friction Angle (degrees)
31

Energy Ratio (%)
70

Soil Profile Type (Site Class)
D

Borehole Correction (Cb)*
1

*inside diameter of Hollow Stem Auger

Estimated Shear Wave Velocity ** Based on Depth Less than 100' (ft/sec)	
713	(Upper 100 feet)

Sampler Liner Correction (Cs)
1.2 Applied if SPT Sampler Used
1.0 Applied if Cal Sampler Used

Soil Profile Type (Site Class)**
D

Rod Length Above Ground (ft)
5

Depth to Estimate Vs Over (ft)*
100

*Caltrans Estimation Method

BOREHOLE, SAMPLER, AND ROD CORRECTION FACTORS

Factor	Equipment Variable	Value
Borehole diameter factor, C_B	2.5 - 6.5 in (65 - 115 mm)	1.00
	8 in (200 mm)	1.05
	9 in (230 mm)	1.15
Sampling method factor, C_S	Standard sampler	1.00
	Sampler without liner	1.20
Rod length factor, C_R	10 - 13 ft (3 - 4 m)	0.75
	13 - 20 ft (4 - 6 m)	0.85
	20 - 30 ft (6 - 10 m)	0.95
	> 30 ft (> 10 m)	1.00

Adapted from Skempton (1986).

	Equipment variable	Correction (%/100)
Energy ratio (Skempton, 1986)	Donut Hammer	0.50 to 1.00
	Safety Hammer	0.70 to 1.20
	Automatic-Trip Donut-type Hammer	0.80 to 1.30

Depth (ft)	Blow Count	Type of Sampler	d_i (feet)	N_{60} (blows/ft)	N_{60HE} (blows/ft)	V_{si}** (m/sec)	V_{si} (ft/sec)	Φ_i (degrees)	d_i/N_{60i}	d_i/V_{si}	d_i/Φ_i	Consistency if Coarse Grained	Consistency if Fine Grained
2.5	14	c	2.5	8.21	10.94	201.15	659.77	29.60	0.22845	0.00379	0.084456	Loose	Stiff
5.0	13	c	2.5	7.62	10.16	196.87	645.74	29.30	0.24602	0.00387	0.08531	Loose	Firm
7.5	16	c	2.5	9.38	12.51	209.09	685.82	30.15	0.19989	0.00365	0.082916	Loose	Stiff
10.0	14	c	2.5	9.30	10.94	201.15	659.77	29.60	0.22845	0.00379	0.084456	Loose	Stiff
15.0	8	c	5.0	5.32	6.25	171.02	560.93	27.51	0.79957	0.00891	0.181743	Loose	Firm
20.0	4	s	5.0	5.32	4.67	157.10	515.29	26.55	1.07143	0.00970	0.188358	Loose	Firm
25.0	10	s	5.0	13.30	11.67	204.92	672.13	29.86	0.42857	0.00744	0.167436	Medium Dense	Stiff
30.0	40	s	5.0	56.00	46.67	306.32	1004.74	36.85	0.10714	0.00498	0.135693	Very Dense	Hard
35.0	48	s	5.0	67.20	56.00	322.95	1059.29	37.99	0.08929	0.00472	0.13162	Very Dense	Hard
40.0	12	s	5.0	16.80	14.00	216.04	708.63	30.63	0.35714	0.00706	0.163228	Medium Dense	Very Stiff
45.0	13	s	5.0	18.20	15.17	221.12	725.27	30.98	0.32967	0.00689	0.16138	Medium Dense	Very Stiff
50.0	13	s	5.0	18.20	15.17	221.12	725.27	30.98	0.32967	0.00689	0.16138	Medium Dense	Very Stiff
		Total:	50.0				Total:		4.41530	0.07169	1.627977		

**Caltrans Geotechnical Services Design Manual, Version 1.0, August 2009 using N60HE corrected only for Hammer Energy

Consistency classification based upon ASCE 1996

Spreadsheet Version 2.2.1, 2011: Prepared by Kevin L. Paul, PE, GE

Boring No.	B-8

Project and Number	LCNG Blythe		12068-01	
ESSW Field Staff	R. Howe			
Drilling Company	Whitcomb & WDC Drilling			
Drilling Method	8" HSA			
Site Latitude (North)	Degrees	Minutes	Seconds	Decimal (deg.)
				0.0000
Site Longitude (West)	Degrees	Minutes	Seconds	Decimal (deg.)
				0.0000

Date Drilled	5/16/2012
Hammer Weight (lbs)	140
Hammer Drop (inches)	30
Energy Ratio (%)	70
Borehole Correction (Cb)*	1

*inside diameter of Hollow Stem Auger

Sampler Liner Correction (Cs)	
1.2 Applied if SPT Sampler Used	
1.0 Applied if Cal Sampler Used	
Rod Length Above Ground (ft)	5
Depth to Estimate Vs Over (ft)*	100

*Caltrans Estimation Method

Ave. SPT N-value (blows/ft)	14
Ave. Shear Wave Velocity (ft/sec)**	723 (Upper 30 feet)
Ave. Friction Angle (degrees)	31
Soil Profile Type (Site Class)	D
Estimated Shear Wave Velocity ** Based on Depth Less than 100' (ft/sec)	727 (Upper 100 feet)
Soil Profile Type (Site Class)**	D

BOREHOLE, SAMPLER, AND ROD CORRECTION FACTORS

Factor	Equipment Variables	Value
Borehole diameter factor, C_B	2.5 - 4.5 in (65 - 115 mm)	1.00
	6 in (150 mm)	1.05
	8 in (200 mm)	1.15
Sampling method factor, C_S	Standard sampler	1.00
	Sampler without liner	1.20
Rod length factor, C_R	10 - 13 ft (3 - 4 m)	0.75
	13 - 20 ft (4 - 6 m)	0.85
	20 - 30 ft (6 - 10 m)	0.95
	> 30 ft (> 10 m)	1.00

Adapted from Skempton (1986).

	Equipment variable	Correction (%/100)
Energy ratio (Skempton, 1986)	Donut Hammer	0.50 to 1.00
	Safety Hammer	0.70 to 1.20
	Automatic-Trip Donut-type Hammer	0.80 to 1.30

Depth (ft)	Blow Count	Type of Sampler	d_i (feet)	N_{60} (blows/ft)	N_{60HE} (blows/ft)	V_{si}** (m/sec)	V_{si} (ft/sec)	Φ_i (degrees)	d_i/N_{60i}	d_i/V_{si}	d_i/Φ_i	Consistency if Coarse Grained	Consistency if Fine Grained
2.5	17	c	2.5	9.97	13.29	212.80	697.99	30.41	0.18813	0.00358	0.082216	Loose	Stiff
5.0	12	c	2.5	7.04	9.38	192.36	630.93	28.99	0.26652	0.00396	0.086231	Loose	Firm
7.5	36	c	2.5	21.11	28.14	264.53	867.65	33.98	0.08884	0.00288	0.07358	Medium Dense	Very Stiff
10.0	20	c	2.5	13.29	15.63	223.07	731.67	31.12	0.15991	0.00342	0.08034	Medium Dense	Stiff
15.0	14	s	5.0	16.66	16.33	225.92	741.02	31.31	0.30612	0.00675	0.159669	Medium Dense	Very Stiff
20.0	10	s	5.0	13.30	11.67	204.92	672.13	29.86	0.42857	0.00744	0.167436	Medium Dense	Stiff
25.0	9	s	5.0	11.97	10.50	198.75	651.91	29.44	0.47619	0.00767	0.169866	Medium Dense	Stiff
30.0	24	s	5.0	33.60	28.00	264.14	866.39	33.95	0.17857	0.00577	0.147275	Dense	Hard
		Total:	30.0				Total:		2.09287	0.04147	0.966614		

**Caltrans Geotechnical Services Design Manual, Version 1.0, August 2009 using N60HE corrected only for Hammer Energy

Consistency classification based upon ASCE 1996

Spreadsheet Version 2.2.1, 2011: Prepared by Kevin L. Paul, PE, GE

LIQUEFY-v 2.3.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Project: LCNG Blythe
Job No: 12068-01
Date: 6/15/2012
Boring: B-7 Data Set: 1

Methods: **Liquefaction Analysis using 1996 & 1998 NCEER workshop method (Youd & Idriss, editors)**
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:

Magnitude: 8.2 7.5
PGA, g: 0.13 0.16
MSF: 0.80
GWT: 8.0 feet
Calc GWT: 8.0 feet
Remediate to: 7.0 feet

SPT N VALUE CORRECTIONS:

Energy Correction to N60 (C_E): 1.16
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 5.0
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 1 Yes
Cal Mod/ SPT Ratio: 0.63

Total (ft) Liquefied Thickness
27.5

Total (in.) Induced Subsidence
4.8

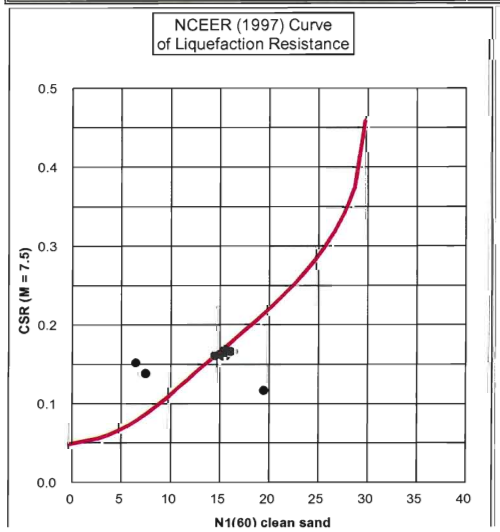
upper 50 ft

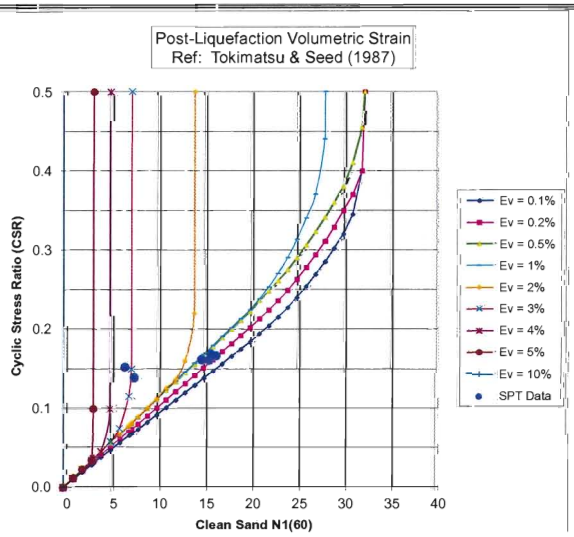
Threshold Acceler., g: 0.06
Required SF: 1.25
Minimum Calculated SF: 0.49

SETTLEMENT (SUBSIDENCE) OF DRY SANDS

Nc = 22.5

Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT po (tsf)	Eff.Stress at SPT p'o (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	*Trigger FC Adj.* $\Delta N_{1(60)}$	*Equiv. Sand* $N_{1(60)CS}$	Kσ	M = 7.5 Available CRR	M =7.5 Induced CSR*	**Liquefac. Safety Factor**	*Post FC Adj.* $\Delta N_{1(60)}$	$N_{1(60)CS}$	Volumetric *Strain (%)*	**Induced Subsidence (in.)**	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	**Dry Sand Subsidence (in.)**
								0.000																								
5.0	14	**50**	1	105	15	2.5	7.5	0.131	0.131	1.00	1.70	0.75	1.00	74.0	100	6.1	80.0	1.00	1.200	0.106	**Non-Liq.**	6.1	80.0	0.00	**0.00**	0.088	571	0.011	2.1E-05	4.0E-06	4.7E-06	**0.00**
8.0	13	**8**	1	120	50	5.0	10.0	0.263	0.263	0.99	1.70	0.75	1.00	12.1	42	7.4	19.5	1.00	0.211	0.105	**Non-Liq.**	7.4	19.5	0.01	**0.00**	0.176	505	0.022	5.0E-05	5.1E-05	6.1E-05	**0.00**
8.0	13	**8**	1	120	50	5.0	10.0	0.263	0.263	0.99	1.70	0.75	1.00	12.1	42	7.4	19.5	1.00	0.211	0.105	**Non-Liq.**	7.4	19.5	0.01	**0.00**	0.176	505	0.022	5.0E-05	5.1E-05	6.1E-05	**0.00**
11.0	16	**10**	1	120	50	7.5	12.5	0.413	0.413	0.98	1.60	0.75	1.00	14.0	45	7.8	21.9	1.00	0.238	0.105	**Non-Liq.**	7.8	21.9	0.00	**0.00**	0.276	657	0.034	5.9E-05			
12.5	14	**9**	1	120	50	10.0	15.0	0.563	0.500	0.98	1.45	0.81	1.00	12.0	41	7.4	19.4	1.00	0.210	0.117	**1.79**	7.4	19.4	0.00	**0.00**	0.377	737	0.047	7.1E-05			
17.5	8	**5**	1	110	9	15.0	20.0	0.850	0.632	0.97	1.29	0.89	1.00	6.8	31	0.7	7.4	1.00	0.084	0.138	**0.60**	0.8	7.6	2.92	**1.75**	0.570	659	0.070	1.3E-04			
25.0		**4**	1	110	9	20.0	25.0	1.125	0.751	0.96	1.19	0.96	1.10	5.8	29	0.7	6.4	1.00	0.075	0.152	**0.49**	0.8	6.6	3.31	**2.98**	0.754	722	0.091	1.5E-04			
27.5		**10**	1	110	9	25.0	30.0	1.400	0.870	0.94	1.10	1.00	1.15	14.8	46	0.8	15.6	1.00	0.168	0.161	**1.04**	0.8	15.6	0.28	**0.08**	0.938	1,081	0.111	1.2E-04			
32.5		**40**	1	110	9	30.0	35.0	1.675	0.989	0.92	1.03	1.00	1.30	62.4	94	1.6	64.0	1.00	1.200	0.166	**7.24**	1.6	64.0	0.00	**0.00**	1.122	1,894	0.130	7.4E-05			
37.5		**48**	1	110	9	35.0	40.0	1.950	1.108	0.89	0.98	1.00	1.30	70.7	100	1.8	72.5	0.98	1.200	0.170	**7.07**	1.8	72.5	0.00	**0.00**	1.307	2,131	0.147	7.4E-05			
42.5		**12**	1	110	9	40.0	45.0	2.225	1.227	0.85	0.93	1.00	1.16	14.9	46	0.8	15.7	0.97	0.170	0.169	**1.01**	0.8	15.7	0.66	**0.39**	1.491	1,368	0.160	1.3E-04			
47.5		**13**	1	110	9	45.0	50.0	2.500	1.346	0.80	0.89	1.00	1.16	15.5	47	0.8	16.3	0.95	0.176	0.166	**1.06**	0.8	16.3	0.23	**0.14**	1.675	1,468	0.170	1.3E-04			
50.0		**13**	1	110	2	50.0	55.0	2.775	1.465	0.75	0.85	1.00	1.15	14.8	46	0.0	14.8	0.94	0.160	0.162	**0.99**	0.0	14.8	0.75	**0.22**	1.859	1,496	0.177	1.3E-04			





$N_{1(60)} = C_N * C_E * C_B * C_R * C_S * N$

C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z(ft))$^{0.5}$))

$C_N = (1\ atm/p'o)^{0.5}$, max 1.7

C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners

$MSF = 10^{2.24}/M^{2.56}$

z = Depth (m)

pa = 1 atm = 101 KPa = 1.058 tsf

p = 0.67*po

τ_{av} = 0.65*PGA*po*rd

$G_{max} = 447 * N_{1(60)CS}^{(1/3)} * p^{0.5}$

a = 0.0389*(p/1)+0.124

b = 6400*(p/1)$^{(-0.5)}$

$\gamma = [1+a*EXP(b*\tau_{av}/G_{max})]/[(1+a)*\tau_{av}/G_{max}]$

$E_{15} = \gamma * (N_{1(60)CS}/20)^{-1.2}$

$E_{nc} = (Nc/15)^{0.45} * E15$

$Nc = (MAG-4)^{2.17}$

$S = 2 * H * E_{nc}$

rd = (1-0.4113*z^0.5+0.04052*z+0.001753*z^1.5)/(1-0.4177*z^0.5+0.05729*z-0.006205*z^1.5+0.00121*z^2))

$\Delta N_{1(60)}$ = min(10,IF(FC<35,exp(1.76-(190/FC^2)),5)+IF(FC<=5,1,IF(FC<35,0.99+(FC^1.5/1000),1.2))*N1(60) - N1(60)

$N_{1(60)CS} = N_{1(60)CS} + \Delta N_{1(60)}$

Kσ = min of 1.0 or (p'o/1.058)$^{(IF(Dr>0.7,0.6,IF(Dr<0.5,0.8,0.7))-1)}$

Dr = $(N_{1(60)}/70)^{0.5}$

CSReq = 0.65*PGA*(po/p'o)*rd

CSR* = CSReq/MSF/Kσ

$CRR_{7.5}$ = (0.048-0.004721*N+0.0006136*N^2-0.00001673*N^3)/(1-0.1248*N+0.009578*N^2-0.0003285*N^3+0.000003714*N^4))

N = $N_{1(60)CS}$

SF = $CRR_{7.5,1atm}$/CSR*

LIQUEFY-v 2.3.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Project: LCNG Blythe
Job No: 12068-01
Date: 6/15/2012
Boring: B-8 Data Set: 2

Methods: **Liquefaction Analysis using 1996 & 1998 NCEER workshop method (Youd & Idriss, editors)**
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:

Magnitude: 8.2 7.5
PGA, g: 0.13 0.16
MSF: 0.80
GWT: 8.0 feet
Calc GWT: 8.0 feet
Remediate to: 7.0 feet

SPT N VALUE CORRECTIONS:

Energy Correction to N60 (C_E): 1.16
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 5.0
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 1 Yes
Cal Mod/ SPT Ratio: 0.63

Total (ft) Liquefied Thickness
22.5

Total (in.) Induced Subsidence
1.7

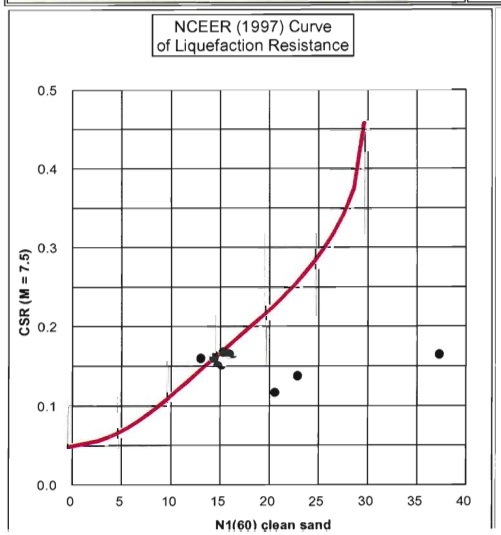
upper 50 ft

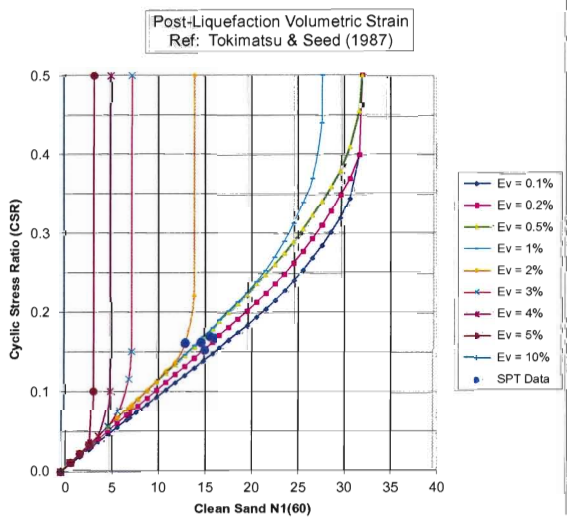
Threshold Acceler., g: 0.11 **Required SF:** 1.25
Minimum Calculated SF: 0.88

SETTLEMENT (SUBSIDENCE) OF DRY SANDS

Nc = 22.5

Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT po (tsf)	Eff.Stress at SPT p'o (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	*Trigger FC Adj.* $\Delta N_{1(60)}$	*Equiv. Sand* $N_{1(60)CS}$	Kσ	M = 7.5 Available CRR	M =7.5 Induced CSR*	**Liquefac. Safety Factor**	*Post FC Adj.* $\Delta N_{1(60)}$	$N_{1(60)CS}$	Volumetric *Strain (%)*	**Induced Subsidence (in.)**	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	**Dry Sand Subsidence (in.)**
								0.000																								
4.0	17	50	1	105	15	2.5	7.5	0.131	0.131	1.00	1.70	0.75	1.00	74.0	100	6.1	80.0	1.00	1.200	0.106	**Non-Liq.**	6.1	80.0	0.00	**0.00**	0.088	571	0.011	2.1E-05	4.0E-06	4.7E-06	**0.00**
8.0	12	8	1	115	50	5.0	10.0	0.268	0.268	0.99	1.70	0.75	1.00	11.2	40	7.2	18.4	1.00	0.199	0.105	**Non-Liq.**	7.2	18.4	0.01	**0.01**	0.179	500	0.022	5.1E-05	5.7E-05	6.8E-05	**0.01**
8.0	12	8	1	115	50	5.0	10.0	0.268	0.268	0.99	1.70	0.75	1.00	11.2	40	7.2	18.4	1.00	0.199	0.105	**Non-Liq.**	7.2	18.4	0.01	**0.00**	0.179	500	0.022	5.1E-05	5.7E-05	6.8E-05	**0.00**
10.0	36	23	1	120	50	7.5	12.5	0.410	0.410	0.98	1.61	0.75	1.00	31.7	67	10.0	41.7	1.00	1.200	0.105	**Non-Liq.**	10.0	41.7	0.00	**0.00**	0.275	812	0.034	4.6E-05			
15.0	20	13	1	120	15	10.0	15.0	0.560	0.498	0.98	1.46	0.81	1.00	17.2	50	3.3	20.5	1.00	0.222	0.117	**1.90**	3.3	20.5	0.00	**0.00**	0.375	750	0.046	7.0E-05			
17.5		14	1	110	3	15.0	20.0	0.860	0.642	0.97	1.28	0.89	1.22	22.8	57	0.0	22.8	1.00	0.251	0.138	**1.82**	0.0	22.8	0.00	**0.00**	0.576	963	0.070	8.2E-05			
22.5		10	1	110	3	20.0	25.0	1.135	0.761	0.96	1.18	0.96	1.16	15.1	46	0.0	15.1	1.00	0.163	0.152	**1.08**	0.0	15.1	0.18	**0.11**	0.760	964	0.092	1.1E-04			
27.5		9	1	110	3	25.0	30.0	1.410	0.880	0.94	1.10	1.00	1.14	13.0	43	0.0	13.0	1.00	0.141	0.160	**0.88**	0.0	13.0	2.00	**1.20**	0.945	1,022	0.112	1.3E-04			
37.5		24	1	110	3	30.0	35.0	1.685	0.999	0.92	1.03	1.00	1.30	37.3	73	0.0	37.3	1.00	1.200	0.165	**7.27**	0.0	37.3	0.00	**0.00**	1.129	1,586	0.131	9.0E-05			
42.5		12	1	110	9	40.0	45.0	2.235	1.237	0.85	0.92	1.00	1.15	14.9	46	0.8	15.7	0.97	0.169	0.169	**1.00**	0.8	15.7	0.67	**0.40**	1.497	1,369	0.161	1.3E-04			
47.5		13	1	110	9	45.0	50.0	2.510	1.356	0.80	0.88	1.00	1.16	15.5	47	0.8	16.3	0.95	0.176	0.166	**1.06**	0.8	16.3	0.24	**0.14**	1.682	1,469	0.170	1.3E-04			
50.0		13	1	110	2	50.0	55.0	2.785	1.475	0.75	0.85	1.00	1.15	14.7	46	0.0	14.7	0.94	0.159	0.161	**0.99**	0.0	14.7	0.77	**0.23**	1.866	1,497	0.177	1.3E-04			





$N_{1(60)} = C_N*C_E*C_B*C_R*C_S*N$
C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= min(1,max(0.75,1.4666-2.556/(z(ft))$^{0.5}$))
C_N = (1 atm/p'o)$^{0.5}$, max 1.7
C_S = max(1.1,min(1.3,1+$N_{1(60)}$/100)) for SPT without liners
MSF = $10^{2.24}/M^{2.56}$
z = Depth (m)
pa = 1 atm = 101 KPa = 1.058 tsf

p = 0.67*po
τ_{av} = 0.65*PGA*po*rd
G_{max} = 447*$N_{1(60)CS}^{(1/3)}$*$p^{0.5}$
a = 0.0389*(p/1)+0.124
b = 6400*(p/1)$^{(-0.6)}$
γ = [1+a*EXP(b*τ_{av}/G_{max})]/[(1+a)*τ_{av}/G_{max}]
E_{15} = γ*($N_{1(60)CS}$/20)$^{-1.2}$
E_{nc} = (Nc/15)$^{0.45}$*E15

Nc = (MAG-4)$^{2.17}$
S = 2*H*E_{nc}

rd = (1-0.4113*z^0.5+0.04052*z+0.001753*z^1.5)/(1-0.4177*z^0.5+0.05729*z-0.006205*z^1.5+0.00121*z^2))
$\Delta N_{1(60)}$ = min(10,IF(FC<35,exp(1.76-(190/FC^2)),5)+IF(FC<=5,1,IF(FC<35,0.99+(FC^1.5/1000),1.2))*N1(60) - N1(60)
$N_{1(60)CS}$ = $N_{1(60)CS}$ + $\Delta N_{1(60)}$
Kσ = min of 1.0 or (p'o/1.058)$^{(IF(Dr>0.7,0.6,IF(Dr<0.5,0.8,0.7))-1)}$
Dr = ($N_{1(60)}$/70)$^{0.5}$
CSReq = 0.65*PGA*(po/p'o)*rd
CSR* = CSReq/MSF/Kσ
$CRR_{7.5}$ = (0.048-0.004721*N+0.0006136*N^2-0.00001673*N^3)/(1-0.1248*N+0.009578*N^2-0.0003285*N^3+0.000003714*N^4))
N = $N_{1(60)CS}$

SF = $CRR_{7.5,1atm}$/CSR*

Table 1
Fault Parameters

Fault Section Name	Distance (miles)	Distance (km)	Avg Dip Angle (deg.)	Avg Dip Direction (deg.)	Avg Rake (deg.)	Trace Length (km)	Fault Type	**Mean Mag**	Mean Return Interval (years)	Slip Rate (mm/yr)
Blue Cut	51.8	83.3	90	177	na	79	B'	**7.1**		
Brawley (Seismic Zone), alt 2	65.8	105.9	90	250	na	61	B'	**7.0**		
Elmore Ranch	65.9	106.0	90	310	0	29	B	**6.6**		1
San Andreas (Coachella) rev	66.2	106.6	90	224	180	69	A	**7.2**	69	20
Brawley (Seismic Zone), alt 1	68.9	111.0	90	250	na	60	B'	**7.0**		
Imperial	72.1	116.0	82	55	180	46	A	**6.8**	89	20
Superstition Hills	78.2	125.8	90	220	180	36	A	**7.4**	199	4
San Jacinto (Superstition Mtn)	80.4	129.4	90	210	180	26	B'	**6.6**		
Superstition Mountain	80.4	129.4	37	37	37	37	B	**7.0**		0.1
Pinto Mtn	84.3	135.7	90	175	0	74	B	**7.2**		2.5
San Jacinto (Borrego)	87.8	141.3	90	223	180	34	A	**7.0**	146	4
Pisgah-Bullion Mtn-Mesquite Lk	88.4	142.2	90	60	180	88	B	**7.3**		0.8
Cerro Prieto	89.2	143.6	90	221	na	84	B'	**7.2**		
San Jacinto (Clark) rev	89.5	144.0	90	214	180	47	A	**7.6**	211	14
Ludlow	93.0	149.6	90	239	na	70	B'	**7.0**		
San Andreas (San Gorgonio Pass-Garnet HIll)	95.2	153.3	58	20	180	56	A	**7.6**	219	10
San Andreas, (North Branch, Mill Creek)	95.2	153.3	76	204	180	106	A	**7.5**	110	17
Laguna Salada	95.6	153.8	90	41	180	99	A	**6.8**	89	3.5
San Jacinto (Coyote Creek)	96.3	155.0	90	223	180	43	A	**7.3**	259	4
Calico-Hidalgo	97.1	156.3	90	52	180	117	B	**7.4**		1.8
So Emerson-Copper Mtn	98.1	157.9	90	51	180	54	B	**7.0**		0.6
Elsinore (Coyote Mountain)	99.1	159.4	82	35	180	39	A	**7.1**	322	3
Joshua Tree (Seismicity)	100.0	160.9	90	271	na	17	B'	**6.5**		
Canada David (Detachment)	100.7	162.1	37	255	na	37	B'	**7.1**		
Eureka Peak	102.8	165.4	90	75	180	19	B	**6.6**		0.6
Burnt Mtn	105.1	169.1	67	265	180	21	B	**6.7**		0.6
Earthquake Valley (So Extension)	106.5	171.5	90	204	180	9	B'	**6.3**		
San Jacinto (Anza) rev	110.2	177.3	90	216	180	46	A	**7.6**	151	18
Earthquake Valley	110.6	178.0	90	217	180	20	B	**6.7**		2
Elsinore (Julian)	110.8	178.3	84	36	180	75	A	**7.6**	725	3
Landers	111.2	179.0	90	60	180	95	B	**7.4**		0.6
Hector Mine	112.7	181.4	90	246	na	28	B'	**6.7**		
Mission Creek	116.3	187.2	65	5	180	31	B'	**6.9**		
Johnson Valley (No)	117.0	188.3	90	51	180	35	B	**6.8**		0.6
Earthquake Valley (No Extension)	118.0	189.9	90	221	180	33	B'	**6.9**		
North Frontal (East)	120.4	193.8	41	187	90	27	B	**6.9**		0.5
San Gorgonio Pass	127.1	204.5	60	11	na	29	B'	**6.9**		
Lenwood-Lockhart-Old Woman Springs	127.6	205.4	90	43	180	145	B	**7.5**		0.9
San Andreas (San Bernardino S)	129.5	208.5	90	210	180	43	A	**7.6**	150	16
San Jacinto (San Jacinto Valley, stepover)	132.5	213.3	90	224	180	24	A	**7.4**	199	9

Reference: USGS OFR 2007-1437 (CGS SP 203)

Mean Magnitude for Type A Faults based on 0.1 weight for unsegmented section, 0.9 weight for segmented model (weighted by probability of each scenario with section listed as given on Table 3 of Appendix G in OFR 2007-1437). Mean magntude is average of Ellworths-B and Hanks & Bakun moment area relationship.

Site Coordinates: 33.604 N 114.603 W

Table 2

Historic Earthquakes in Vicinity of Project Site, M > 5.5

Event Name	Day	Year	Epicenter Latittude (Degrees)	Epicenter Longitude (Degrees)	Distance from Site (mi)	Reported Magnitudes M_W	M_S	M_L	M_I	Estimated Site PGA (g)
	05/03	1872	33.00	115.00	*48*				5.8	0.02
	07/29	1950	33.12	115.57	*65*			*5.5*		0.01
Pinto Mountain	05/02	1949	34.02	115.68	*68*	**5.9**		*5.9*		0.02
	05/28	1917	32.80	115.30	*69*				5.5	0.01
Westmorland	04/26	1981	33.10	115.63	*69*	**5.9**	*6.0*	*5.6*		0.02
	10/22	1942	33.23	115.72	*69*			*5.5*		0.01
Brawley Aftershock	10/15	1979	32.98	115.55	*70*			*5.8*		0.02
Imperial Valley	04/19	1906	32.90	115.50	*71*	**6.2**	*6.2*		5.8	0.02
Imperial Valley	06/23	1915	32.80	115.50	*76*		*5.9*		5.6	0.02
Imperial Valley	06/23	1915	32.80	115.50	*76*	**6.0**	*6.0*		5.6	0.02
Elmore Ranch	11/23	1987	33.08	115.78	*77*	**5.9**	*6.2*	*5.8*		0.02
	01/24	1951	32.98	115.73	*78*			*5.6*		0.01
	06/14	1953	32.95	115.72	*79*			*5.5*		0.01
El Centro	05/19	1940	32.73	115.50	*80*	**7.0**	*7.2*	*6.2*	7.0	0.03
Fort Yuma	11/29	1852	32.50	115.00	*80*	**7.0**			7.0	0.03
Imperial Valley	10/15	1979	32.61	115.32	*80*	**6.5**	*6.8*	*6.6*	6.0	0.02
Superstition Hills	11/24	1987	33.01	115.84	*82*	**6.5**	*6.6*	*6.0*		0.02
	08/15	1945	33.22	116.13	*92*			*5.7*		0.01
	11/15	1875	32.50	115.50	*92*	**6.2**			6.2	0.01
North San Jacinto	11/07	1923	32.50	115.50	*92*				5.5	0.01
	01/01	1927	32.50	115.50	*92*			*5.5*		0.01
	01/01	1927	32.50	115.50	*92*			*5.8*		0.01
Borrego Mountain	04/09	1968	33.19	116.13	*92*	**6.5**	*6.8*	*6.8*	6.3	0.02
Fish Creek Mountain	10/21	1942	33.05	116.08	*94*	**6.6**		*6.5*	6.3	0.02
Arroyo Salada	03/19	1954	33.28	116.18	*94*	**6.4**		*6.2*	6.2	0.02
Laguna Salada	02/24	1892	32.55	115.63	*94*	**7.0**			7.0	0.02
	05/28	1892	33.20	116.20	*96*	**6.5**			6.3	0.02
	02/01	1954	32.30	115.30	*99*			*5.6*		0.01
	02/09	1890	33.40	116.30	*99*	**6.5**			6.3	0.02
Victoria	06/09	1980	32.20	115.08	*101*	**6.4**	*6.4*	*6.1*		0.02
Joshua Tree	04/22	1992	33.96	116.32	*102*	**6.1**		*6.1*		0.01

Notes:

1.) Earthquake information primarily from Ellsworth (1990) in USGS Professional Paper 1515

2.) Magnitude Scales: M_W - moment magntude, M_L - Local (Richter) magnitude, M_S - surface wave magnitude, M_I - estimated from felt area intensity.

3.) Before 1932, Epicenters of earthquakes are approximate, indicated to nearest 0.5 to 0.1 degree.

APPENDIX B

Laboratory Results

File No.: 12068-01 June 21, 2012

Lab No.: 12-0077

UNIT DENSITIES AND MOISTURE CONTENT ASTM D2937-04 & D2216-05

Job Name: Willow St. LCNG Refueling Station.

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B1	0-5	---	14	CL-SM
B1	3	100	6	SM
B1	5	95	7	SM
B2	1	110	19	CL
B2	3	93	8	SM
B2	5	96	24	ML
B3	1	122	17	ML
B3	3	109	12	CL
B3	5	93	9	SP-SM
B4	1	---	5	SM
B4	3	95	26	CL
B4	5	90	30	CL
B5	1	103	23	CL
B5	3	97	5	SM/ML
B5	5	102	11	SM
B6	1	107	21	CL
B6	3	98	10	SM/ML
B6	5	93	28	CL
B7	2.5	97	7	SM
B7	5	101	22	SM/ML
B7	7.5	99	24	SM/ML
B7	10	98	25	SM/ML

File No.: 12068-01 June 21, 2012

Lab No.: 12-0077

UNIT DENSITIES AND MOISTURE CONTENT ASTM D2937-04 & D2216-05

Job Name: Willow St. LCNG Refueling Station.

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B8	2.5	102	2	SM
B8	5	105	8	ML
B8	7.5	101	23	ML
B8	10	98	25	ML
B9	1	97	4	SM
B9	3	108	11	SM/ML
B9	5	98	13	SM
B10	1	100	1	SM
B10	3	93	5	SM
B10	7	99	25	ML

File No.: 12068-01 June 21, 2012

Job Name: Willow St. LCNG Refueling Station.

Lab Number: 12-0077

AMOUNT PASSING NO. 200 SIEVE

ASTM D 1140-03a

Sample Location	Depth (feet)	Fines Content (%)	USCS Group Symbol
B4	3	99	CL
B5	1	94	CL
B5	3	53	SM/ML
B5	5	24	SM
B7	5	95	ML
B7	35	9	SP-SM
B7	50	2	SP
B8	20	3	SP
B9	3	76	ML

File No.: LCNG Blythe
Lab No.: 12-0083

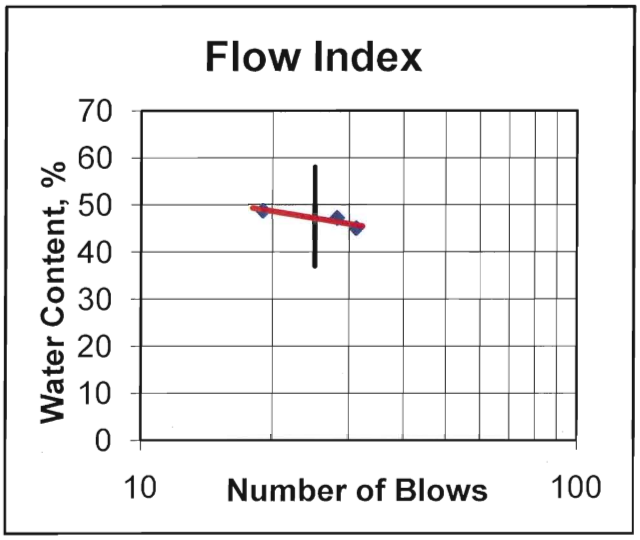
June 21, 2012

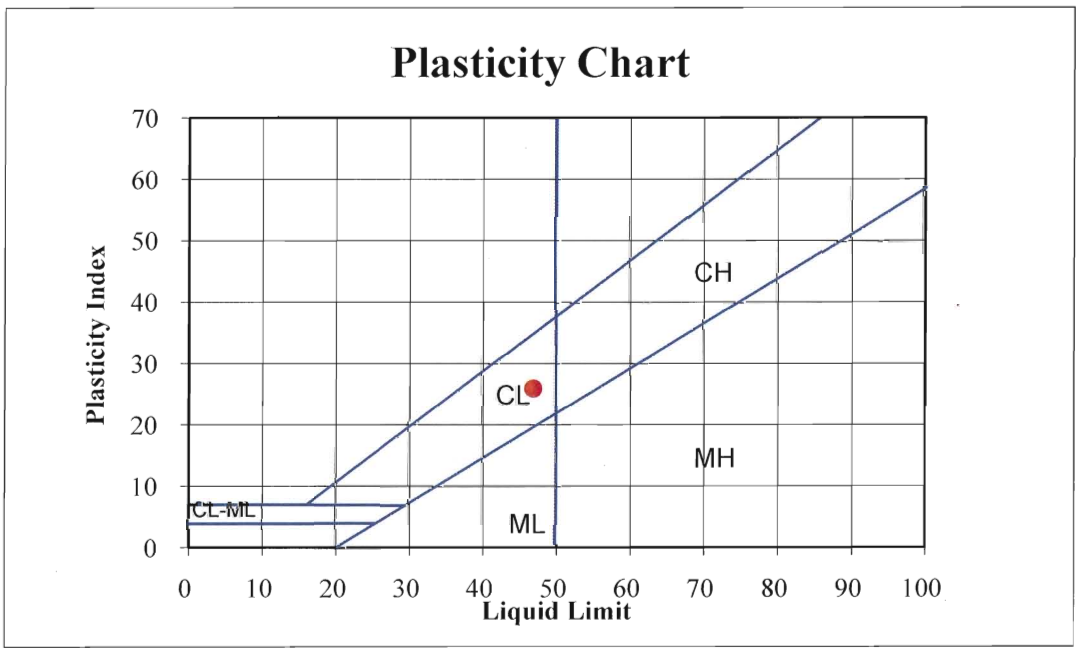
PLASTICITY INDEX

ASTM D 4318-05

Job Name: 12068-01
Sample ID: B4 @ 3 feet
Soil Description: Silty Clay (CL)

DATA SUMMARY				TEST RESULTS	
Number of Blows:	31	28	19	**LIQUID LIMIT**	**48**
Water Content, %	45.1	47.2	48.8	**PLASTIC LIMIT**	**21**
				PLASTICITY INDEX	**26**





File No.: LCNG Blythe
Lab No.: 12-0083

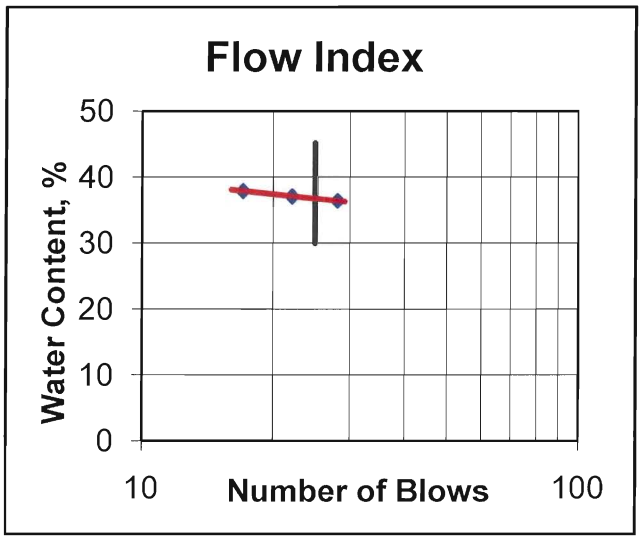
June 21, 2012

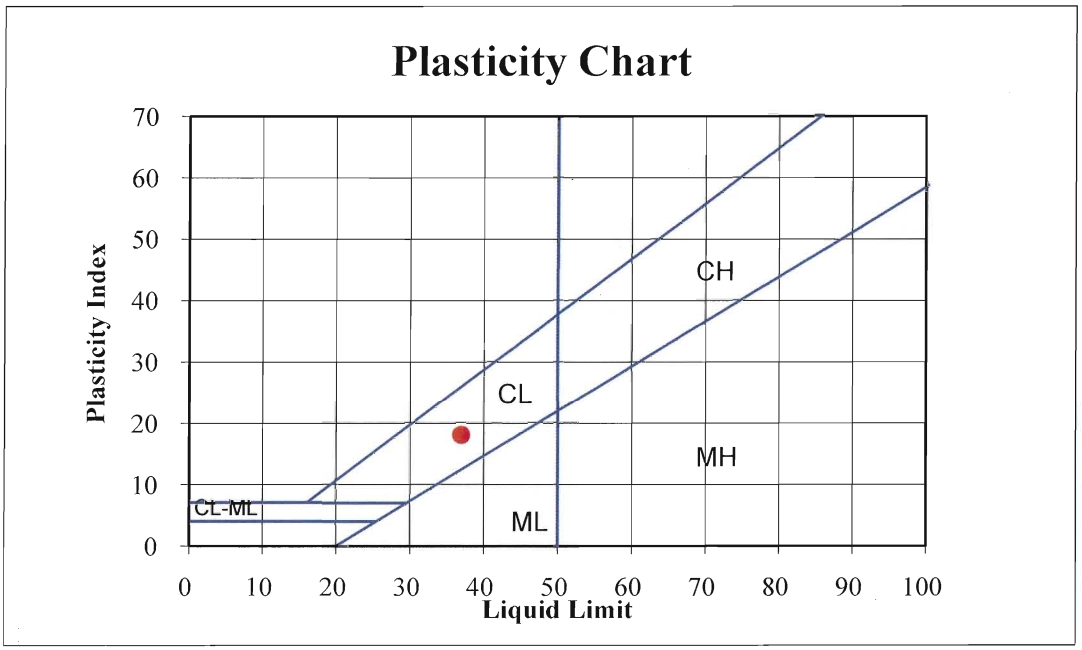
PLASTICITY INDEX

ASTM D 4318-05

Job Name: 12068-01
Sample ID: B5 @ 1 feet
Soil Description: Silty Clay (CL)

DATA SUMMARY				TEST RESULTS	
Number of Blows:	28	22	17	**LIQUID LIMIT**	**36**
Water Content, %	36.4	37.0	37.8	**PLASTIC LIMIT**	**19**
				PLASTICITY INDEX	**18**





File No.: 12068-01
Lab No.: 12-0077

June 21, 2012

CONSOLIDATION TEST

ASTM D 2435-04 & D 5333

Willow St. LCNG Refueling Station.
B-7 @ 5 feet

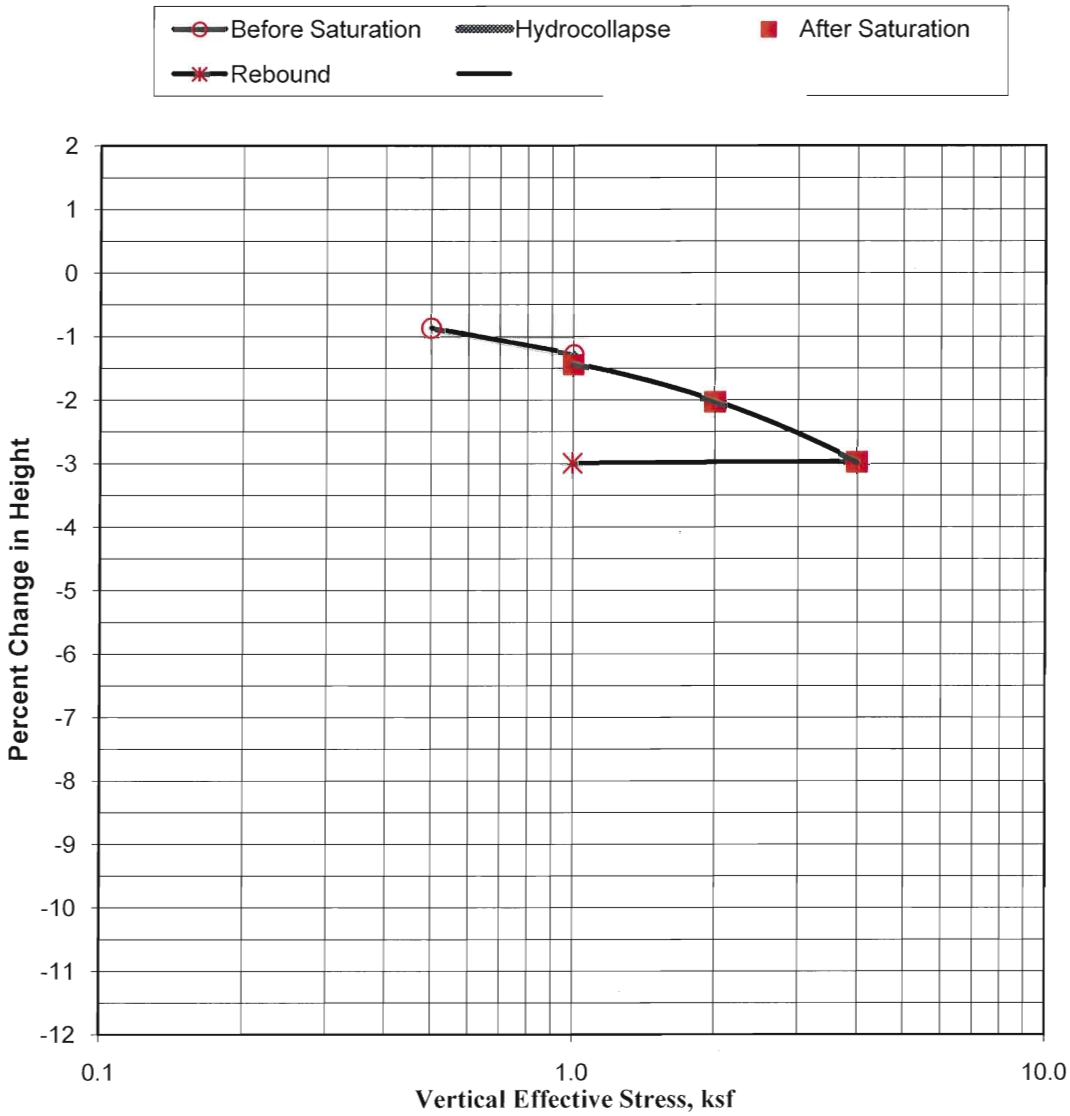
Sandy Silt (ML)

Ring Sample

Initial Dry Density: 95.1 pcf
Initial Moisture, %: 22.0%
Specific Gravity (assumed): 2.67
Initial Void Ratio: 0.753

Hydrocollapse: 0.2% @ 1.0 ksf

% Change in Height vs Normal Presssure Diagram



File No.: 12068-01 June 21, 2012
Lab No.: 12-0077

CONSOLIDATION TEST ASTM D 2435-04

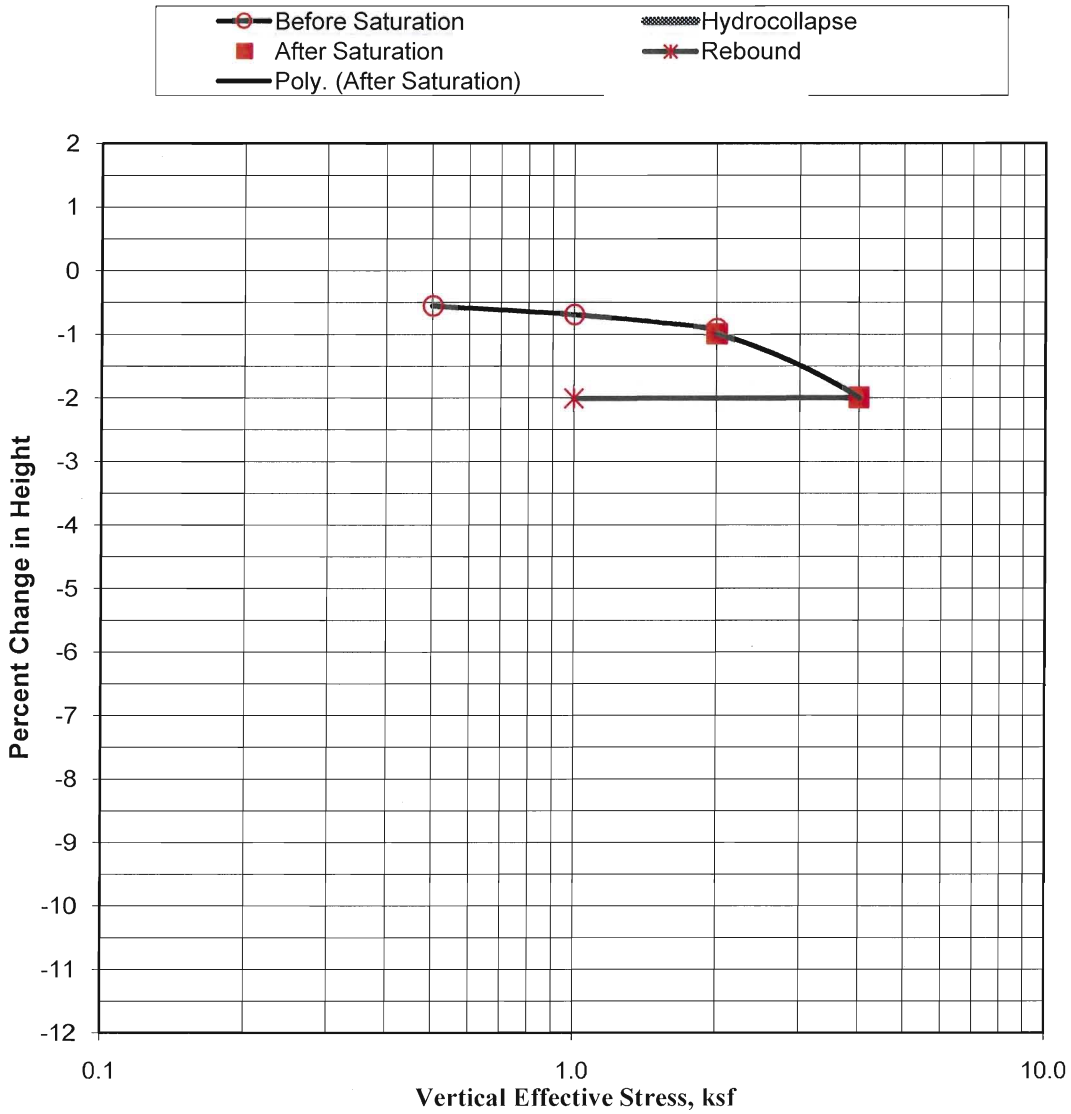
Willow St. LCNG Refueling Station.
B-7 @ 7.5 feet

Silty Sand (SM)

Ring Sample

Initial Dry Density: 97.8 pcf
Initial Moisture, %: 23.8%
Specific Gravity (assumed): 2.67
Initial Void Ratio: 0.704

% Change in Height vs Normal Presssure Diagram



File No.: 12068-01
Lab No.: 12-0077

June 21, 2012

CONSOLIDATION TEST

ASTM D 2435-04 & D 5333

Willow St. LCNG Refueling Station.
B-8 @ 2.5 feet

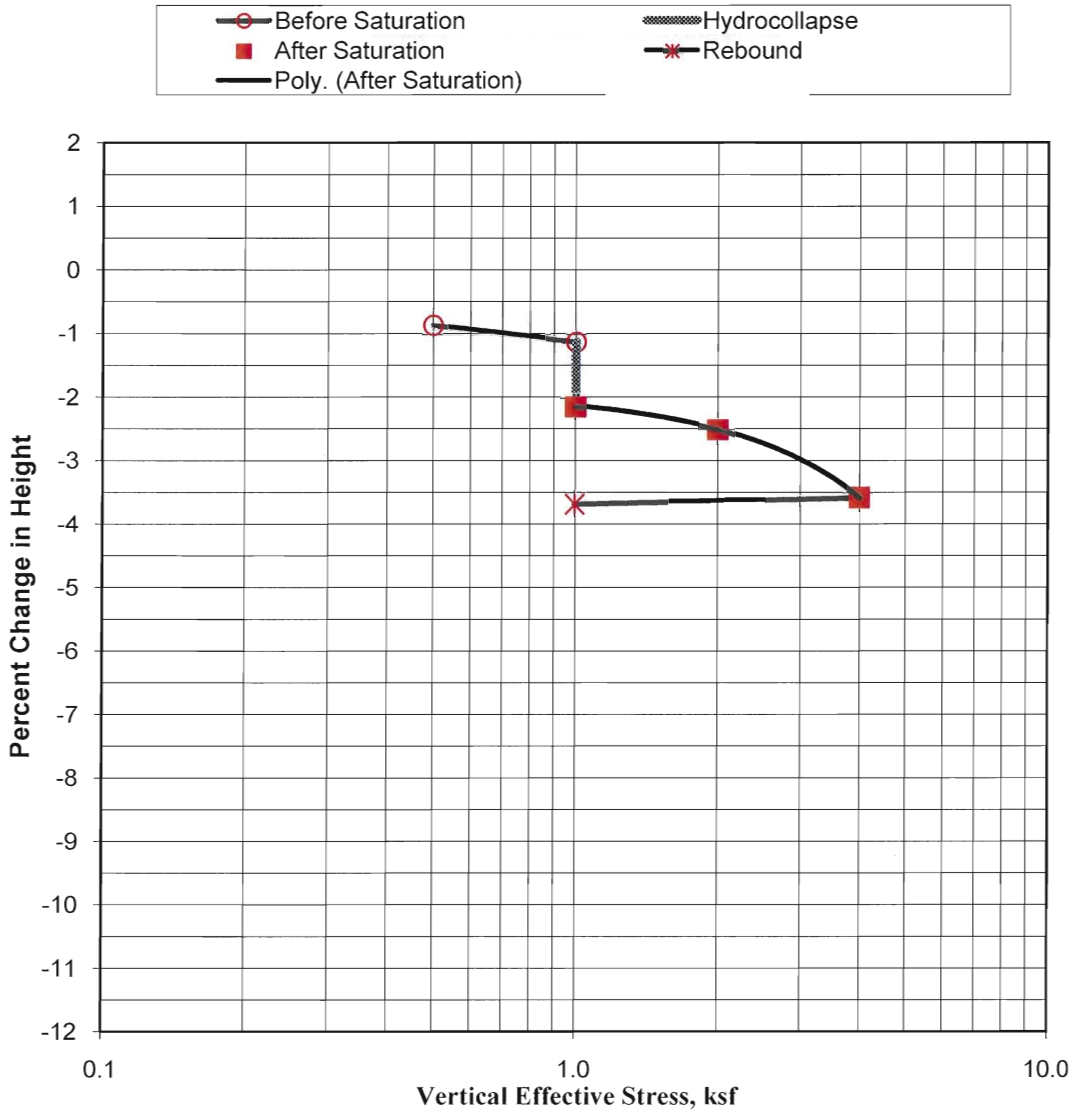
Silty Sand (SM)

Ring Sample

Initial Dry Density: 96.7 pcf
Initial Moisture, %: 2.3%
Specific Gravity (assumed): 2.67
Initial Void Ratio: 0.724

Hydrocollapse: 1.0% @ 1.0 ksf

% Change in Height vs Normal Presssure Diagram



File No.: 12068-01
Lab No.: 12-0077

June 21, 2012

CONSOLIDATION TEST

ASTM D 2435-04 & D 5333

Willow St. LCNG Refueling Station.
B-8 @ 10 feet

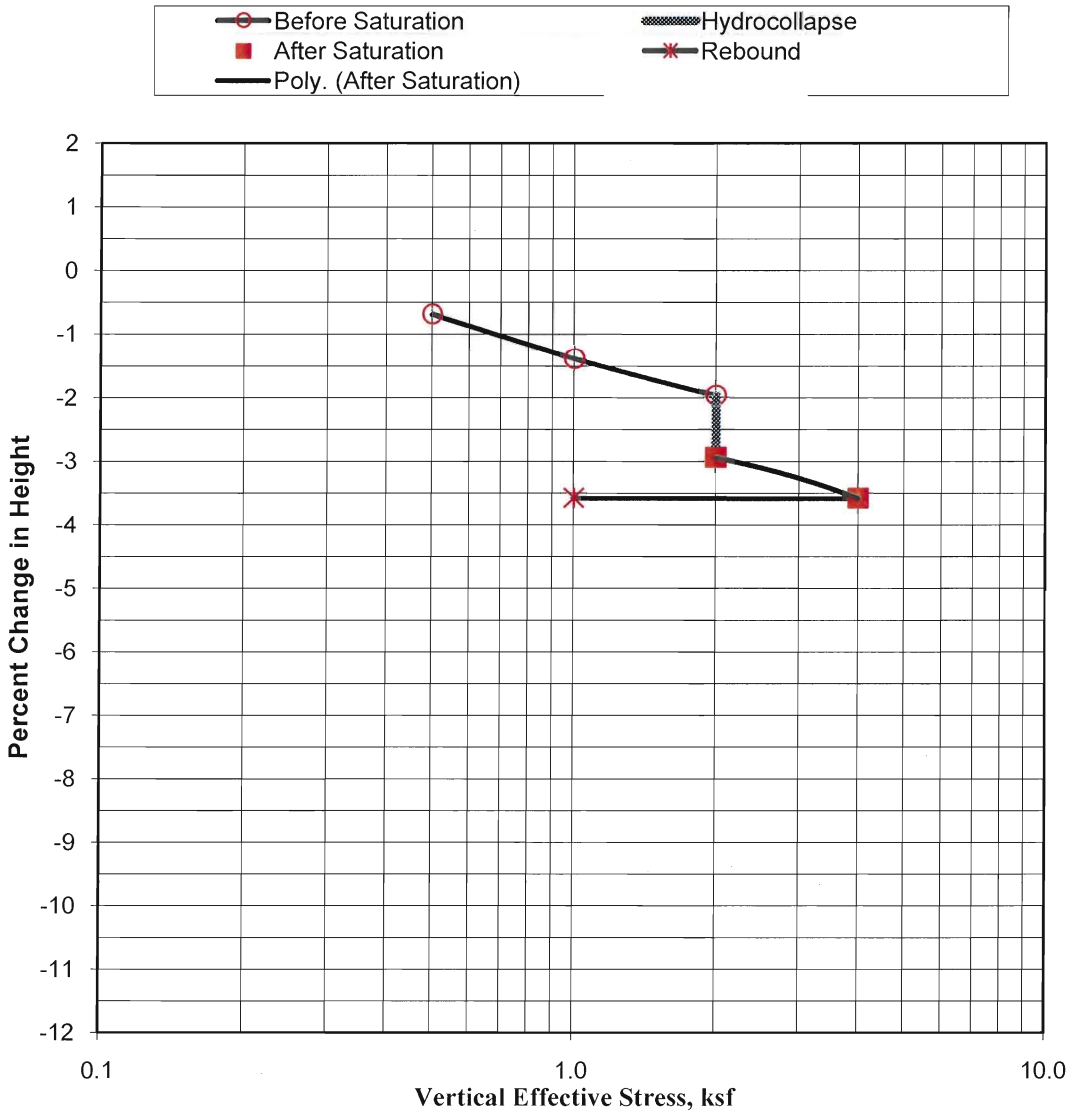
Sandy Silt (ML)

Ring Sample

Initial Dry Density: 94.4 pcf
Initial Moisture, %: 24.8%
Specific Gravity (assumed): 2.67
Initial Void Ratio: 0.765

Hydrocollapse: 1.0% @ 2.0 ksf

% Change in Height vs Normal Presssure Diagram



File No.: 12068-01 June 21, 2012
Lab No.: 12-0077

EXPANSION INDEX

ASTM D-4829-08a, UBC 18-2

Job Name: Willow St. LCNG Refueling Station.
Sample ID: B7 @ 0-5 feet
Soil Description: Silty Sand, Slightly Clayey (SM)

Initial Moisture, %:	10.6
Initial Compacted Dry Density, pcf:	106.9
Initial Saturation, %:	50
Final Moisture, %:	21.0
Volumetric Swell, %:	3.7

Expansion Index, EI: **37** **Low**

EI measured at 50 +/- 1% saturation

EI	UBC Classification
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

File No.: 12068-01 June 21, 2012

Lab No.: 12-0077

MAXIMUM DENSITY / OPTIMUM MOISTURE

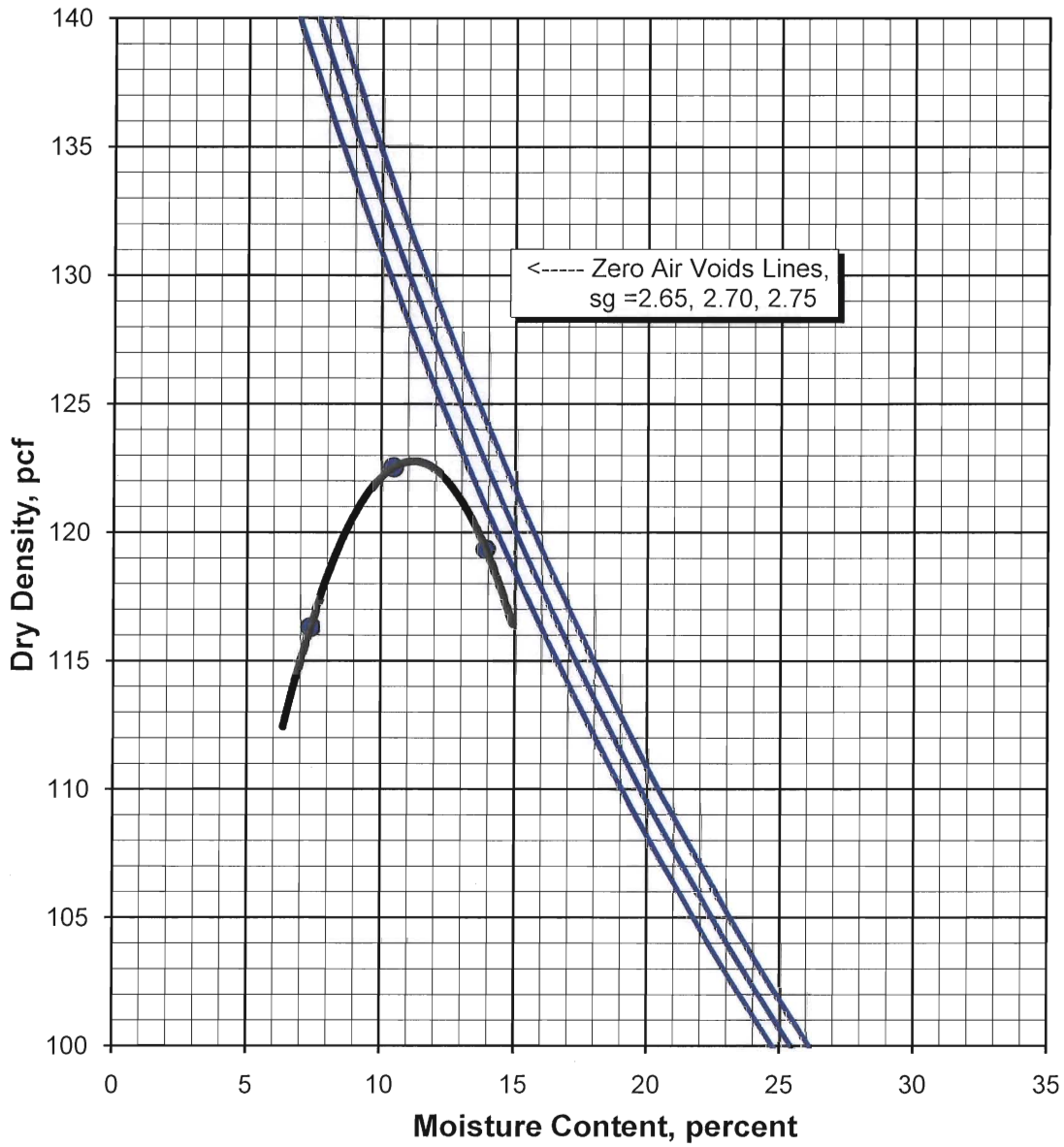
ASTM D 1557-09 (Modified)

Job Name: Willow St. LCNG Refueling Station.
Sample ID: 1
Location: B6 @ 0-5 feet
Description: Clayey Silt w/Sand (ML/CL)

Procedure Used: A
Preparation Method: Moist
Rammer Type: Mechanical
Lab Number: 12-0077

Maximum Density: **122.8 pcf**
Optimum Moisture: **11.2%**

Sieve Size	% Retained (Cumulative)
3/4"	0.0
3/8"	0.8
#4	4.6



File No.: 12068-01 June 21, 2012

Lab No.: 12-0077

MAXIMUM DENSITY / OPTIMUM MOISTURE

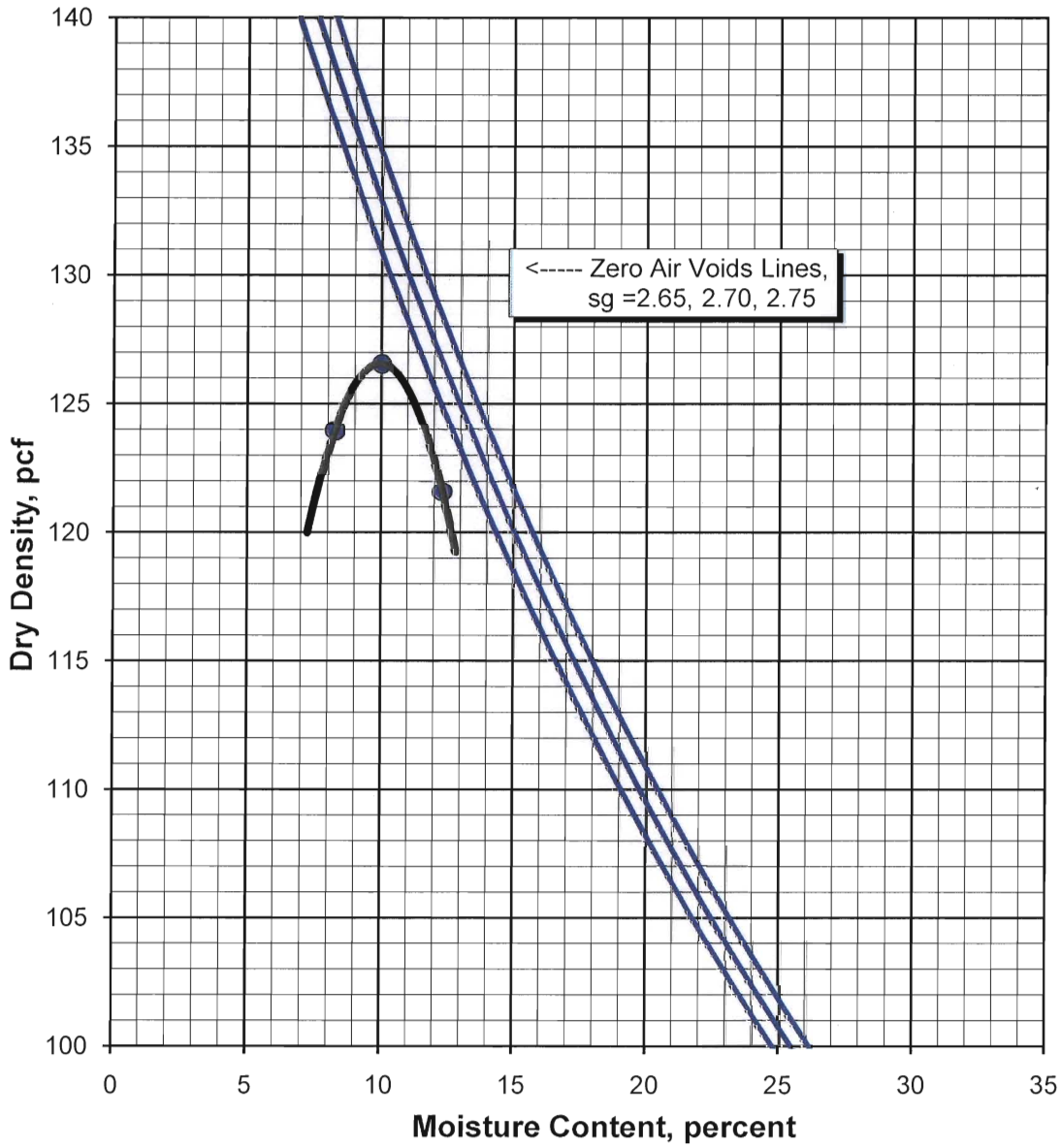
ASTM D 1557-09 (Modified)

Job Name: Willow St. LCNG Refueling Station.
Sample ID: 2
Location: B7 @ 0-5 feet
Description: Clayey Silty Sand (SM)

Procedure Used: A
Preparation Method: Moist
Rammer Type: Mechanical
Lab Number: 12-0077

Maximum Density: **126.5 pcf**
Optimum Moisture: **10%**

Sieve Size	% Retained (Cumulative)
3/4"	0.0
3/8"	0.0
#4	0.0



File No.: 12068-01 6/21/2012
Lab No.: 12-0077

SOIL CHEMICAL ANALYSES

Job Name: Willow St. LCNG Refueling Station.
Job No.: 12068-01

		DF	RL
Sample ID:	B7		
Sample Depth, feet:	0-5		
Sulfate, mg/Kg (ppm): (ASTM D 4327)	**2,740**	20	10.00
Chloride, mg/Kg (ppm): (ASTM D 4327)	**2,360**	20	4.00
pH, (pH Units): (ASTM D 1293)	**8.10**	1	---
Resistivity, (ohm-cm):	**178**	---	---
Conductivity, (µmhos-cm): (ASTM D 1125)	**5,620**	1	2.00

Note: Tests performed by Subcontract Laboratory:
Truesdail Laboratories, Inc.
14201 Franklin Avenue
Tustin, California 92780-7008 Tel: (714) 730-6462

DF: Dilution Factor
RL: Reporting Limit
N.D.: Not Detectable

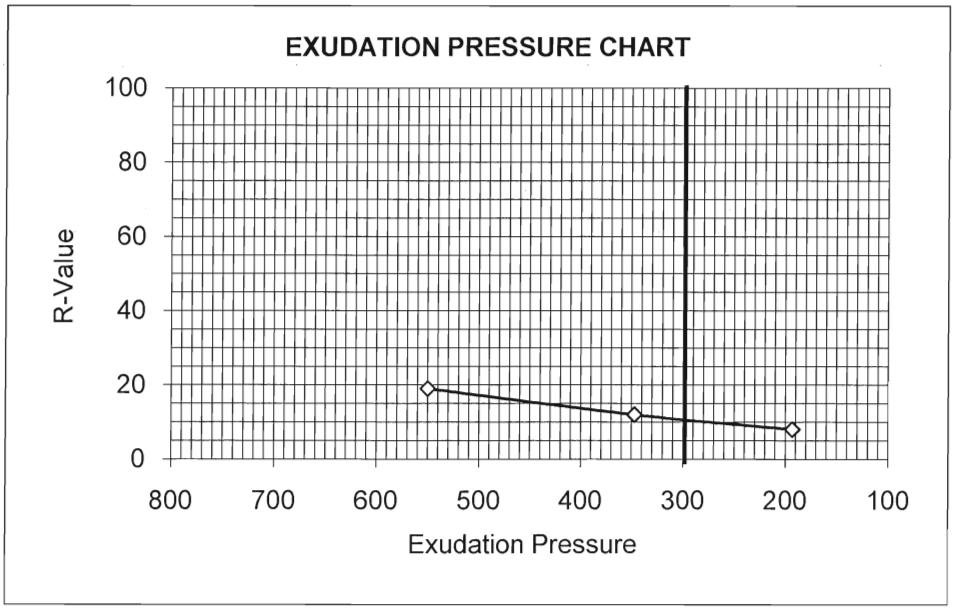
General Guidelines for Soil Corrosivity

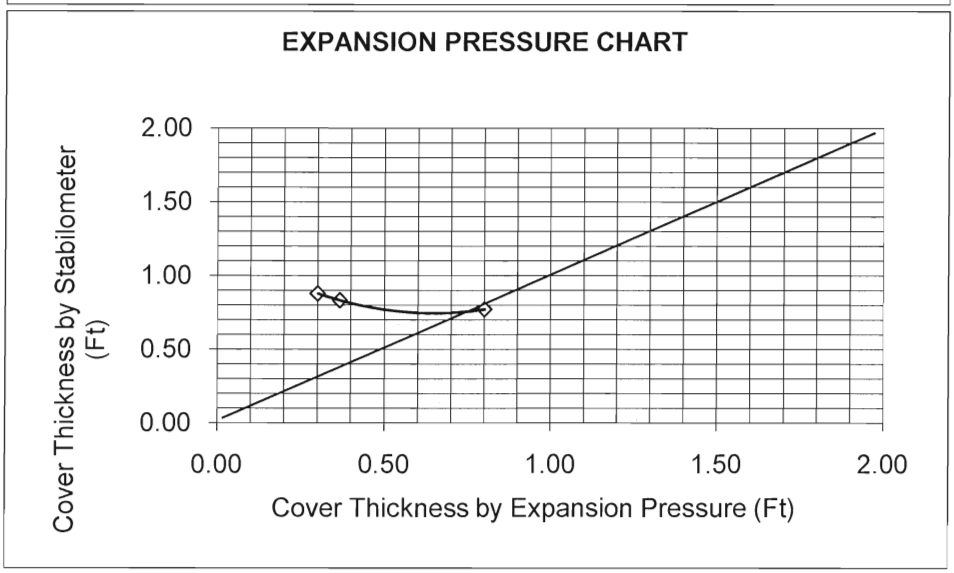
Chemical Agent	Amount in Soil	Degree of Corrosivity
Soluble Sulfates[1]	0 -1,000 mg/Kg (ppm) [0-.1%]	Low
	1,000 - 2,000 mg/Kg (ppm) [0.1-0.2%]	Moderate
	2,000 - 20,000 mg/Kg (ppm) [0.2-2.0%]	Severe
	> 20,000 mg/Kg (ppm) [>2.0%]	Very Severe
Resistivity[2]	0- 900 ohm-cm	Very Severely Corrosive
	900 to 2,300 ohm-cm	Severely Corrosive
	2,300 to 5,000 ohm-cm	Moderately Corrosive
	5,000-10,000 ohm-cm	Mildly Corrosive
	10,000+ ohm-cm	Progressively Less Corrosive

1 - Water Soluble Sulfate in Soil by Weight, ACI 318, Tables 4.2.1 - Exposure Categories and Classes and Table 4.3.1 - Requirements for Concrete By Exposure Class."

2 - Although no standard has been developed and accepted by corrosion engineering organizations, it is generally agreed that the classification shown above, or other similar classifications, reflect soil corrosivity. Source: Corrosionsource.com. The classification presented is excerpted from ASTM STP 1013 titled "Effects of Soil Characteristics on Corrosion" (February, 1989)

June 26, 2012 **File No.: 12068-01**





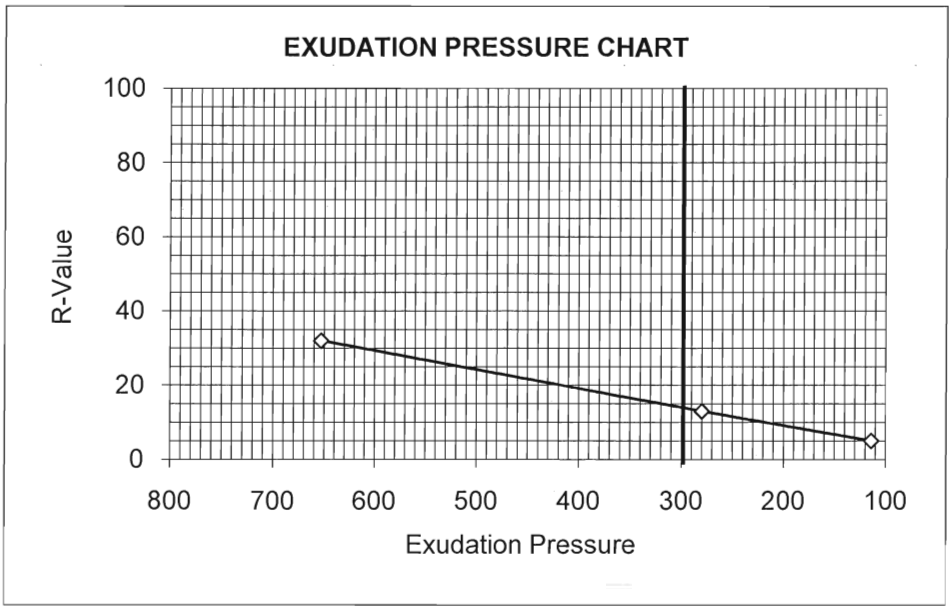
JOB NAME: Willow Street LNG Fuel Station
SAMPLE I. D.: Boring B3@0-5'
SOIL DESCRIPTION: Clayey Silt with Fine Sand (ML)

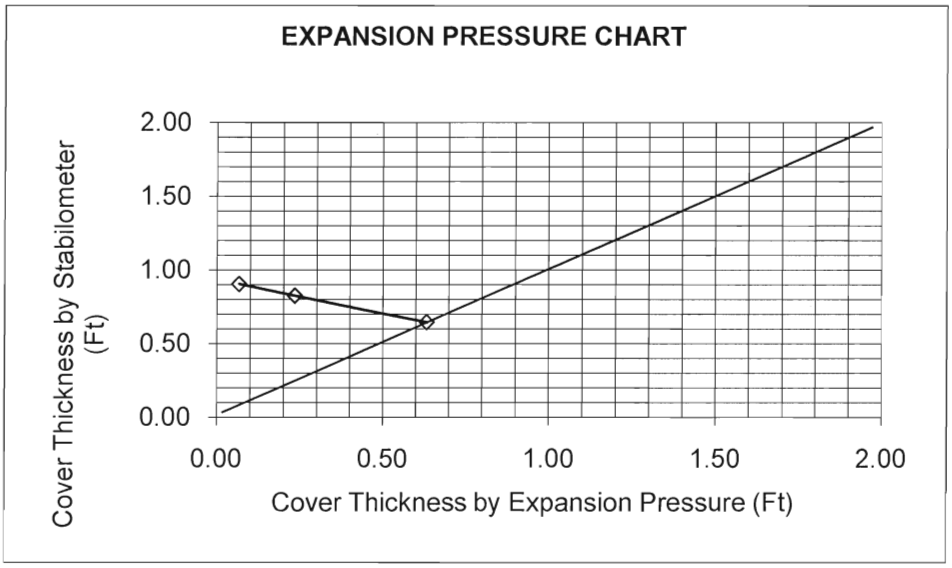
SPECIMEN NUMBER	A	B	C
EXUDATION PRESSURE	550	347	193
RESISTANCE VALUE	19	12	8
EXPANSION DIAL(0.0001")	24	11	9
EXPANSION PRESSURE (PSF)	103.9	47.6	39.0
% MOISTURE AT TEST	11.5	12.6	14.7
DRY DENSITY AT TEST	120.9	119.3	117.4

R-VALUE @ 300 PSI EXUDATION	**10**
R-VALUE by Expansion Pressure*	**21**

**Based on a Traffic Index of 5.0 and a Gravel Factor of 1.70*

June 26, 2012 **File No.: 12068-01**





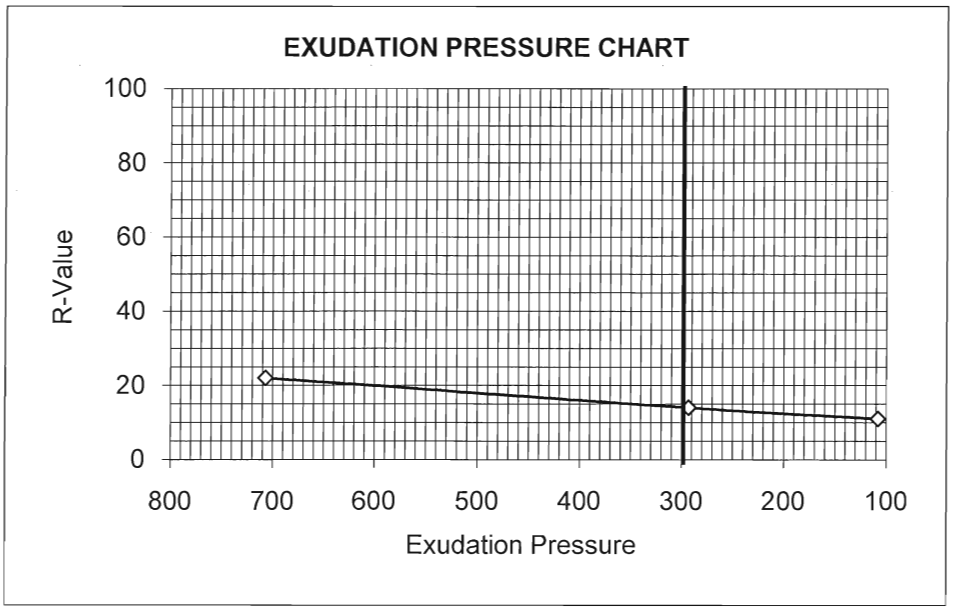
JOB NAME: Willow Street LNG Fuel Station
SAMPLE I. D.: Boring B6@0-5'
SOIL DESCRIPTION: Clayey Silt with Fine Sand (ML)

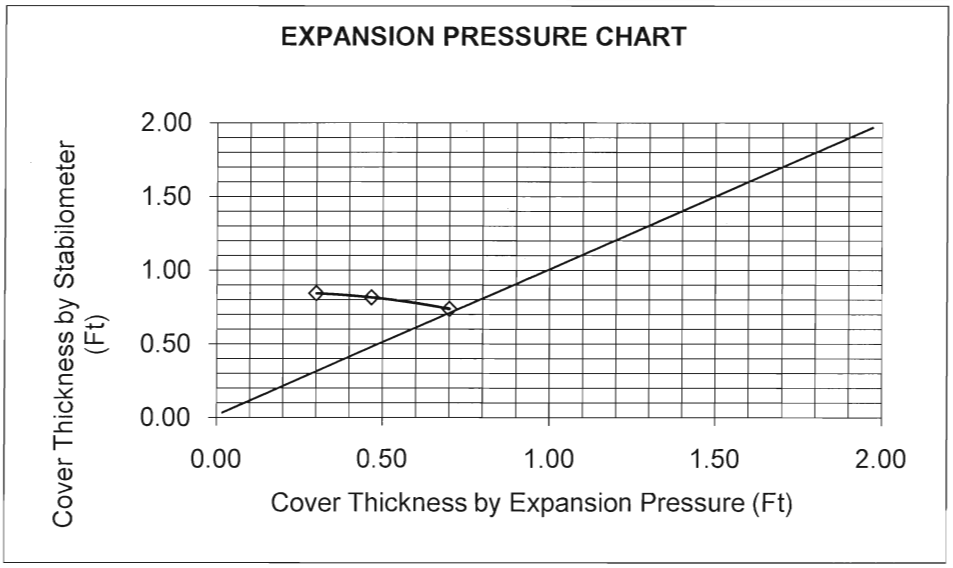
SPECIMEN NUMBER	A	B	C
EXUDATION PRESSURE	653	280	114
RESISTANCE VALUE	32	13	5
EXPANSION DIAL(0.0001")	19	7	2
EXPANSION PRESSURE (PSF)	82.3	30.3	8.7
% MOISTURE AT TEST	12.9	15.2	17.9
DRY DENSITY AT TEST	113.1	112.8	112.6

R-VALUE @ 300 PSI EXUDATION	**14**
R-VALUE by Expansion Pressure*	**35**

**Based on a Traffic Index of 5.0 and a Gravel Factor of 1.70*

June 26, 2012 **File No.: 12068-01**



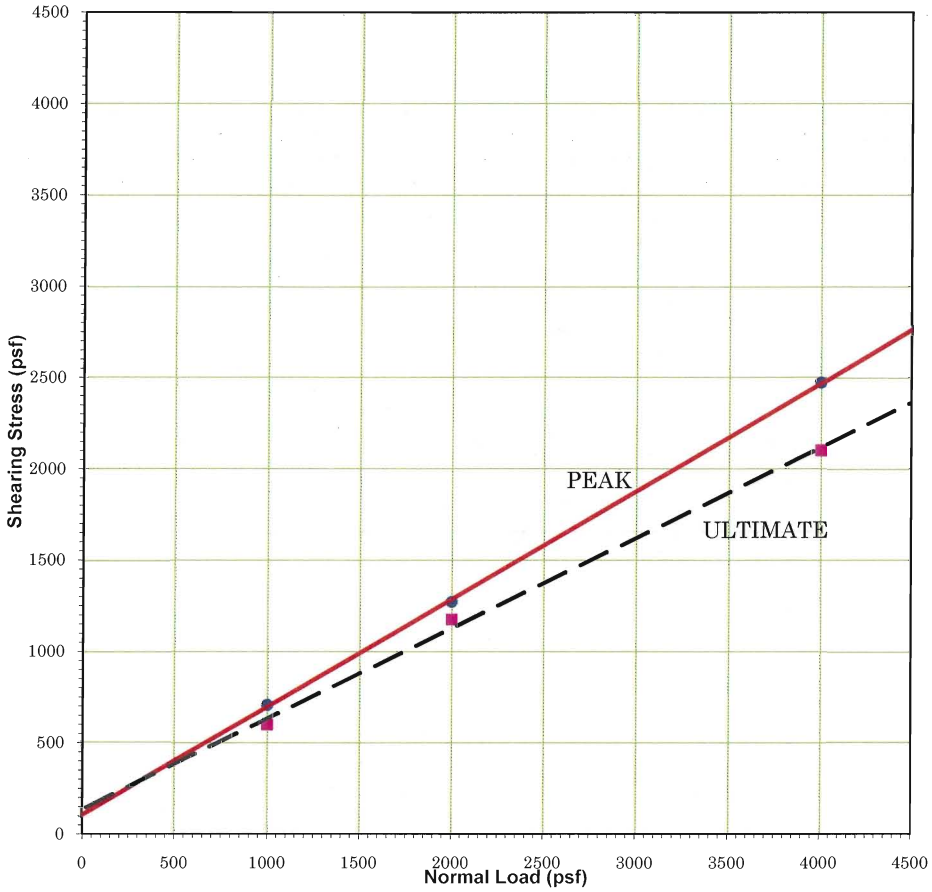


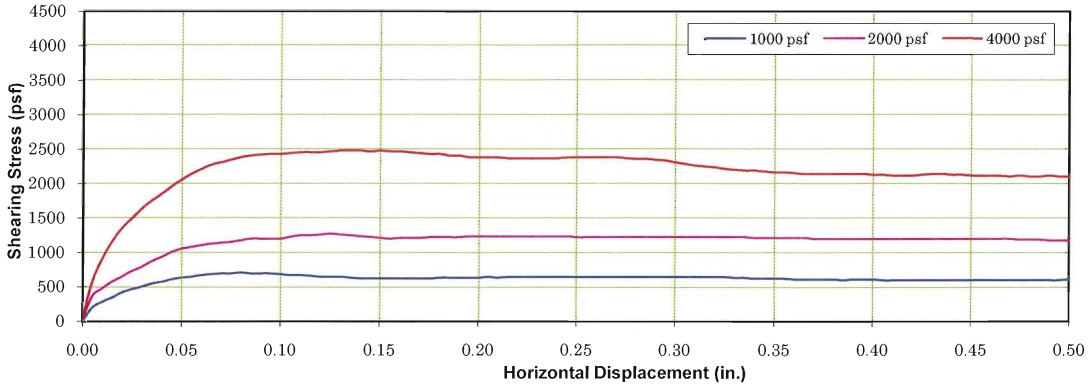
JOB NAME: Willow Street LNG Fuel Station
SAMPLE I. D.: Boring B9@0-5'
SOIL DESCRIPTION: Clayey Silt with Fine Sand (ML)

SPECIMEN NUMBER	A	B	C
EXUDATION PRESSURE	707	293	108
RESISTANCE VALUE	22	14	11
EXPANSION DIAL(0.0001")	21	14	9
EXPANSION PRESSURE (PSF)	90.9	60.6	39.0
% MOISTURE AT TEST	12.2	20.4	23.1
DRY DENSITY AT TEST	114.4	112.2	110.7

R-VALUE @ 300 PSI EXUDATION	**14**
R-VALUE by Expansion Pressure*	**26**

**Based on a Traffic Index of 5.0 and a Gravel Factor of 1.70*





DIRECT SHEAR DATA*

Sample Location: B8 at 5 feet
Material: Sandy Silt (ML)
Dry Density (pcf): 104.9

	Initial	Final
Moisture Content (%):	7.8	20.6
Saturation (%):	35	100
	Peak	Ultimate
ϕ Angle of Friction (degrees):	31	26
c Cohesive Strength (psf):	100	130

Test Type: Peak and Ulitimate
Shear Rate (in/min): 0.01

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

Willow St. LCNG Fueling Station

Blythe, California

Earth Systems Southwest

6/21/2012 | 12068-01

APPENDIX C
Drainage Study

BLYTHE LCNG SITE

DRAINAGE STUDY

July 16, 2012

THG Project No.
1130.006

The Holt Group
1601 N. Imperial Ave.
El Centro, CA 92243

INDEX

SECTION 1

DRAINAGE STUDY

Purpose

The purpose of this drainage study is to determine the retention requirements for the Willow Street LCNG (Liquefied and Compressed Natural Gas) Fueling Facility.

The conditions from the City of Blythe are:

> The applicant shall prepare a hydrology report addressing a 10 and 100-year storm event as per the City of Blythe Standard Drawing and Specifications and design a storm water retention basin capable of accommodating the proposed run-off from the project for a ten-year event and shall be dry within 72 hours. The retention basin shall have five feet of separation between the groundwater table and the invert elevation and shall be maintained by the owner and/or applicant. The basin shall not reside within city right-of-way.

This study will determine the runoff generated from both the 10 and 100-year storms for the site as well as determining an approximate size for the required retention basins.

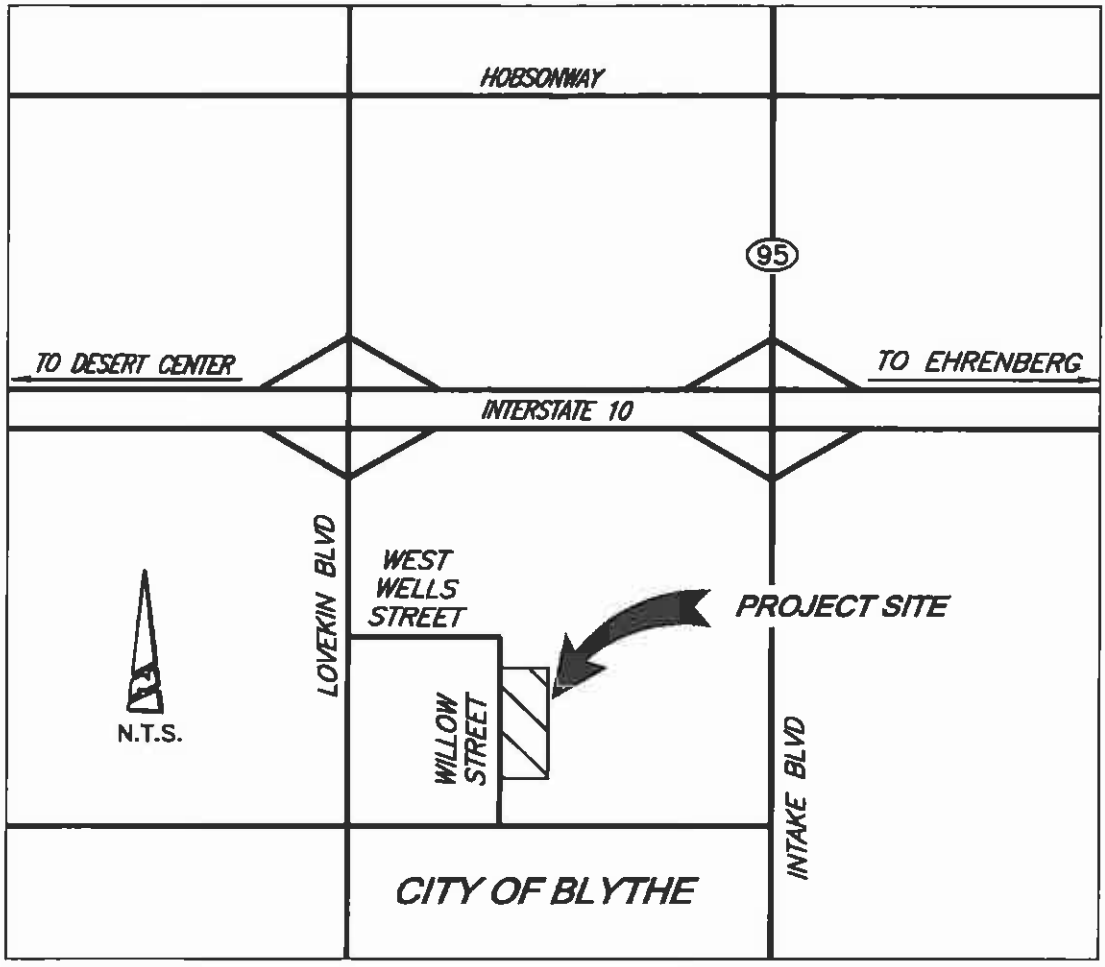
Location

The Willow Street Liquefied and Compressed Natural Gas Fueling Facility (LCNG) is comprised of approximately 1.73 acres located at 450 South Willow Street, in the City of Blythe, California. The project site is located near the northeast corner of the intersection of South Willow Street and 14th Avenue. The project is located at 33.6039 degree North latitude, 114.6031 degree West longitude and is identified on the Figure 1 – Project Location Map below.

The project site is bound to the north by the existing Super 8 motel truck/RV parking lot; to the east by the Southern California Edison Blythe Service Center; a vacant commercial parcel to the south; and South Willow Street frontage on the west. The project site is vacant with sparse vegetation. The proposed project site is relatively flat with a slight slope to the east. There are no storm drainage facilities within the project site or vicinity.

The proposed improvements include site grading activities; construction of a retention basin; construction of Portland Cement Concrete (P.C.C.) foundations; curb and gutter, sidewalk, pavements, and driveways; installation of above ground LCNG tanks and ancillary infrastructure; and a rest room facility.

Figure 1 – Project Location Map



Site Characteristics

As noted above the site is currently undeveloped and flat with a slight slope to the east. The soils report for the site indicated that the soils are mostly fill sand and alluvial soils underlain by a clay/silt layer. Groundwater was encountered at a depth of approximately 8 feet below the existing ground surface.

Based on information from the National Oceanographic and Atmospheric Administration the following are the rainfall amounts anticipated for the 10 and 100-year storm events (see also Exhibits A – M).

	10-year storm	100-year storm
1-hour storm	1.1 in.	2.2 in.
3-hours storm	1.3 in.	2.5 in
6-hours storm	1.6 in.	3.0 in.
24-hour storm	2.2 in.	3.5 in.

Results

The following are the results from the **on-site** hydrologic analysis. The chart shows the flood volumes generated on-site from the 10 and 100 year storm events. The amounts shown are the net storm volumes and do not include infiltration occurring during the storm event. Actual calculations are included in Section 3.

Table 1 – On-Site Hydrology Analysis

	Flood Volume 10-year storm (cubic ft.)	Flood Volume 100-year storm (cubic ft.)
1 hr.	3,505	**11,701**
3 hr.	2,714	9,917
6 hr.	2,250	9,963
24 hr.	794	8,017

As shown, the largest storm volume occurs with the 100-year 1 hour storm event. Therefore, the basin for the site will be designed to retain a minimum of 11,701 cubic feet.

Recommendations

Retention Basin - Site

Based on the hydrology calculations for the site we are recommending a 3 foot deep basin that is 10'x150' at the bottom with 5:1 side slopes. The basin would be 40'x180' at the top. The basin would retain a maximum of 12,670 cubic feet of runoff.

Assuming a percolation rate of 1 inch per hour[1] at a depth of 2.85 feet (34 inches) the basin would drain within 34 hours. This would meet the City's requirements of draining within 72 hours with a factor of safety of almost 3.

[1] A soils report prepared by Earth Systems Engineering in June 2012 had percolation rates ranging from 15.9 in/hr at a depth of 3 feet to 0.2 inches per hour a depth of 4.5 feet. An assumed infiltration rate of 1 inch per hour gives a reasonable factor of safety and still provides a reasonable basin size.

RAINFALL INTENSITY

BLYTHE AIRPORT

10-YEAR STORM

Duration	Rainfall
1 hr.	1.0”
3 hr. *	1.2”
6 hr.	1.5”
24 hr.	2.0”

100-YEAR STORM

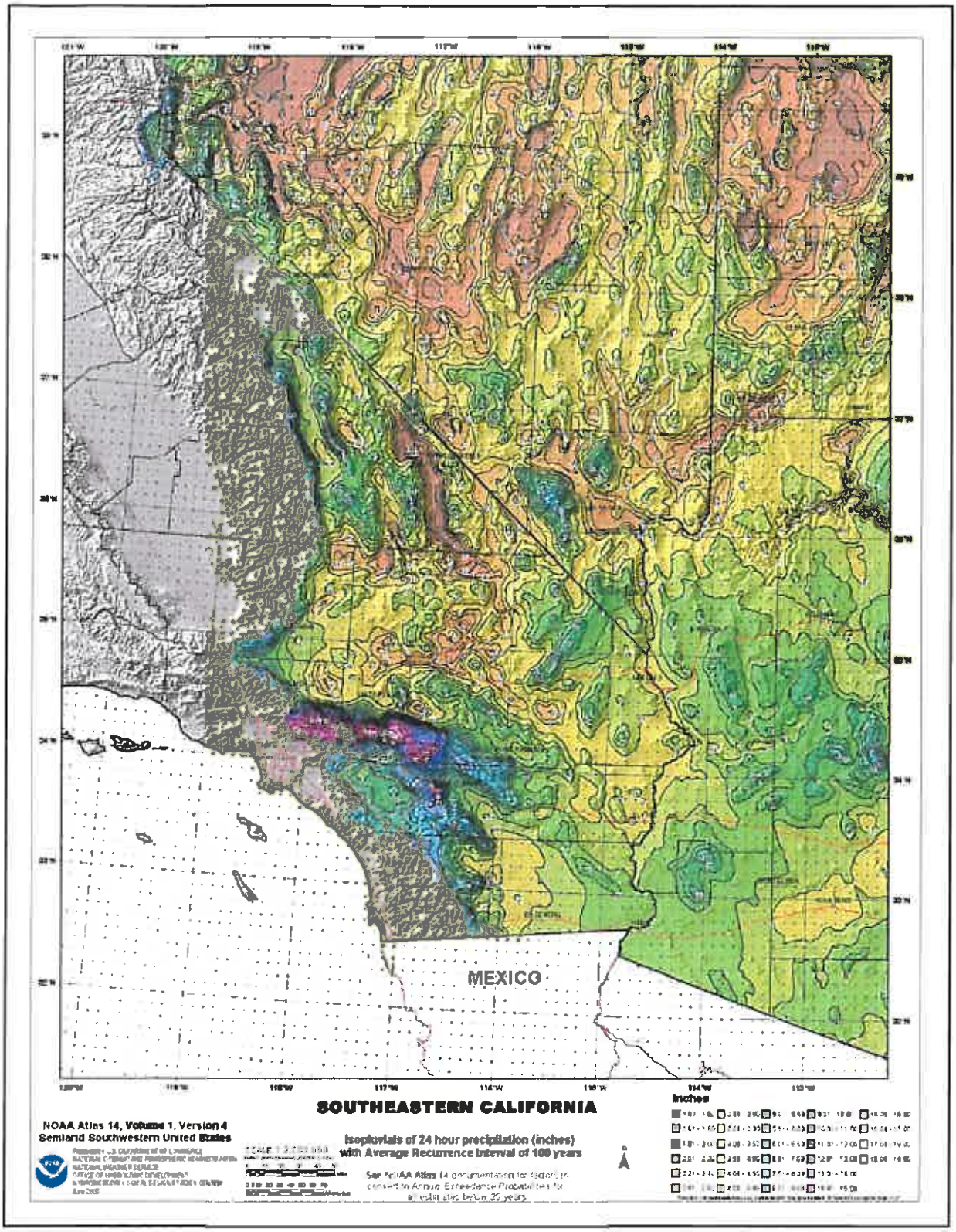
Duration	Rainfall
1 hr.	2.2”
3 hr. *	2.4”
6 hr.	2.9”
24 hr.	3.5”

* Calculated, see Exhibit M.

SECTION 2

RAINFALL DATA

EXHIBIT A
100 YR. – 24 HR. RAINFALL



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(760) 922-4656
(760) 337-3883
(928) 927-8899

EXHIBIT B
100 YR. – 24 HR. RAINFALL
DETAIL

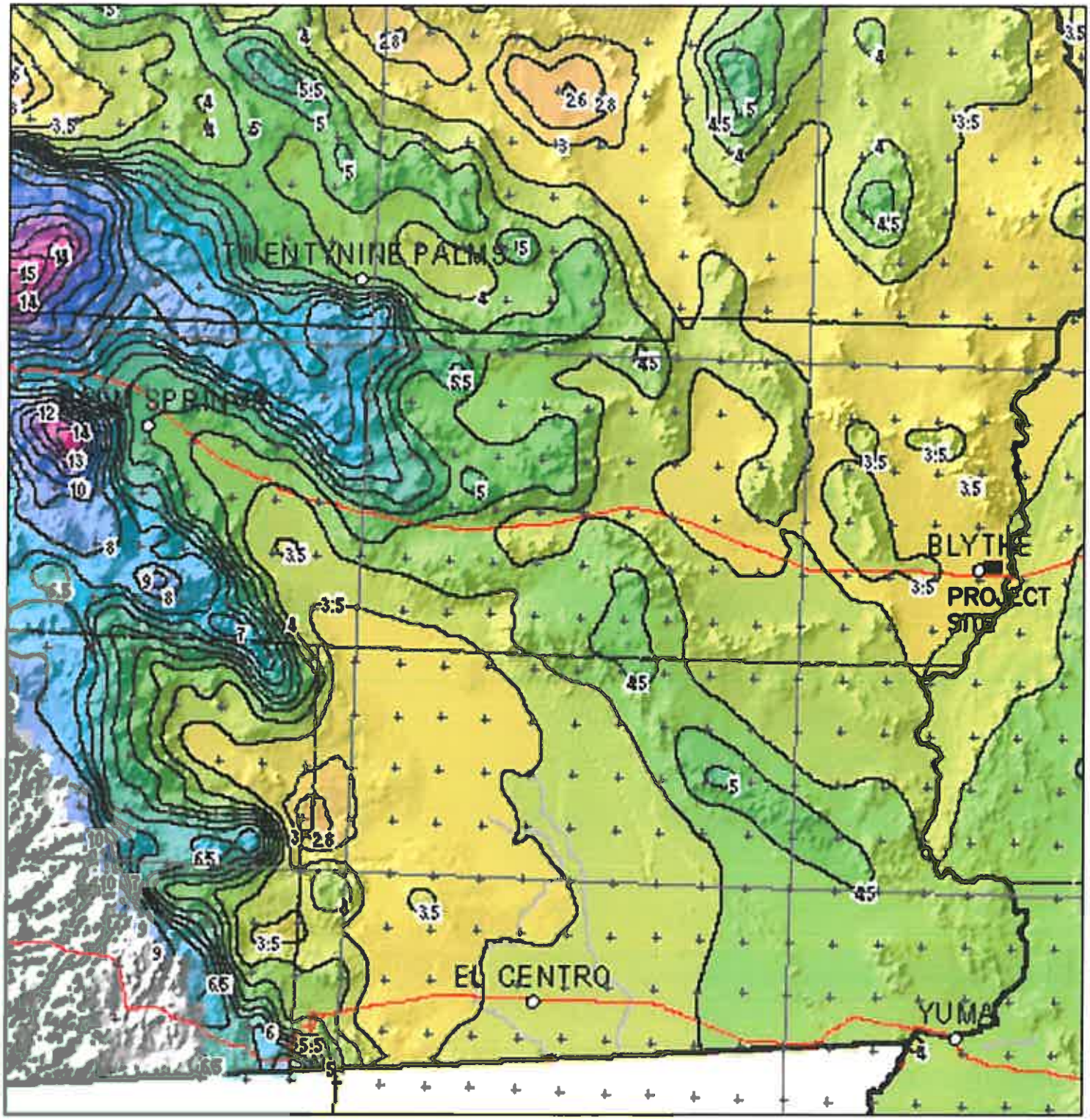

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EXHIBIT C
100 YR. – 6 HR. RAINFALL

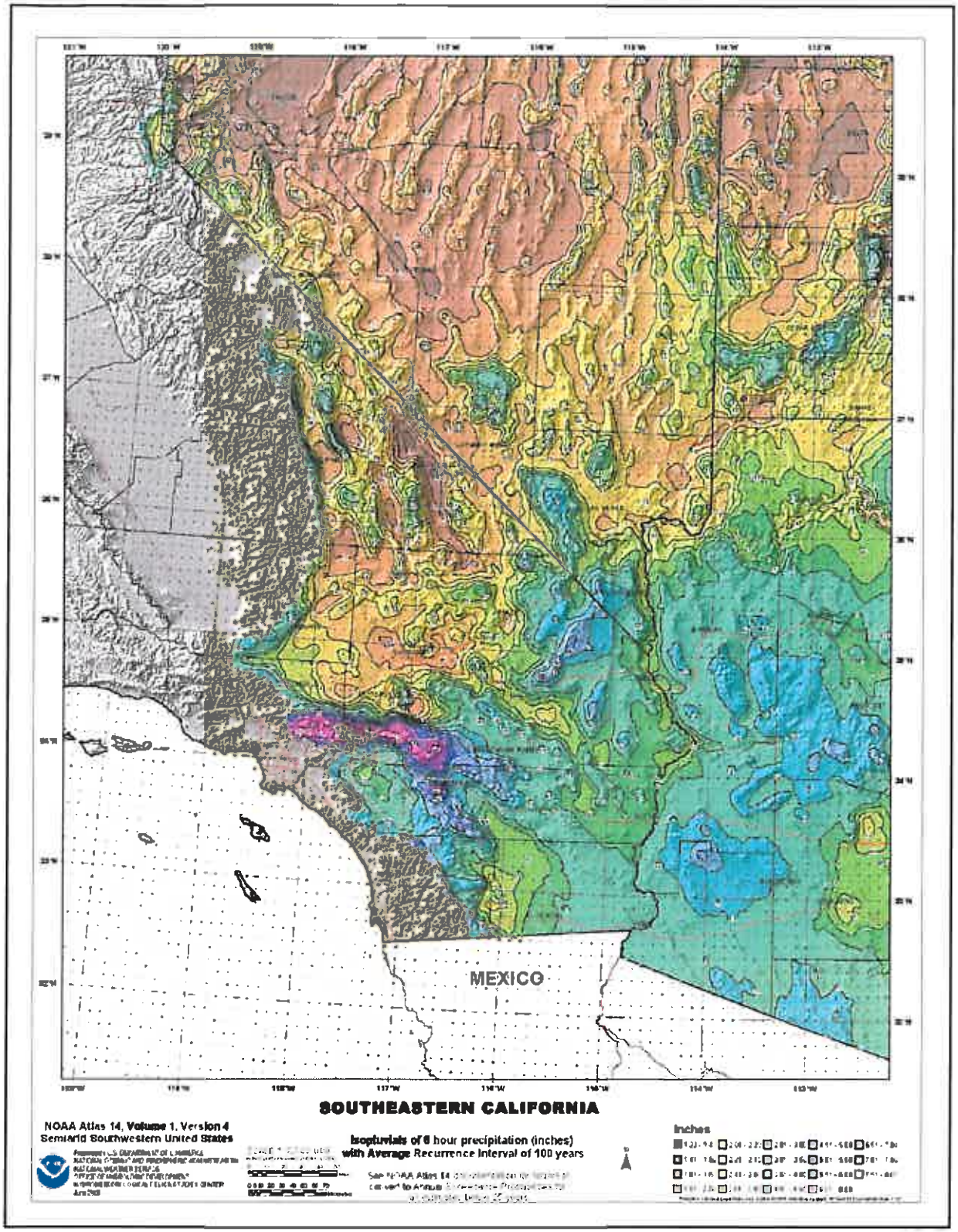

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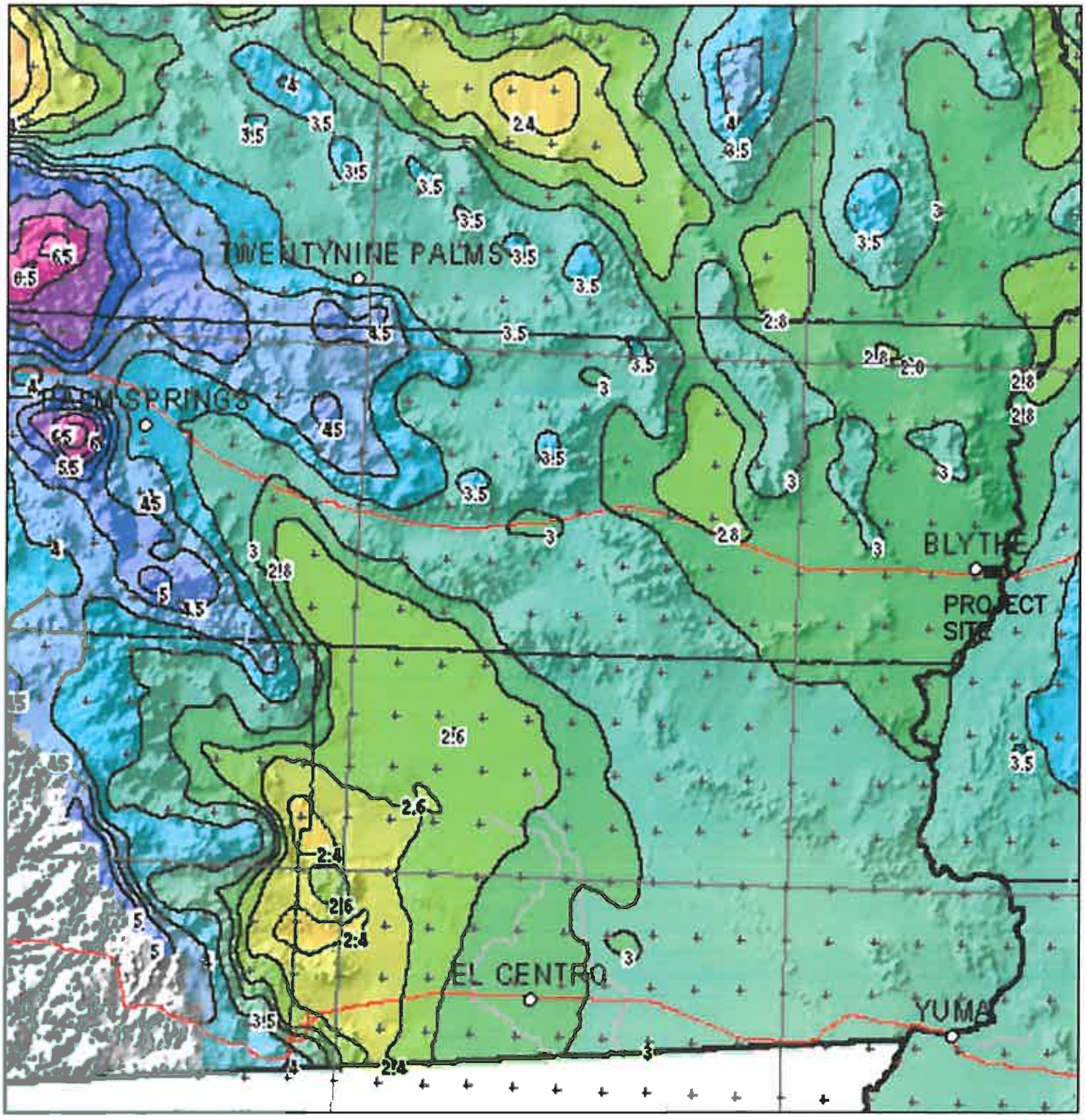
EXHIBIT D
100 YR. – 6 HR. RAINFALL
DETAIL



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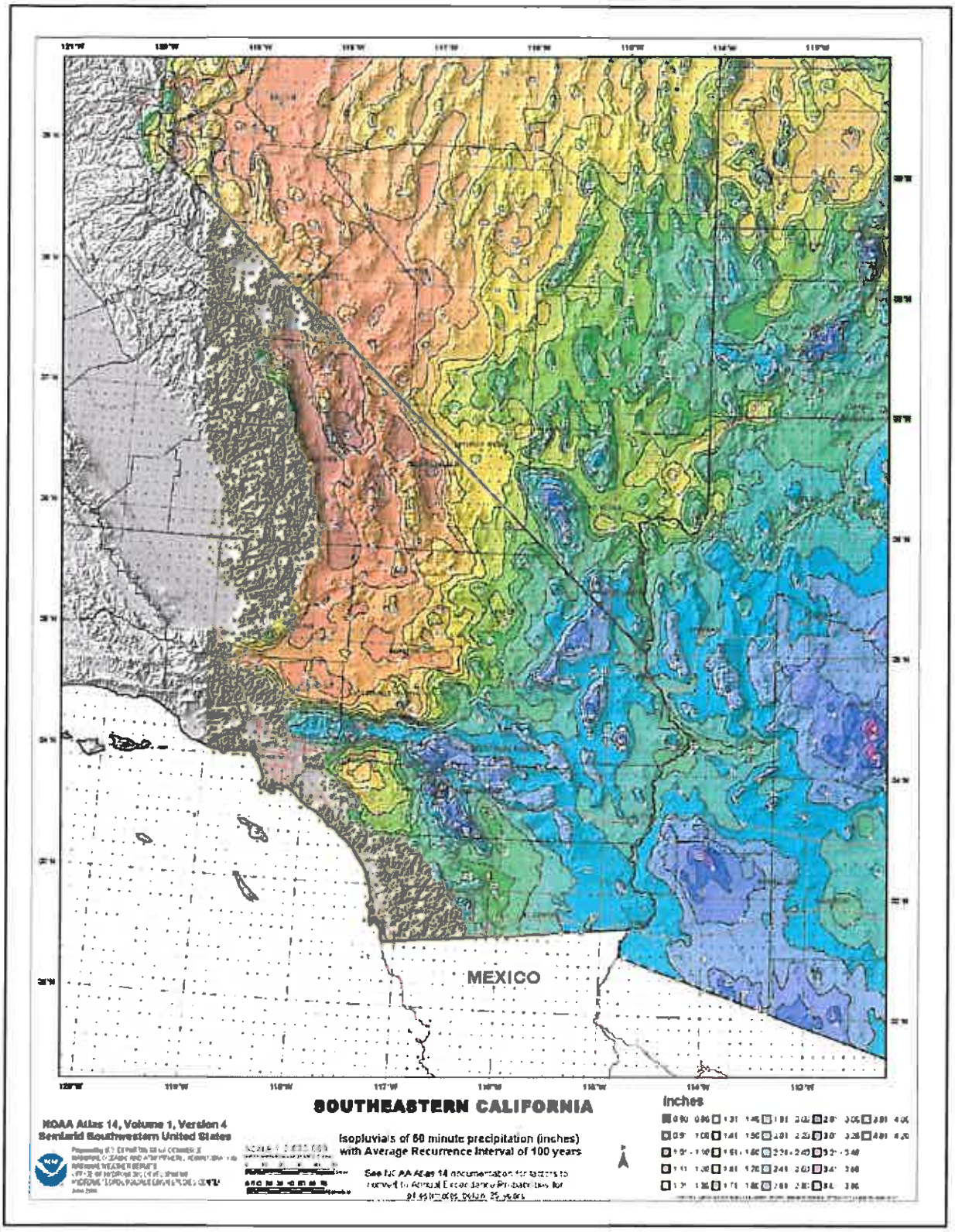
(928) 927-8699

EXHIBIT E
100 YR. – 1 HR. RAINFALL



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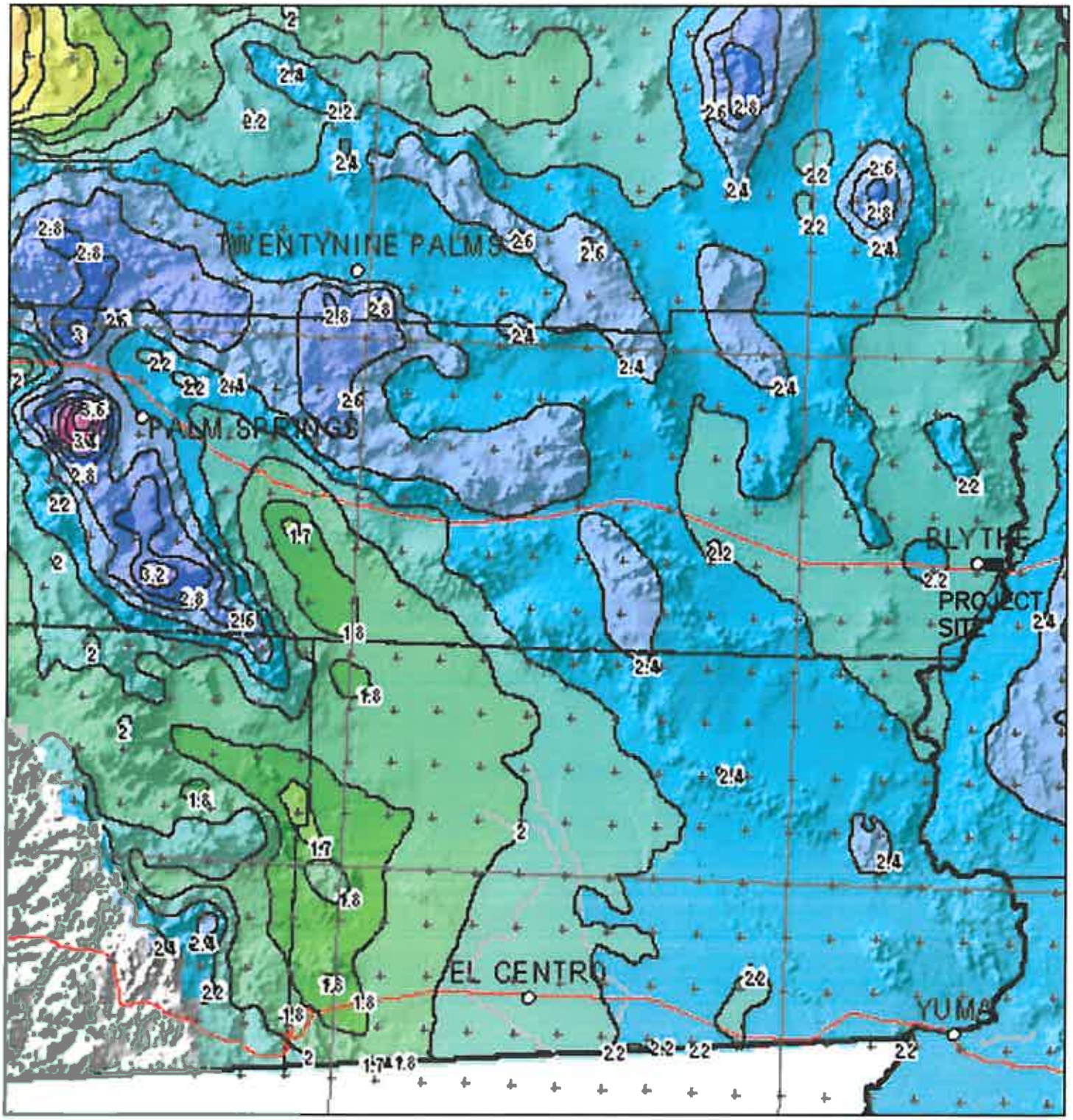
(760) 922-4658
(760) 337-3883
(928) 927-6699

EXHIBIT F
100 YR. – 1 HR. RAINFALL
DETAIL



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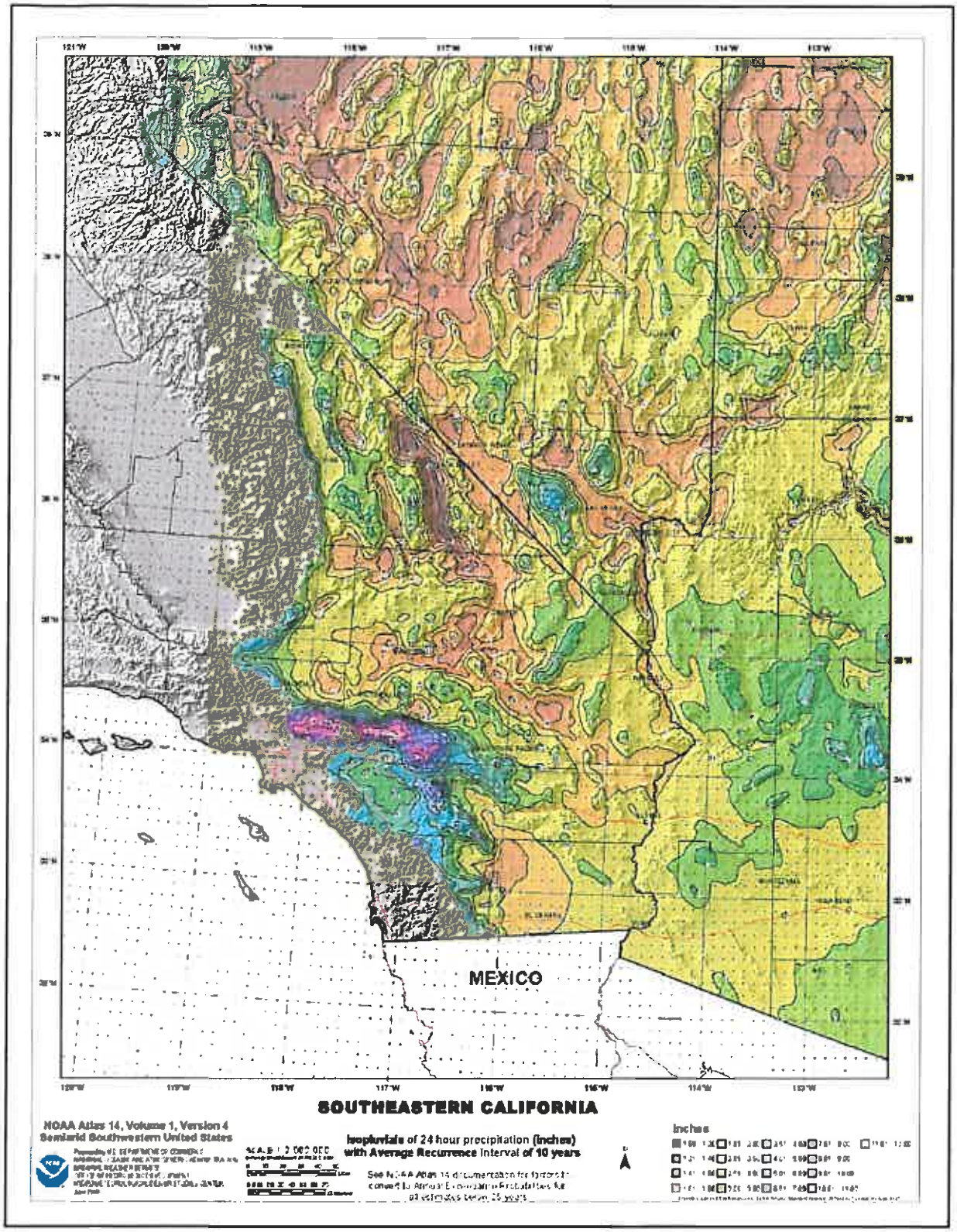
1601 Imperial Avenue — El Centro, California 92224 — (760) 337-3883
P.O. Box 2532 / 425 E. Main — Quartzsite, Arizona 85346 — (928) 927-8699

EXHIBIT G
10 YR. – 24 HR. RAINFALL



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P.O. Box 2532 / 425 E. Main — Quartzsite, Arizona 85346 — (928) 927-8699

EXHIBIT H
10 YR. – 24 HR. RAINFALL
DETAIL

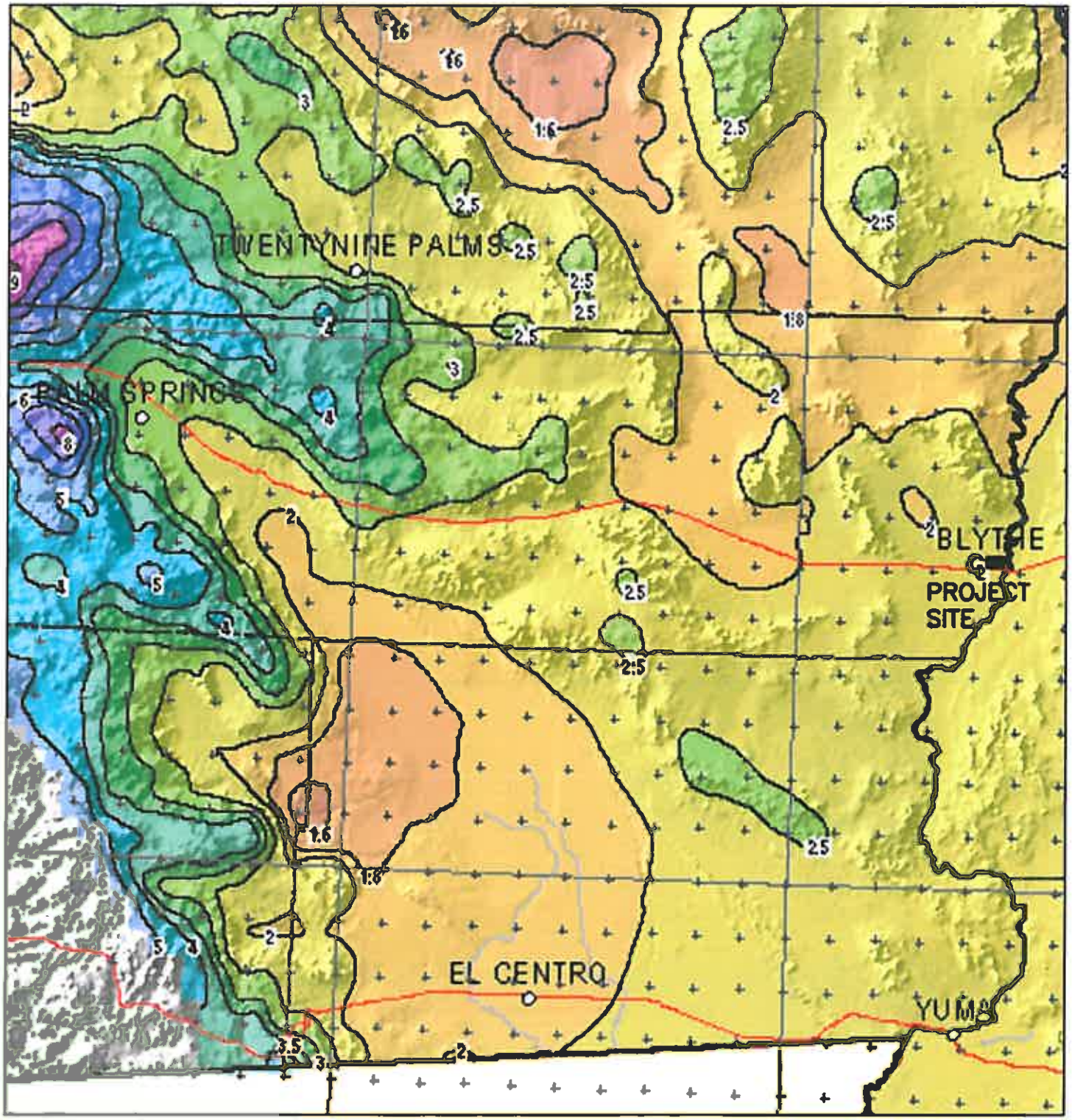

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EXHIBIT I
10 YR. – 6 HR. RAINFALL

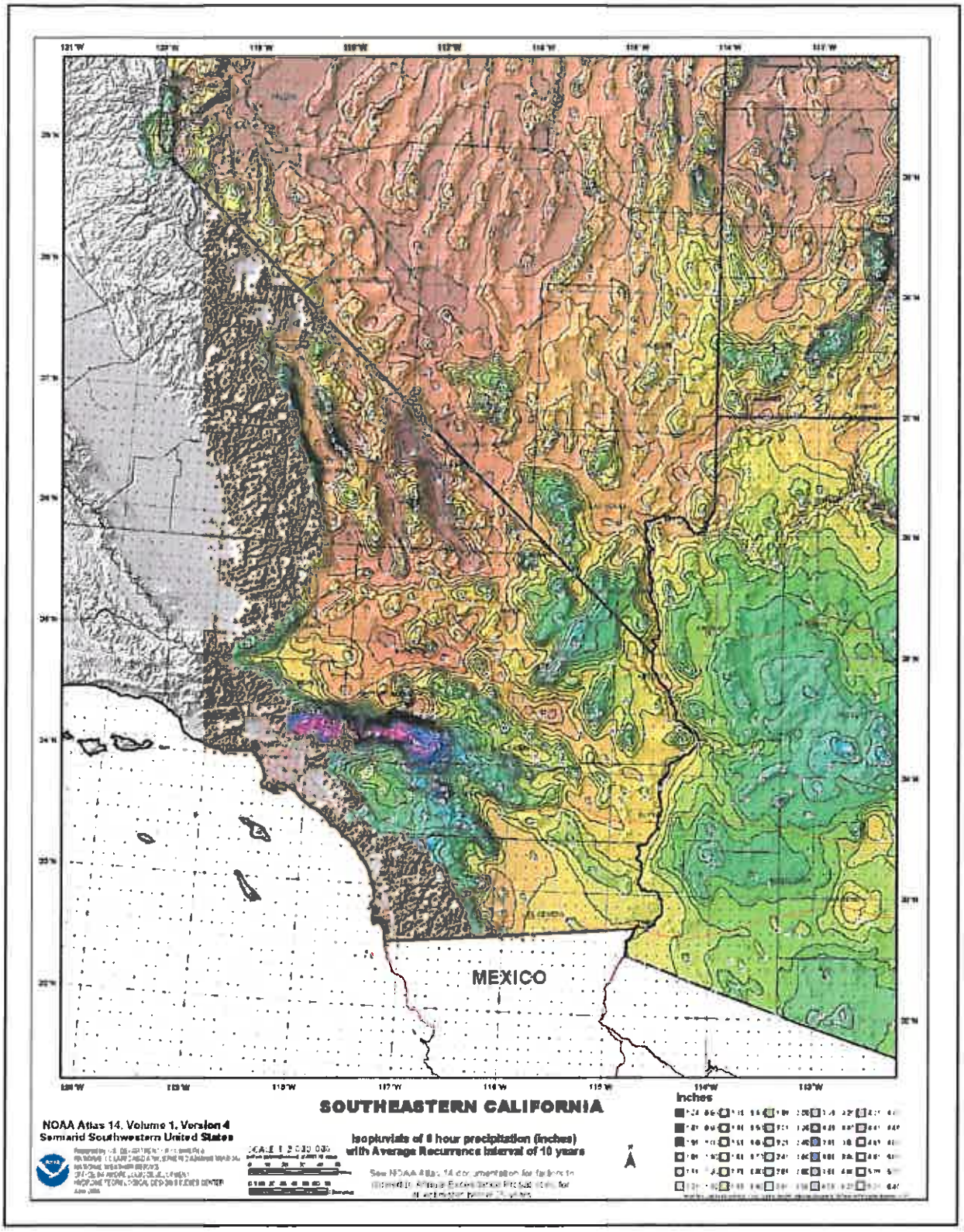

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EXHIBIT J
10 YR. – 6 HR. RAINFALL
DETAIL

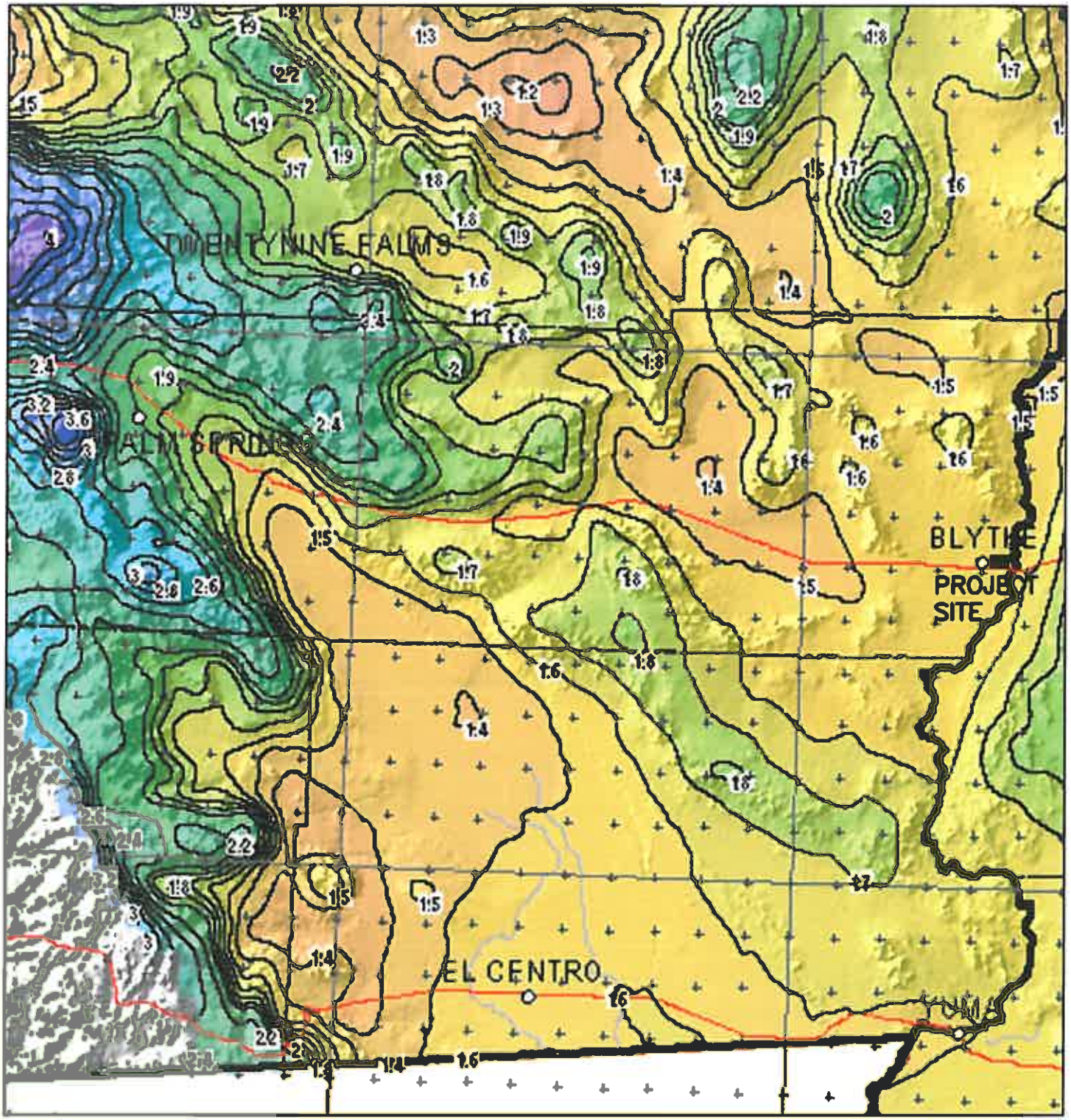

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EXHIBIT K
10 YR. – 1 HR. RAINFALL

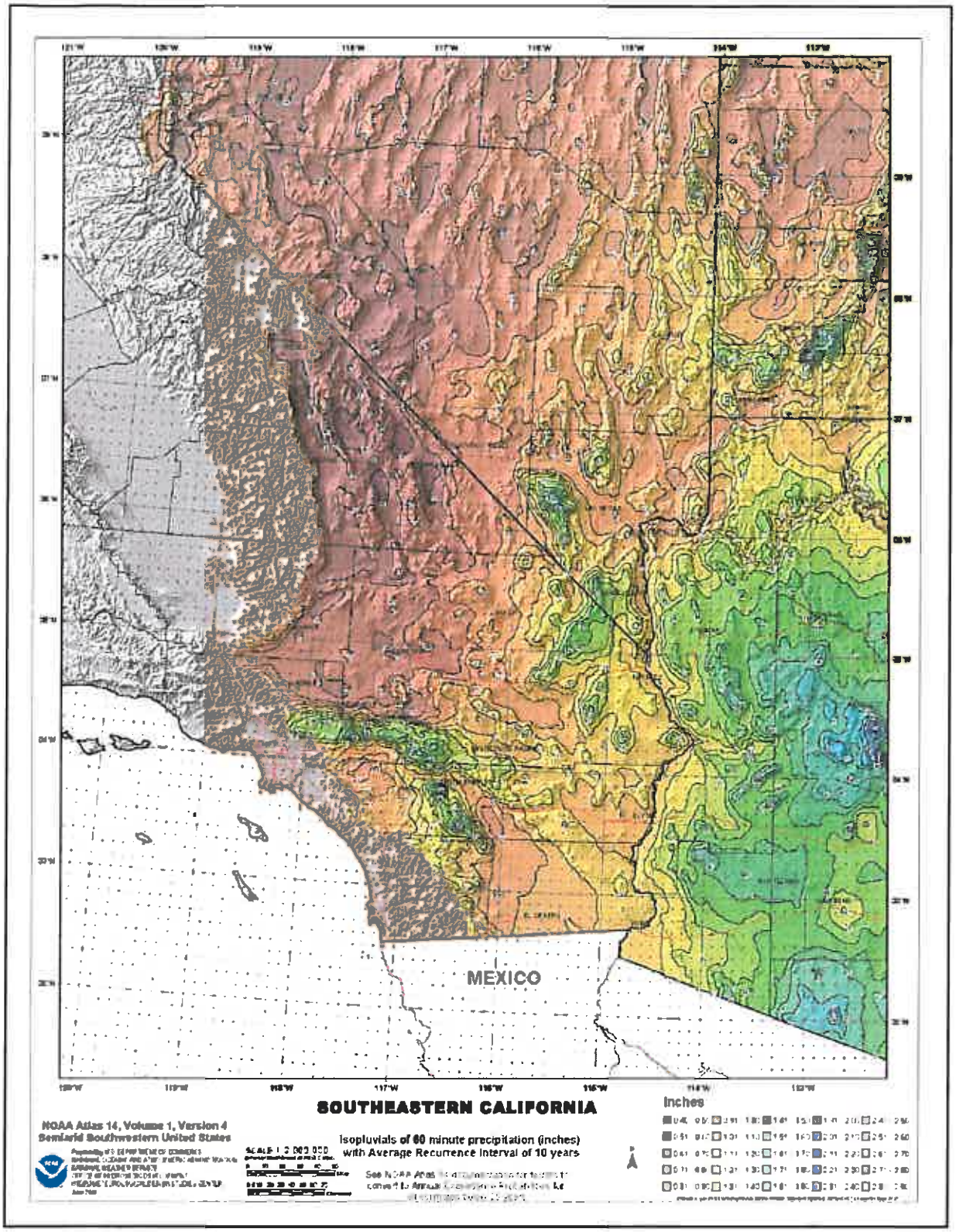

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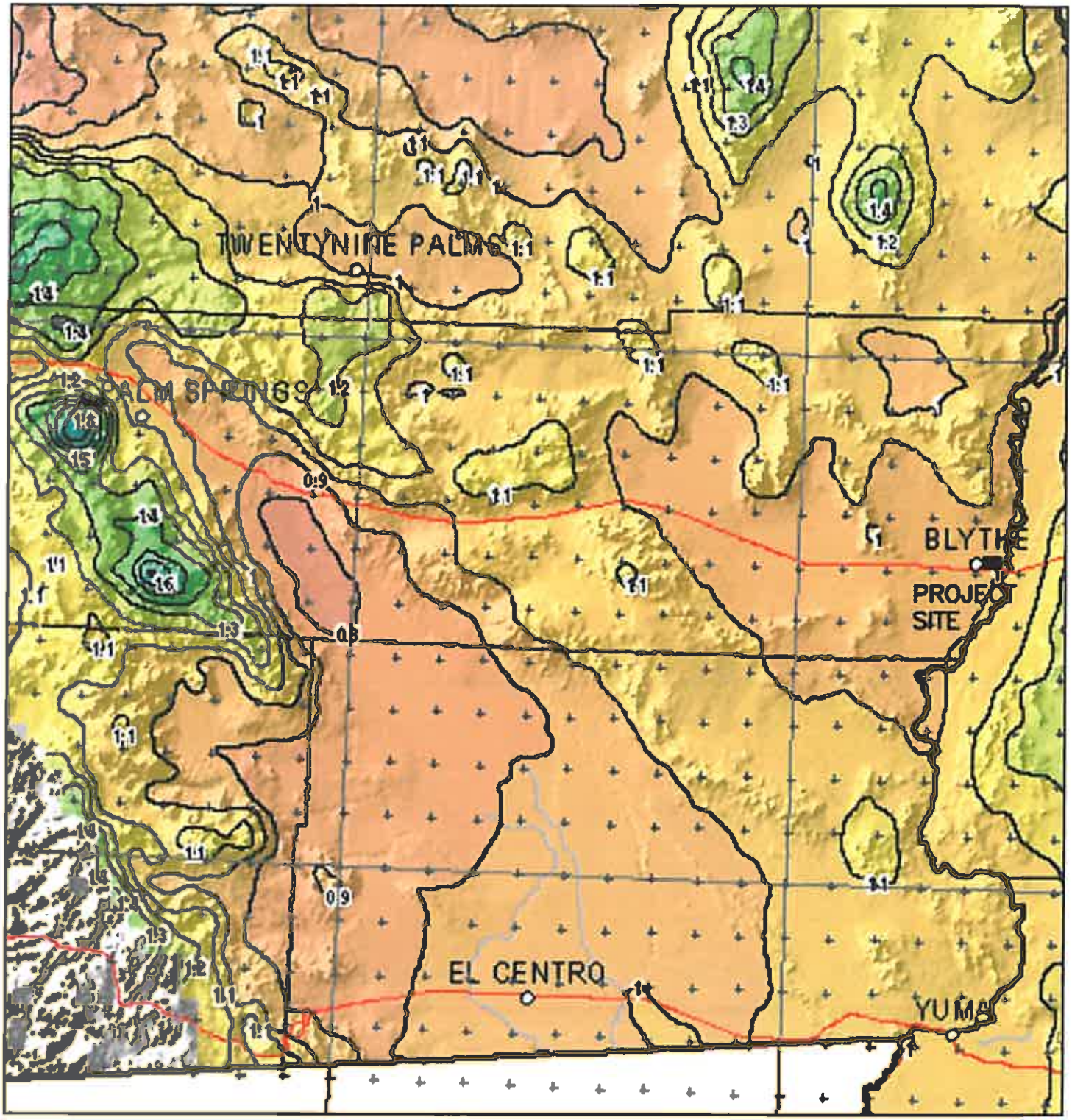
EXHIBIT L
10 YR. – 1 HR. RAINFALL
DETAIL



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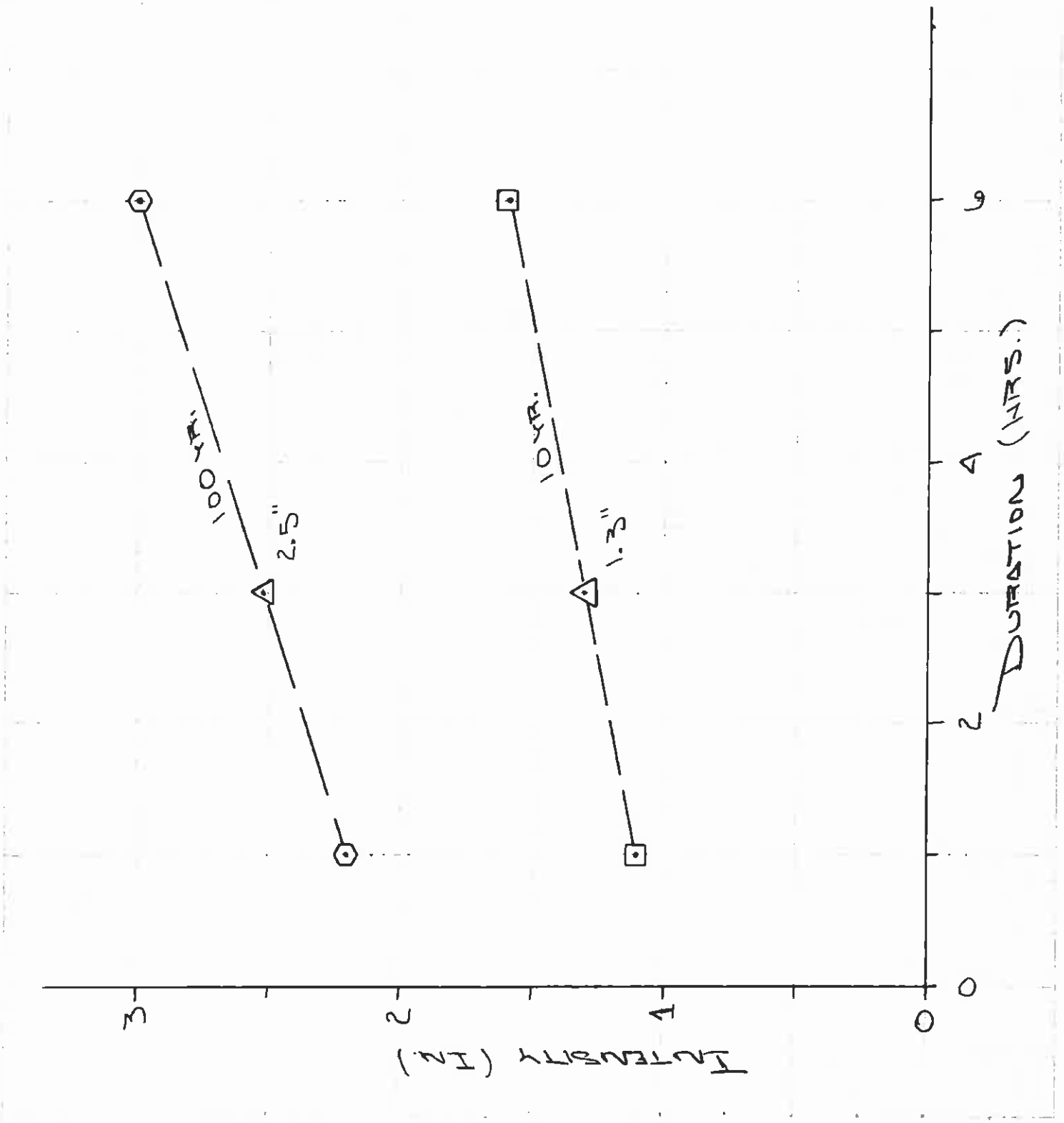
Project BLYTHE B.P.

Sheet 1 of 1

Date 8-17-11

Drawn by

EXHIBIT M



SECTION 3

HYDROLOGY CALCULATIONS
ON-SITE

RCFCD SYNTHETIC UNIT HYDROGRAPH - SHORTCUT METHOD

DATA INPUT SHEET

DATE	July 16, 2012
WORKSHEET PREPARED BY:	N.O.
PROJECT NAME	Blythe LCNG
PROJECT NUMBER	
CONCENTRATION POINT DESIGNATION	
AREA DESIGNATION	On site area
AMC NUMBER	2

Low Loss Conditions: X=Existing; D=Developed; BS=Retention

AREA DESIG	SOIL GROUP	TRIBUTARY AREAS	ACRES	LOW LOSS CONDITION	RI NUMBER	AMC II INFILTRATION RATE	IMPERVIOUS PERCENT
7	B	PAVING/HARDSCAPE	0.07	D	56	0.51	1.00
11	B	EXISTING BARREN	1.02	X	86	0.18	0.05

LENGTH OF WATERCOURSE (L)	400 ft
LENGTH TO POINT OPPOSITE CENTROID (Lca)	200 ft
ELEVATION OF HEADWATER	265.0 ft
ELEVATION OF CONCENTRATION POINT	260.0 ft
AVERAGE MANNINGS 'N' VALUE	0.02
STORM FREQUENCY (YEAR)	10
POINT RAIN	
1-HOUR	1.10 in
3-HOUR	1.30 in
6-HOUR	1.60 in
24-HOUR	2.20 in

BASIN CHARACTERISTICS:

ELEVATION	AREA
1.0 ft	1,500 sf
2.0 ft	3,200 sf
3.0 ft	5,100 sf
4.0 ft	7,500 sf

PERCOLATION RATE (in/hr)	1.0 in/hr
DRYWELL DATA	
NUMBER USED	0
PERCOLATION RATE	0.15 cfs
LOWEST FLOWLINE ELEVATION	
LOWEST PAD ELEVATION	

RCFC & WCD HYDROLOGY MANUAL	SYNTHETIC UNIT HYDROGRAPH METHOD BASIC DATA CALCULATION FORM	PROJECT: Blythe LCNG Job No.: BY: N.O. DATE: 7/16/12

PHYSICAL DATA

[1] CONCENTRATION POINT	
[2] AREA DESIGNATION	On site area
[3] AREA - ACRES	1.09
[4] L-FEET	400
[5] L-MILES	0.076
[6] La-FEET	200.00
[7] La-MILES	0.038
[8] ELEVATION OF HEADWATER	265
[9] ELEVATION OF CONCENTRATION POINT	260
[10] H-FEET	5
[11] S-FEET/MILE	66.0
[12] S^0.5	8.12
[13] L*LCA/S^0.5	0.000
[14] AVERAGE MANNINGS 'N'	0.02
[15] LAG TIME-HOURS	0.02
[16] LAG TIME-MINUTES	1.4
[17] 100% OF LAG-MINUTES	1.4
[18] 200% OF LAG-MINUTES	2.8

RAINFALL DATA

[1] AMC	II
[2] FREQUENCY-YEARS	10
[3] STORM DURATION:	Point Rain
1-HOUR	1.10 in
3-HOUR	1.30 in
6-HOUR	1.60 in
24-HOUR	2.20 in

STORM EVENT SUMMARY

STORM DURATION		1-HOUR	3-HOUR	6-HOUR	24-HOUR
EFFECTIVE RAIN	(in)	0.94	0.82	0.74	0.53
FLOOD VOLUME	(cu-ft)	3,711	3,232	2,933	2,091
	(acre-ft)	0.09	0.07	0.07	0.05
REQUIRED STORAGE	(cu-ft)	3,505	2,714	2,255	794
	(acre-ft)	0.08	0.06	0.05	0.02
FACTOR OF SAFETY		3.62	4.67	5.62	15.97
STORAGE PROVIDED	(cu-ft)	12,672			
	(acre-ft)	0.29			
PEAK FLOW	(cfs)	4.83	1.23	1.00	0.17
MAXIMUM WSEL	(ft)	2.29	2.10	1.98	1.35
DEPTH	(ft)	1.29	1.10	0.98	0.35
LOWEST FLOWLINE ELEVATION					
DIFFERENCE	(ft)				
LOWEST PAD ELEVATION					
DIFFERENCE	(ft)				
ESTIMATED TIME TO DEWATER BASIN Based on Total Flood Volume & Average Percolation Rate	(days)	0.8	0.7	0.8	0.6

NOTE: PEAK FLOW FOR THE 1-HOUR STORM IS NOT REPRESENTATIVE. PER RCFCD PEAK DISCHARGES FROM THE 3-HOUR STORM SHOULD NORMALLY COMPARE WELL WITH RATIONAL PEAKS.

RCFC & WCD HYDROLOGY MANUAL	SYNTHETIC UNIT HYDROGRAPH METHOD BASIC DATA CALCULATION FORM AMC II	PROJECT: Blythe LCNG Job No.: BY: N.O. DATE. 7/16/12

AVERAGE ADJUSTED LOSS RATE

SOIL GROUP [Plate C-1]	LAND USE	RI NUMBER [Plate E-6.1]	PERVIOUS AREA INFILTRATION RATE (in/hr) [Plate E-6.2]	DECIMAL PERCENT OF AREA IMPERVIOUS [Plate E-6.3]	ADJUSTED INFILTRATION RATE (in/hr)	AREA	AREA WEIGHTED AVERAGE	MAX AVERAGE ADJUSTED INFILTRATION RATE (in/hr)	LOW LOSS CONDITION	LOW LOSS RATE PER RCFC/2322	MIN AVERAGE ADJUSTED INFILTRATION RATE
B	PAVING/HARDSCAPE	56	0.51	100%	0.05	0.07	0.066	0.0034	DEVELOPED	0.1000	0.0066
B	EXISTING BARREN	86	0.18	5%	0.17	1.02	0.934	0.1606	UNDEVELOPED	0.9000	0.8407
					SUM	1.09	SUM	0.1639			0.8473

VARIABLE LOSS RATE CURVE (24-HOUR STORM ONLY)

Fm= 0.081964286

C= 0.00152

$F_t = C(24-(T/60))^{1.55} + F_m$ = 0.00152 (24-(T/60))^1.55 + 0.08 in/hr

CONSTANT LOSS RATE (3 & 6 HOUR STORMS) = 0.1639

LOW LOSS RATE = 0.8473

Where:

T=Time in minutes. To get an average value for each unit time period, Use T=1/2 the unit time for the first time period, T=1 1/2 unit time for the second period, etc.

NOTE: Low loss rates established per RCFC/2322 (Dated: May-30-95)

Undeveloped Condition: Low Loss = 90%

Developed Condition: Low Loss = 0.9 - (0.8 * %Impervious)

Basin Site: Low Loss = 10%

RCFC & WCD
HYDROLOGY
MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

1-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/18/12

DRAINAGE AREA-ACRES	1.09
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN-INCHES	1.10
CONSTANT LOSS RATE-in/hr	0.16
LOW LOSS RATE - PERCENT	84.73%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time Minutes	Time Hours	Pattern Percent (Plate E-5.9)	Storm Rain in/hr	Loss Rate in/hr Max	Loss Rate in/hr Low	Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume in cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total in Basin cu-ft	Total in Basin ac-ft	Basin WSEL ft
1	5	0.08	3.8	0.48	0.16	0.40	0.31	0.34	103	103	1,576	11	92	0.00	1.04
2	10	0.17	4.2	0.55	0.16	0.47	0.39	0.43	129	221	1,683	12	209	0.00	1.09
3	15	0.25	4.4	0.58	0.16	0.49	0.42	0.46	138	347	1,757	12	335	0.01	1.15
4	20	0.33	4.6	0.61	0.16	0.51	0.44	0.49	146	481	1,856	13	468	0.01	1.20
5	25	0.42	5.0	0.66	0.16	0.56	0.50	0.55	164	632	1,968	14	619	0.01	1.27
6	30	0.50	5.6	0.74	0.16	0.63	0.58	0.63	190	809	2,098	15	794	0.02	1.35
7	35	0.58	6.4	0.84	0.16	0.72	0.68	0.75	225	1,019	2,254	16	1,003	0.02	1.44
8	40	0.67	8.1	1.07	0.16	0.91	0.91	1.00	299	1,302	2,464	17	1,285	0.03	1.56
9	45	0.75	13.1	1.73	0.16	1.47	1.57	1.72	517	1,802	2,834	20	1,783	0.04	1.78
10	50	0.83	34.5	4.55	0.16	3.88	4.39	4.83	1,450	3,233	3,832	25	3,208	0.07	2.22
11	55	0.92	6.7	0.88	0.16	0.75	0.72	0.79	238	3,446	3,731	26	3,420	0.08	2.27
12	60	1.00	3.8	0.50	0.16	0.42	0.34	0.37	112	3,531	3,770	26	3,505	0.08	2.29

EFFECTIVE RAIN & FLOOD VOLUMES SUMMARY

EFFECTIVE **RAIN**	**0.94** in
FLOOD **VOLUME**	**0.09** ac-ft
FLOOD **VOLUME**	**3,711** cu-ft
REQUIRED **STORAGE**	**0.08** ac-ft
REQUIRED **STORAGE**	**3,505** cu-ft
MAX **WSEL**	**2.29** ft
PEAK **FLOW RATE**	**4.83** cfs
AVERAGE PERCOLATION RATE	3.43 cuft/min

RCFC & WCD
HYDROLOGY
MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

3-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE

DRAINAGE AREA-ACRES	1.09
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN (in)	1.30
CONSTANT LOSS RATE (in/hr)	0.16
LOW LOSS RATE - PERCENT	84.73%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern Percent	Storm Rain in/hr	Loss Rate in/hr		Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume In cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total In Basin		Basin WSEL ft
	Minutes	Hours	(Plate E-5.9)		Max	Low							cu-ft	ac-ft	
1	5	0.08	1.3	0.20	0.16	0.17	0.04	0.04	13	13	1,510	10	2	0.00	1.00
2	10	0.17	1.3	0.20	0.16	0.17	0.04	0.04	13	15	1,511	10	5	0.00	1.00
3	15	0.25	1.1	0.17	0.16	0.15	0.01	0.01	3	7	1,505	10	0	0.00	1.00
4	20	0.33	1.5	0.23	0.16	0.20	0.07	0.08	23	23	1,517	11	13	0.00	1.01
5	25	0.42	1.5	0.23	0.16	0.20	0.07	0.08	23	36	1,526	11	25	0.00	1.01
6	30	0.50	1.8	0.28	0.16	0.24	0.12	0.13	39	64	1,547	11	53	0.00	1.02
7	35	0.58	1.5	0.23	0.16	0.20	0.07	0.08	23	76	1,556	11	65	0.00	1.03
8	40	0.67	1.8	0.28	0.16	0.24	0.12	0.13	39	104	1,577	11	93	0.00	1.04
9	45	0.75	1.8	0.28	0.16	0.24	0.12	0.13	39	132	1,597	11	121	0.00	1.05
10	50	0.83	1.5	0.23	0.16	0.20	0.07	0.08	23	144	1,606	11	133	0.00	1.06
11	55	0.92	1.6	0.25	0.16	0.21	0.09	0.09	28	161	1,619	11	150	0.00	1.07
12	60	1.00	1.8	0.28	0.16	0.24	0.12	0.13	39	188	1,639	11	177	0.00	1.08
13	65	1.08	2.2	0.34	0.16	0.29	0.18	0.20	59	236	1,675	12	224	0.01	1.10
14	70	1.17	2.2	0.34	0.16	0.29	0.18	0.20	59	284	1,710	12	272	0.01	1.12
15	75	1.25	2.2	0.34	0.16	0.29	0.18	0.20	59	331	1,745	12	319	0.01	1.14
16	80	1.33	2.0	0.31	0.16	0.26	0.15	0.16	49	368	1,772	12	355	0.01	1.15
17	85	1.42	2.6	0.41	0.16	0.34	0.24	0.27	80	435	1,822	13	423	0.01	1.18
18	90	1.50	2.7	0.42	0.16	0.36	0.26	0.28	85	508	1,876	13	495	0.01	1.22
19	95	1.58	2.4	0.37	0.16	0.32	0.21	0.23	70	564	1,917	13	551	0.01	1.24
20	100	1.67	2.7	0.42	0.16	0.36	0.26	0.28	85	636	1,971	14	622	0.01	1.27
21	105	1.75	3.3	0.51	0.16	0.44	0.35	0.39	116	738	2,046	14	724	0.02	1.32
22	110	1.83	3.1	0.48	0.16	0.41	0.32	0.35	106	829	2,114	15	815	0.02	1.35
23	115	1.92	2.9	0.45	0.16	0.38	0.29	0.32	95	910	2,173	15	895	0.02	1.39
24	120	2.00	3.0	0.47	0.16	0.40	0.30	0.33	100	995	2,237	16	980	0.02	1.43

RCFC & WCD
HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

3-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE

DRAINAGE AREA-ACRES	1.09
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN (In)	1.30
CONSTANT LOSS RATE (In/hr)	0.16
LOW LOSS RATE - PERCENT	84.73%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern Percent	Storm Rain in/hr	Loss Rate In/hr		Effective Rain	Flood Hydrograph Flow	Volume In	Basin Volume	Percolation Area	Percolation Out	Total In Basin		Basin WSEL
	Minutes	Hours	(Plate E-5.9)		Max	Low	in/hr	cfs	cu-ft	cu-ft	sf	cu-ft	cu-ft	ac-ft	ft
25	125	2.08	3.1	0.48	0.16	0.41	0.32	0.35	106	1,085	2,303	16	1,069	0.02	1.47
26	130	2.17	4.2	0.66	0.16	0.58	0.49	0.54	162	1,232	2,412	17	1,215	0.03	1.53
27	135	2.25	5.0	0.78	0.16	0.66	0.62	0.68	204	1,418	2,550	18	1,401	0.03	1.61
28	140	2.33	3.5	0.55	0.16	0.46	0.38	0.42	126	1,527	2,630	18	1,509	0.03	1.66
29	145	2.42	6.8	1.06	0.16	0.90	0.90	0.99	296	1,805	2,636	20	1,785	0.04	1.78
30	150	2.50	7.3	1.14	0.16	0.98	0.97	1.07	322	2,107	3,060	21	2,086	0.05	1.91
31	155	2.58	8.2	1.28	0.16	1.08	1.12	1.23	368	2,454	3,273	23	2,432	0.06	2.03
32	160	2.67	5.9	0.92	0.16	0.78	0.76	0.83	250	2,682	3,378	23	2,658	0.06	2.09
33	165	2.75	2.0	0.31	0.16	0.26	0.15	0.16	49	2,707	3,389	24	2,684	0.06	2.09
34	170	2.83	1.6	0.28	0.16	0.24	0.12	0.13	39	2,722	3,398	24	2,699	0.06	2.10
35	175	2.92	1.8	0.28	0.16	0.24	0.12	0.13	39	2,737	3,403	24	2,714	0.06	2.10
36	180	3.00	0.6	0.09	0.16	0.08	0.01	0.02	5	2,718	3,395	24	2,695	0.06	2.10

EFFECTIVE RAIN & FLOOD VOLUMES SUMMARY

EFFECTIVE RAIN	0.82	in
FLOOD VOLUME	0.07	ac-ft
FLOOD VOLUME	3,232	cu-ft
REQUIRED STORAGE	0.06	ac-ft
REQUIRED STORAGE	2,714	cu-ft
MAX WSEL	2.10	ft
PEAK FLOW RATE	1.23	cfs
AVERAGE PERCOLATION RATE	3.00	cuft/min

RCFC & WCD
HYDROLOGY
MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

6-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.09
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN (in)	1.60
CONSTANT LOSS RATE (in/hr)	0.16
LOW LOSS RATE - PERCENT	84.73%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern Percent	Storm Rain	Loss Rate in/hr		Effective Rain	Flood Hydrograph Flow	Volume In	Basin Volume	Percolation Area	Percolation Out	Total In Basin		Basin WSEL
	Minutes	Hours	(Plate E-5.9)	in/hr	Max	Low	in/hr	cfs	cu-ft	cu-ft	sf	cu-ft	cu-ft	ac-ft	ft
1	5	0.08	0.5	0.10	0.16	0.08	0.01	0.02	5	5	1,504	10	0	0.00	1.00
2	10	0.17	0.6	0.12	0.16	0.10	0.02	0.02	6	6	1,504	10	0	0.00	1.00
3	15	0.25	0.6	0.12	0.16	0.10	0.02	0.02	6	6	1,504	10	0	0.00	1.00
4	20	0.33	0.6	0.12	0.16	0.10	0.02	0.02	6	6	1,504	10	0	0.00	1.00
5	25	0.42	0.6	0.12	0.16	0.10	0.02	0.02	6	6	1,504	10	0	0.00	1.00
6	30	0.50	0.7	0.13	0.16	0.11	0.02	0.02	7	7	1,505	10	0	0.00	1.00
7	35	0.58	0.7	0.13	0.16	0.11	0.02	0.02	7	7	1,505	10	0	0.00	1.00
8	40	0.67	0.7	0.13	0.16	0.11	0.02	0.02	7	7	1,505	10	0	0.00	1.00
9	45	0.75	0.7	0.13	0.16	0.11	0.02	0.02	7	7	1,505	10	0	0.00	1.00
10	50	0.83	0.7	0.13	0.16	0.11	0.02	0.02	7	7	1,505	10	0	0.00	1.00
11	55	0.92	0.7	0.13	0.16	0.11	0.02	0.02	7	7	1,505	10	0	0.00	1.00
12	60	1.00	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
13	65	1.08	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
14	70	1.17	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
15	75	1.25	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
16	80	1.33	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
17	85	1.42	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
18	90	1.50	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
19	95	1.58	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
20	100	1.67	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
21	105	1.75	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
22	110	1.83	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
23	115	1.92	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
24	120	2.00	0.9	0.17	0.16	0.15	0.01	0.01	3	3	1,502	10	0	0.00	1.00
25	125	2.08	0.8	0.15	0.16	0.13	0.02	0.03	8	8	1,506	10	0	0.00	1.00
26	130	2.17	0.9	0.17	0.16	0.15	0.01	0.01	3	3	1,502	10	0	0.00	1.00
27	135	2.25	0.9	0.17	0.16	0.15	0.01	0.01	3	3	1,502	10	0	0.00	1.00
28	140	2.33	0.9	0.17	0.16	0.15	0.01	0.01	3	3	1,502	10	0	0.00	1.00
29	145	2.42	0.9	0.17	0.16	0.15	0.01	0.01	3	3	1,502	10	0	0.00	1.00
30	150	2.50	0.9	0.17	0.16	0.15	0.01	0.01	3	3	1,502	10	0	0.00	1.00
31	155	2.58	0.9	0.17	0.16	0.15	0.01	0.01	3	3	1,502	10	0	0.00	1.00
32	160	2.67	0.9	0.17	0.16	0.15	0.01	0.01	3	3	1,502	10	0	0.00	1.00
33	165	2.75	1.0	0.19	0.16	0.16	0.03	0.03	9	9	1,507	10	0	0.00	1.00
34	170	2.83	1.0	0.19	0.16	0.16	0.03	0.03	9	9	1,507	10	0	0.00	1.00

RCFC & WCD
HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

6-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.09
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN (in)	1.60
CONSTANT LOSS RATE (in/hr)	0.16
LOW LOSS RATE - PERCENT	84.73%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern Percent	Storm Rain in/hr	Loss Rate in/hr		Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume In cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total In Basin		Basin WSEL ft
	Minutes	Hours	(Plate E-5.9)		Max	Low							cu-ft	ac-ft	
35	175	2.92	1.0	0.19	0.16	0.16	0.03	0.03	9	9	1,507	10	0	0.00	1.00
36	180	3.00	1.0	0.19	0.16	0.16	0.03	0.03	9	9	1,507	10	0	0.00	1.00
37	185	3.08	1.0	0.19	0.16	0.16	0.03	0.03	9	9	1,507	10	0	0.00	1.00
38	190	3.17	1.1	0.21	0.16	0.18	0.05	0.05	16	16	1,512	10	5	0.00	1.00
39	195	3.25	1.1	0.21	0.16	0.18	0.05	0.05	16	21	1,515	11	10	0.00	1.00
40	200	3.33	1.1	0.21	0.16	0.18	0.05	0.05	16	26	1,519	11	15	0.00	1.01
41	205	3.42	1.2	0.23	0.16	0.20	0.07	0.07	22	37	1,528	11	27	0.00	1.01
42	210	3.50	1.3	0.25	0.16	0.21	0.09	0.09	28	55	1,541	11	44	0.00	1.02
43	215	3.58	1.4	0.27	0.16	0.23	0.10	0.12	35	79	1,558	11	68	0.00	1.03
44	220	3.67	1.4	0.27	0.16	0.23	0.10	0.12	35	103	1,576	11	92	0.00	1.04
45	225	3.75	1.5	0.29	0.16	0.24	0.12	0.14	41	133	1,598	11	122	0.00	1.05
46	230	3.83	1.5	0.29	0.16	0.24	0.12	0.14	41	163	1,620	11	151	0.00	1.07
47	235	3.92	1.6	0.31	0.16	0.26	0.14	0.16	47	199	1,647	11	187	0.00	1.08
48	240	4.00	1.6	0.31	0.16	0.26	0.14	0.16	47	235	1,674	12	223	0.01	1.10
49	245	4.08	1.7	0.33	0.16	0.28	0.16	0.18	54	277	1,705	12	265	0.01	1.12
50	250	4.17	1.8	0.35	0.16	0.29	0.18	0.20	60	325	1,740	12	313	0.01	1.14
51	255	4.25	1.9	0.36	0.16	0.31	0.20	0.22	66	379	1,781	12	367	0.01	1.16
52	260	4.33	2.0	0.38	0.16	0.33	0.22	0.24	73	439	1,825	13	427	0.01	1.19
53	265	4.42	2.1	0.40	0.16	0.34	0.24	0.26	79	506	1,874	13	493	0.01	1.21
54	270	4.50	2.1	0.40	0.16	0.34	0.24	0.26	79	572	1,923	13	558	0.01	1.24
55	275	4.58	2.2	0.42	0.16	0.36	0.26	0.28	85	644	1,976	14	630	0.01	1.27
56	280	4.67	2.3	0.44	0.16	0.37	0.28	0.31	92	722	2,034	14	708	0.02	1.31
57	285	4.75	2.4	0.46	0.16	0.39	0.30	0.33	98	806	2,096	15	791	0.02	1.34
58	290	4.83	2.4	0.46	0.16	0.39	0.30	0.33	98	889	2,158	15	874	0.02	1.38
59	295	4.92	2.5	0.48	0.16	0.41	0.32	0.35	104	979	2,224	15	963	0.02	1.42
60	300	5.00	2.6	0.50	0.16	0.42	0.34	0.37	111	1,074	2,295	16	1,058	0.02	1.46
61	305	5.08	3.1	0.60	0.16	0.50	0.43	0.47	142	1,201	2,389	17	1,184	0.03	1.52
62	310	5.17	3.6	0.69	0.16	0.59	0.53	0.58	174	1,358	2,505	17	1,341	0.03	1.58
63	315	5.25	3.9	0.75	0.16	0.63	0.58	0.64	193	1,534	2,635	18	1,516	0.03	1.66
64	320	5.33	4.2	0.81	0.16	0.66	0.64	0.71	212	1,728	2,779	19	1,709	0.04	1.74
65	325	5.42	4.7	0.90	0.16	0.76	0.74	0.81	244	1,952	2,945	20	1,932	0.04	1.84
66	330	5.50	5.6	1.08	0.16	0.91	0.91	1.00	301	2,233	3,153	22	2,211	0.05	1.96
67	335	5.58	1.9	0.36	0.16	0.31	0.20	0.22	66	2,278	3,166	22	2,255	0.05	1.98
68	340	5.67	0.9	0.17	0.16	0.15	0.01	0.01	3	2,258	3,171	22	2,236	0.05	1.97

RCFC & WCD
HYDROLOGY
MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

6-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.09
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN (In)	1.60
CONSTANT LOSS RATE (In/hr)	0.16
LOW LOSS RATE - PERCENT	84.73%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern Percent	Storm Rain	Loss Rate in/hr		Effective Rain	Flood Hydrograph Flow	Volume In	Basin Volume	Percolation Area	Percolation Out	Total In Basin		Basin WSEL
	Minutes	Hours	(Plate E-5.9)	In/hr	Max	Low	In/hr	cfs	cu-ft	cu-ft	sf	cu-ft	cu-ft	ac-ft	ft
69	345	5.75	0.6	0.12	0.16	0.10	0.02	0.02	6	2,242	3,159	22	2,220	0.05	1.97
70	350	5.83	0.5	0.10	0.16	0.08	0.01	0.02	5	2,225	3,147	22	2,203	0.05	1.96
71	355	5.92	0.3	0.06	0.16	0.05	0.01	0.01	3	2,206	3,133	22	2,184	0.05	1.95
72	360	6.00	0.2	0.04	0.16	0.03	0.01	0.01	2	2,186	3,118	22	2,165	0.05	1.94

EFFECTIVE RAIN & FLOOD VOLUMES SUMMARY

EFFECTIVE RAIN	0.74 in
FLOOD VOLUME	0.07 ac-ft
FLOOD VOLUME	2,933 cu-ft
REQUIRED STORAGE	0.05 ac-ft
REQUIRED STORAGE	2,255 cu-ft
MAX WSEL	1.98 ft
PEAK FLOW RATE	1.00 cfs
AVERAGE PERCOLATION RATE	2.54 cuft/min

RCFC & WCD
HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

24-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.09	VARIABLE LOSS RATE (AVG) IN/HR	
UNIT TIME-MINUTES	15	Fm = Minimum value on loss curve (in/hr)	0.08
LAG TIME - MINUTES	1.40	C	0.00152
UNIT TIME-PERCENT OF LAG	1068%	Low Loss Rate (percent)	84.73%
TOTAL ADJUSTED STORM RAIN (in)	2.20		

Basin Percolation Rate 1.0 in/hr

Maxwell Drywells
Number 0
Drywell Percolation Rate 0.15 cfs 0.00 cfm

Unit Time Period	Time Minutes	Hours	Pattern Percent (Plate E-5.8)	Storm Rain In/hr	Loss Rate In/hr Max	Loss Rate In/hr Low	Effective Rain In/hr	Flood Hydrograph Flow cfs	Volume In cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total In Basin cu-ft	Total In Basin ac-ft	Basin WSEL ft
1	15	0.25	0.2	0.018	0.289	0.015	0.00	0.00	3	3	1,502	31	0	0.00	1.00
2	30	0.50	0.3	0.026	0.286	0.022	0.00	0.00	4	4	1,503	31	0	0.00	1.00
3	45	0.75	0.3	0.026	0.283	0.022	0.00	0.00	4	4	1,503	31	0	0.00	1.00
4	60	1.00	0.4	0.035	0.279	0.030	0.01	0.01	5	5	1,504	31	0	0.00	1.00
5	75	1.25	0.3	0.026	0.276	0.022	0.00	0.00	4	4	1,503	31	0	0.00	1.00
6	90	1.50	0.3	0.026	0.273	0.022	0.00	0.00	4	4	1,503	31	0	0.00	1.00
7	105	1.75	0.3	0.026	0.270	0.022	0.00	0.00	4	4	1,503	31	0	0.00	1.00
8	120	2.00	0.4	0.035	0.266	0.030	0.01	0.01	5	5	1,504	31	0	0.00	1.00
9	135	2.25	0.4	0.035	0.263	0.030	0.01	0.01	5	5	1,504	31	0	0.00	1.00
10	150	2.50	0.4	0.035	0.260	0.030	0.01	0.01	5	5	1,504	31	0	0.00	1.00
11	165	2.75	0.5	0.044	0.257	0.037	0.01	0.01	7	7	1,505	31	0	0.00	1.00
12	180	3.00	0.5	0.044	0.254	0.037	0.01	0.01	7	7	1,505	31	0	0.00	1.00
13	195	3.25	0.5	0.044	0.250	0.037	0.01	0.01	7	7	1,505	31	0	0.00	1.00
14	210	3.50	0.5	0.044	0.247	0.037	0.01	0.01	7	7	1,505	31	0	0.00	1.00
15	225	3.75	0.5	0.044	0.244	0.037	0.01	0.01	7	7	1,505	31	0	0.00	1.00
16	240	4.00	0.6	0.053	0.241	0.045	0.01	0.01	8	8	1,506	31	0	0.00	1.00
17	255	4.25	0.6	0.053	0.238	0.045	0.01	0.01	8	8	1,506	31	0	0.00	1.00
18	270	4.50	0.7	0.062	0.235	0.052	0.01	0.01	9	9	1,507	31	0	0.00	1.00
19	285	4.75	0.7	0.062	0.232	0.052	0.01	0.01	9	9	1,507	31	0	0.00	1.00
20	300	5.00	0.8	0.070	0.229	0.060	0.01	0.01	11	11	1,508	31	0	0.00	1.00
21	315	5.25	0.8	0.053	0.226	0.045	0.01	0.01	8	8	1,506	31	0	0.00	1.00
22	330	5.50	0.7	0.062	0.223	0.052	0.01	0.01	9	9	1,507	31	0	0.00	1.00
23	345	5.75	0.8	0.070	0.220	0.060	0.01	0.01	11	11	1,508	31	0	0.00	1.00
24	360	6.00	0.8	0.070	0.217	0.060	0.01	0.01	11	11	1,508	31	0	0.00	1.00
25	375	6.25	0.9	0.079	0.214	0.067	0.01	0.01	12	12	1,509	31	0	0.00	1.00
26	390	6.50	0.9	0.079	0.212	0.067	0.01	0.01	12	12	1,509	31	0	0.00	1.00
27	405	6.75	1.0	0.088	0.209	0.075	0.01	0.01	13	13	1,510	31	0	0.00	1.00
28	420	7.00	1.0	0.088	0.206	0.075	0.01	0.01	13	13	1,510	31	0	0.00	1.00
29	435	7.25	1.0	0.088	0.203	0.075	0.01	0.01	13	13	1,510	31	0	0.00	1.00
30	450	7.50	1.1	0.097	0.200	0.082	0.01	0.02	15	15	1,511	31	0	0.00	1.00
31	465	7.75	1.2	0.106	0.198	0.089	0.02	0.02	18	18	1,512	31	0	0.00	1.00
32	480	8.00	1.3	0.114	0.195	0.097	0.02	0.02	17	17	1,513	32	0	0.00	1.00
33	495	8.25	1.5	0.132	0.192	0.112	0.02	0.02	20	20	1,515	32	0	0.00	1.00
34	510	8.50	1.5	0.132	0.190	0.112	0.02	0.02	20	20	1,515	32	0	0.00	1.00
35	525	8.75	1.6	0.141	0.187	0.119	0.02	0.02	21	21	1,516	32	0	0.00	1.00
36	540	9.00	1.7	0.150	0.184	0.127	0.02	0.03	23	23	1,517	32	0	0.00	1.00
37	555	9.25	1.9	0.167	0.182	0.142	0.03	0.03	25	25	1,519	32	0	0.00	1.00
38	570	9.50	2.0	0.176	0.179	0.149	0.03	0.03	27	27	1,520	32	0	0.00	1.00
39	585	9.75	2.1	0.185	0.176	0.157	0.01	0.01	8	8	1,506	31	0	0.00	1.00
40	600	10.00	2.2	0.194	0.174	0.164	0.02	0.02	19	19	1,514	32	0	0.00	1.00
41	615	10.25	1.5	0.132	0.171	0.112	0.02	0.02	20	20	1,515	32	0	0.00	1.00
42	630	10.50	1.5	0.132	0.169	0.112	0.02	0.02	20	20	1,515	32	0	0.00	1.00

RCFC & WCD HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

24-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.09	VARIABLE LOSS RATE (AVG) IN/HR		Basin Percolation Rate	1.0 in/hr
UNIT TIME-MINUTES	15	Fm = Minimum value on loss curve (in/hr)	0.08		
LAG TIME - MINUTES	1.40	C	0.00152	Maxwell Drywells	
UNIT TIME-PERCENT OF LAG	1068%	Low Loss Rate (percent)	84.73%	Number	0
TOTAL ADJUSTED STORM RAIN (in)	2.20			Drywell Percolation Rate	0.15 cfs 0.00 cfm

Unit Time Period	Time Minutes	Hours	Pattern Percent (Plate E-5.9)	Storm Rain in/hr	Loss Rate in/hr Max	Loss Rate in/hr Low	Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume In cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total In Basin cu-ft	Total In Basin ac-ft	Basin WSEL ft
43	645	10.75	2.0	0.176	0.166	0.149	0.01	0.01	9	9	1,507	31	0	0.00	1.00
44	660	11.00	2.0	0.176	0.164	0.149	0.01	0.01	12	12	1,509	31	0	0.00	1.00
45	675	11.25	1.9	0.167	0.162	0.142	0.01	0.01	6	6	1,504	31	0	0.00	1.00
46	690	11.50	1.9	0.167	0.159	0.142	0.01	0.01	8	8	1,506	31	0	0.00	1.00
47	705	11.75	1.7	0.150	0.157	0.127	0.02	0.03	23	23	1,517	32	0	0.00	1.00
48	720	12.00	1.6	0.158	0.155	0.134	0.00	0.00	4	4	1,503	31	0	0.00	1.00
49	735	12.25	2.5	0.220	0.152	0.186	0.07	0.07	67	67	1,550	32	35	0.00	1.02
50	750	12.50	2.6	0.229	0.150	0.194	0.08	0.09	78	113	1,584	33	80	0.00	1.03
51	765	12.75	2.8	0.246	0.148	0.209	0.10	0.11	98	178	1,632	34	144	0.00	1.06
52	780	13.00	2.9	0.255	0.145	0.216	0.11	0.12	109	252	1,687	35	217	0.00	1.09
53	795	13.25	3.4	0.299	0.143	0.253	0.16	0.17	154	372	1,775	37	335	0.01	1.15
54	810	13.50	3.4	0.299	0.141	0.253	0.16	0.17	157	492	1,864	39	453	0.01	1.20
55	825	13.75	2.3	0.202	0.139	0.171	0.06	0.07	63	516	1,882	39	476	0.01	1.21
56	840	14.00	2.3	0.202	0.137	0.171	0.07	0.07	65	541	1,901	40	502	0.01	1.22
57	855	14.25	2.7	0.238	0.135	0.201	0.10	0.11	102	604	1,947	41	563	0.01	1.25
58	870	14.50	2.6	0.229	0.133	0.194	0.10	0.11	95	658	1,987	41	617	0.01	1.27
59	885	14.75	2.6	0.229	0.131	0.194	0.10	0.11	97	714	2,028	42	672	0.02	1.29
60	900	15.00	2.5	0.220	0.129	0.186	0.09	0.10	90	762	2,064	43	719	0.02	1.31
61	915	15.25	2.4	0.211	0.127	0.179	0.08	0.09	84	803	2,094	44	759	0.02	1.33
62	930	15.50	2.3	0.202	0.125	0.171	0.08	0.09	77	838	2,119	44	792	0.02	1.34
63	945	15.75	1.9	0.167	0.123	0.142	0.04	0.05	44	838	2,119	44	792	0.02	1.34
64	960	16.00	1.9	0.167	0.121	0.142	0.05	0.05	46	838	2,120	44	794	0.02	1.35
65	975	16.25	0.4	0.035	0.119	0.030	0.01	0.01	5	799	2,091	44	755	0.02	1.33
66	990	16.50	0.4	0.035	0.117	0.030	0.01	0.01	5	761	2,063	43	718	0.02	1.31
67	1005	16.75	0.3	0.026	0.116	0.022	0.00	0.00	4	722	2,034	42	679	0.02	1.30
68	1020	17.00	0.3	0.026	0.114	0.022	0.00	0.00	4	683	2,006	42	641	0.01	1.28
69	1035	17.25	0.5	0.044	0.112	0.037	0.01	0.01	7	648	1,980	41	607	0.01	1.26
70	1050	17.50	0.5	0.044	0.110	0.037	0.01	0.01	7	614	1,954	41	573	0.01	1.25
71	1065	17.75	0.5	0.044	0.109	0.037	0.01	0.01	7	579	1,929	40	539	0.01	1.23
72	1080	18.00	0.4	0.035	0.107	0.030	0.01	0.01	5	545	1,903	40	505	0.01	1.22
73	1095	18.25	0.4	0.035	0.106	0.030	0.01	0.01	5	510	1,878	39	471	0.01	1.21
74	1110	18.50	0.4	0.035	0.104	0.030	0.01	0.01	5	477	1,853	39	438	0.01	1.19
75	1125	18.75	0.3	0.026	0.103	0.022	0.00	0.00	4	442	1,827	38	404	0.01	1.18
76	1140	19.00	0.2	0.018	0.101	0.015	0.00	0.00	3	407	1,801	38	369	0.01	1.16
77	1155	19.25	0.3	0.026	0.100	0.022	0.00	0.00	4	373	1,776	37	336	0.01	1.15
78	1170	19.50	0.4	0.035	0.098	0.030	0.01	0.01	5	341	1,753	37	305	0.01	1.13
79	1185	19.75	0.3	0.026	0.097	0.022	0.00	0.00	4	309	1,729	36	273	0.01	1.12
80	1200	20.00	0.2	0.018	0.096	0.015	0.00	0.00	3	275	1,704	35	240	0.01	1.10
81	1215	20.25	0.3	0.026	0.094	0.022	0.00	0.00	4	244	1,681	35	209	0.00	1.09
82	1230	20.50	0.3	0.026	0.093	0.022	0.00	0.00	4	213	1,658	35	178	0.00	1.08
83	1245	20.75	0.3	0.026	0.092	0.022	0.00	0.00	4	182	1,635	34	148	0.00	1.06
84	1260	21.00	0.2	0.018	0.091	0.015	0.00	0.00	3	151	1,612	34	117	0.00	1.05

RCFC & WCD HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

24-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.09	VARIABLE LOSS RATE (AVG) IN/HR		Basin Percolation Rate	1.0 in/hr
UNIT TIME-MINUTES	15	Fm = Minimum value on loss curve (in/hr)	0.08		
LAG TIME - MINUTES	1.40	C	0.00152	Maxwell Drywells	
UNIT TIME-PERCENT OF LAG	1068%	Low Loss Rate (percent)	84.73%	Number	0
TOTAL ADJUSTED STORM RAIN (in)	2.20			Drywell Percolation Rate	0.15 cfs 0.00 cfm

Unit Time Period	Time Minutes	Hours	Pattern Percent (Plate E-5.9)	Storm Rain in/hr	Loss Rate in/hr Max	Loss Rate in/hr Low	Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume In cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total In Basin cu-ft	Total In Basin ac-ft	Basin WSEL ft
85	1275	21.25	0.3	0.026	0.090	0.022	0.00	0.00	4	121	1,590	33	88	0.00	1.04
86	1290	21.50	0.2	0.018	0.089	0.015	0.00	0.00	3	91	1,567	33	58	0.00	1.03
87	1305	21.75	0.3	0.026	0.088	0.022	0.00	0.00	4	82	1,548	32	30	0.00	1.01
88	1320	22.00	0.2	0.018	0.087	0.015	0.00	0.00	3	33	1,524	32	1	0.00	1.00
89	1335	22.25	0.3	0.026	0.086	0.022	0.00	0.00	4	5	1,504	31	0	0.00	1.00
90	1350	22.50	0.2	0.018	0.085	0.015	0.00	0.00	3	3	1,502	31	0	0.00	1.00
91	1365	22.75	0.2	0.018	0.084	0.015	0.00	0.00	3	3	1,502	31	0	0.00	1.00
92	1380	23.00	0.2	0.018	0.084	0.015	0.00	0.00	3	3	1,502	31	0	0.00	1.00
93	1395	23.25	0.2	0.018	0.083	0.015	0.00	0.00	3	3	1,502	31	0	0.00	1.00
94	1410	23.50	0.2	0.018	0.083	0.015	0.00	0.00	3	3	1,502	31	0	0.00	1.00
95	1425	23.75	0.2	0.018	0.082	0.015	0.00	0.00	3	3	1,502	31	0	0.00	1.00
96	1440	24.00	0.2	0.018	0.082	0.015	0.00	0.00	3	3	1,502	31	0	0.00	1.00

EFFECTIVE RAIN & FLOOD VOLUMES SUMMARY

EFFECTIVE RAIN	0.53 in
FLOOD VOLUME	0.05 ac-ft
FLOOD VOLUME	2,091 cu-ft
REQUIRED STORAGE	0.02 ac-ft
REQUIRED STORAGE	794 cu-ft
MAX WSEL	1.35 ft
PEAK FLOW RATE	0.17 cfs
AVERAGE PERCOLATION RATE	2.28 cuft/min

BASIN VOLUME WORKSHEET

PROECT Blythe LCNG
JOB No.
BASIN DESIGNATION:

BASIN CHARACTERISTICS

CONTOUR ELEVATION	DEPTH INCR (ft)	DEPTH TOTAL (ft)	AREA INCR (sf)	AREA TOTAL (sf)	VOLUME INCR (cuft)	VOLUME TOTAL (cuft)	VOLUME TOTAL (acre-ft)
1	0	0		1,500	0	0	0.00
2	1	1	1,700	3,200	2,297	2,297	0.05
3	1	2	1,900	5,100	4,113	6,410	0.15
4	1	3	2,400	7,500	6,262	12,672	0.29

WHERE: $$V = \frac{1}{3}(E_1 - E_2)\left(A_1 + A_2 + \sqrt{A_1 A_2}\right)$$

RCFCD SYNTHETIC UNIT HYDROGRAPH - SHORTCUT METHOD

DATA INPUT SHEET

DATE	July 16, 2012
WORKSHEET PREPARED BY:	N.O.
PROJECT NAME	Blythe LCNG
PROJECT NUMBER	
CONCENTRATION POINT DESIGNATION	
AREA DESIGNATION	On-site Area
AMC NUMBER	2

Low Loss Conditions: X=Existing; D=Developed; BS=Retention

AREA DESIG	SOIL GROUP	TRIBUTARY AREAS	ACRES	LOW LOSS CONDITION	RI NUMBER	AMC II INFILTRATION RATE	IMPERVIOUS PERCENT
2	B	PAVING/HARDSCAPE	0.72	D	56	0.51	1.00
10	b	RETENTION	1.02	BS	56	0.51	0.10

LENGTH OF WATERCOURSE (L)	400 ft
LENGTH TO POINT OPPOSITE CENTROID (Lca)	200 ft
ELEVATION OF HEADWATER	265.0 ft
ELEVATION OF CONCENTRATION POINT	260.0 ft
AVERAGE MANNINGS 'N' VALUE	0.02
STORM FREQUENCY (YEAR)	100
POINT RAIN	
1-HOUR	2.20 in
3-HOUR	2.50 in
6-HOUR	3.00 in
24-HOUR	3.50 in

BASIN CHARACTERISTICS:

ELEVATION	AREA
1.0 ft	1,500 sf
2.0 ft	3,200 sf
3.0 ft	5,100 sf
4.0 ft	7,500 sf

PERCOLATION RATE (in/hr)	1.0 in/hr
DRYWELL DATA	
NUMBER USED	0
PERCOLATION RATE	0.15 cfs
LOWEST FLOWLINE ELEVATION	
LOWEST PAD ELEVATION	

RCFC & WCD HYDROLOGY MANUAL	SYNTHETIC UNIT HYDROGRAPH METHOD BASIC DATA CALCULATION FORM	PROJECT: Blythe LCNG Job No.: BY: N.O. DATE: 7/16/12

PHYSICAL DATA

[1] CONCENTRATION POINT	
[2] AREA DESIGNATION	On-site Area
[3] AREA - ACRES	1.74
[4] L-FEET	400
[5] L-MILES	0.076
[6] La-FEET	200.00
[7] La-MILES	0.038
[8] ELEVATION OF HEADWATER	265
[9] ELEVATION OF CONCENTRATION POINT	260
[10] H-FEET	5
[11] S-FEET/MILE	66.0
[12] S^0.5	8.12
[13] L*LCA/S^0.5	0.000
[14] AVERAGE MANNINGS 'N'	0.02
[15] LAG TIME-HOURS	0.02
[16] LAG TIME-MINUTES	1.4
[17] 100% OF LAG-MINUTES	1.4
[18] 200% OF LAG-MINUTES	2.8

RAINFALL DATA

[1] AMC	II
[2] FREQUENCY-YEARS	100
[3] STORM DURATION:	Point Rain
1-HOUR	2.20 In
3-HOUR	2.50 In
6-HOUR	3.00 in
24-HOUR	3.50 In

STORM EVENT SUMMARY

STORM DURATION		1-HOUR	3-HOUR	6-HOUR	24-HOUR
EFFECTIVE RAIN	(in)	1.91	1.64	1.87	2.32
FLOOD VOLUME	(cu-ft)	12,044	10,380	11,797	14,654
	(acre-ft)	0.28	0.24	0.27	0.34
REQUIRED STORAGE	(cu-ft)	11,701	9,517	9,963	8,017
	(acre-ft)	0.27	0.22	0.23	0.18
FACTOR OF SAFETY		1.08	1.33	1.27	1.58
STORAGE PROVIDED	(cu-ft)	12,672			
	(acre-ft)	0.29			
PEAK FLOW	(cfs)	15.47	3.80	3.02	0.49
MAXIMUM WSEL	(ft)	3.85	3.50	3.57	3.26
DEPTH	(ft)	2.85	2.50	2.57	2.26
LOWEST FLOWLINE ELEVATION					
DIFFERENCE	(ft)				
LOWEST PAD ELEVATION					
DIFFERENCE	(ft)				
ESTIMATED TIME TO DEWATER BASIN Based on Total Flood Volume & Average Percolation Rate	(days)	1.5	1.5	1.6	1.7

NOTE: PEAK FLOW FOR THE 1-HOUR STORM IS NOT REPRESENTATIVE. PER RCFCD PEAK DISCHARGES FROM THE 3-HOUR STORM SHOULD NORMALLY COMPARE WELL WITH RATIONAL PEAKS.

RCFC & WCD HYDROLOGY MANUAL	SYNTHETIC UNIT HYDROGRAPH METHOD BASIC DATA CALCULATION FORM AMC II	PROJECT: Blythe LCNG Job No.: BY: N.O. DATE: 7/16/12

AVERAGE ADJUSTED LOSS RATE

SOIL GROUP [Plate C-1]	LAND USE	RI NUMBER [Plate E-6.1]	PERVIOUS AREA INFILTRATION RATE (in/hr) [Plate E-6.2]	DECIMAL PERCENT OF AREA IMPERVIOUS [Plate E-6.3]	ADJUSTED INFILTRATION RATE (in/hr)	AREA	AREA WEIGHTED AVERAGE	MAX AVERAGE ADJUSTED INFILTRATION RATE (in/hr)	LOW LOSS CONDITION	LOW LOSS RATE PER RCFC/2322	MIN AVERAGE ADJUSTED INFILTRATION RATE
B	PAVING/HARDSCAPE	56	0.51	100%	0.05	0.72	0.414	0.0211	DEVELOPED	0.1000	0.0414
b	RETENTION	56	0.51	10%	0.46	1.02	0.586	0.2721	BASIN	0.1000	0.0586
					SUM	1.74	SUM	0.2932			0.1000

VARIABLE LOSS RATE CURVE (24-HOUR STORM ONLY)

Fm= 0.146581034

C= 0.00271

$F_t = C(24-(T/60))^{1.55} + F_m$ = 0.00271 (24-(T/60))^1.55 + 0.15 in/hr

CONSTANT LOSS RATE (3 & 6 HOUR STORMS) = 0.2932

LOW LOSS RATE = 0.1000

Where:

T=Time in minutes. To get an average value for each unit time period, Use T=1/2 the unit time for the first time period, T=1 1/2 unit time for the second period, etc.

NOTE: Low loss rates established per RCFC/2322 (Dated: May-30-95)

Undeveloped Condition: Low Loss = 90%

Developed Condition: Low Loss = 0.9 - (0.8 * %Impervious)

Basin Site: Low Loss = 10%

RCFC & WCD
HYDROLOGY
MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

1-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT Blythe LCNG
Job No
BY: N.O. DATE 7/18/12

DRAINAGE AREA-ACRES	1.74
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN-INCHES	2.20
CONSTANT LOSS RATE-in/hr	0.29
LOW LOSS RATE - PERCENT	10.00%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern Percent	Storm Rain in/hr	Loss Rate in/hr		Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume in cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total in Basin		Basin WSEL ft
	Minutes	Hours	(Plate E-5.9)		Max	Low							cu-ft	ac-ft	
1	5	0.08	3.6	0.95	0.29	0.10	0.66	1.15	346	346	1,756	12	334	0.01	1.15
2	10	0.17	4.2	1.11	0.29	0.11	0.82	1.43	429	763	2,065	14	749	0.02	1.33
3	15	0.25	4.4	1.16	0.29	0.12	0.87	1.52	457	1,206	2,392	17	1,189	0.03	1.52
4	20	0.33	4.6	1.21	0.29	0.12	0.92	1.62	485	1,674	2,739	19	1,655	0.04	1.72
5	25	0.42	5.0	1.32	0.29	0.13	1.03	1.80	540	2,196	3,125	22	2,174	0.05	1.95
6	30	0.50	5.8	1.48	0.29	0.15	1.19	2.08	624	2,798	3,431	24	2,774	0.06	2.12
7	35	0.58	6.4	1.69	0.29	0.17	1.40	2.45	735	3,509	3,760	26	3,483	0.08	2.29
8	40	0.67	8.1	2.14	0.29	0.21	1.85	3.24	971	4,454	4,196	29	4,425	0.10	2.52
9	45	0.75	13.1	3.46	0.29	0.35	3.17	5.55	1,666	6,091	4,953	34	6,057	0.14	2.91
10	50	0.83	34.5	9.11	0.29	0.91	8.81	15.47	4,640	10,696	6,743	47	10,649	0.24	3.68
11	55	0.92	6.7	1.77	0.29	0.18	1.48	2.59	777	11,426	7,023	49	11,377	0.26	3.79
12	60	1.00	3.8	1.00	0.29	0.10	0.71	1.25	374	11,751	7,147	50	11,701	0.27	3.85

EFFECTIVE RAIN & FLOOD VOLUMES SUMMARY

EFFECTIVE RAIN	1.91 in
FLOOD VOLUME	0.28 ac-ft
FLOOD VOLUME	12,044 cu-ft
REQUIRED STORAGE	0.27 ac-ft
REQUIRED STORAGE	11,701 cu-ft
MAX WSEL	3.85 ft
PEAK FLOW RATE	15.47 cfs
AVERAGE PERCOLATION RATE	5.71 cuft/min

RCFC & WCD HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

3-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE

DRAINAGE AREA-ACRES	1.74
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN (in)	2.50
CONSTANT LOSS RATE (in/hr)	0.29
LOW LOSS RATE - PERCENT	10.00%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern Percent	Storm Rain in/hr	Loss Rate in/hr		Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume In cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total In Basin		Basin WSEL ft
	Minutes	Hours	(Plate E-5.9)		Max	Low							cu-ft	ac-ft	
1	5	0.08	1.3	0.39	0.29	0.04	0.10	0.17	51	51	1,538	11	40	0.00	1.02
2	10	0.17	1.3	0.39	0.29	0.04	0.10	0.17	51	91	1,568	11	80	0.00	1.03
3	15	0.25	1.1	0.33	0.29	0.03	0.04	0.06	19	100	1,574	11	89	0.00	1.04
4	20	0.33	1.5	0.45	0.29	0.05	0.16	0.28	83	171	1,627	11	160	0.00	1.07
5	25	0.42	1.5	0.45	0.29	0.05	0.16	0.28	83	243	1,680	12	231	0.01	1.10
6	30	0.50	1.8	0.54	0.29	0.05	0.25	0.43	130	361	1,767	12	349	0.01	1.15
7	35	0.58	1.5	0.45	0.29	0.05	0.16	0.28	83	431	1,819	13	419	0.01	1.18
8	40	0.67	1.8	0.54	0.29	0.05	0.25	0.43	130	548	1,906	13	535	0.01	1.23
9	45	0.75	1.8	0.54	0.29	0.05	0.25	0.43	130	665	1,992	14	651	0.01	1.28
10	50	0.83	1.5	0.45	0.29	0.05	0.16	0.28	83	734	2,043	14	720	0.02	1.31
11	55	0.92	1.6	0.48	0.29	0.05	0.19	0.33	98	818	2,105	15	803	0.02	1.35
12	60	1.00	1.8	0.54	0.29	0.05	0.25	0.43	130	933	2,191	15	918	0.02	1.40
13	65	1.08	2.2	0.66	0.29	0.07	0.37	0.64	193	1,111	2,322	16	1,095	0.03	1.48
14	70	1.17	2.2	0.66	0.29	0.07	0.37	0.64	193	1,288	2,453	17	1,271	0.03	1.55
15	75	1.25	2.2	0.66	0.29	0.07	0.37	0.64	193	1,464	2,584	18	1,446	0.03	1.63
16	80	1.33	2.0	0.60	0.29	0.06	0.31	0.54	162	1,608	2,690	19	1,589	0.04	1.69
17	85	1.42	2.6	0.78	0.29	0.08	0.49	0.85	256	1,845	2,866	20	1,825	0.04	1.79
18	90	1.50	2.7	0.81	0.29	0.08	0.52	0.91	272	2,097	3,052	21	2,076	0.05	1.90
19	95	1.58	2.4	0.72	0.29	0.07	0.43	0.75	225	2,301	3,202	22	2,278	0.05	1.99
20	100	1.67	2.7	0.81	0.29	0.08	0.52	0.91	272	2,551	3,317	23	2,528	0.06	2.08
21	105	1.75	3.3	0.99	0.29	0.10	0.70	1.22	367	2,895	3,476	24	2,870	0.07	2.14
22	110	1.83	3.1	0.93	0.29	0.09	0.64	1.12	335	3,206	3,620	25	3,180	0.07	2.21
23	115	1.92	2.9	0.87	0.29	0.09	0.58	1.01	304	3,484	3,748	26	3,458	0.08	2.28
24	120	2.00	3.0	0.90	0.29	0.09	0.61	1.06	319	3,777	3,884	27	3,750	0.09	2.35

RCFC & WCD
HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

3-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE

DRAINAGE AREA-ACRES	1.74
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN (in)	2.50
CONSTANT LOSS RATE (in/hr)	0.29
LOW LOSS RATE - PERCENT	10.00%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern	Storm Rain	Loss Rate in/hr		Effective Rain	Flood Hydrograph Flow	Volume In	Basin Volume	Percolation Area	Percolation Out	Total In Basin		Basin WSEL
	Minutes	Hours	Percent (Plate E-5.9)	in/hr	Max	Low	in/hr	cfs	cu-ft	cu-ft	sf	cu-ft	cu-ft	ac-ft	ft
25	125	2.08	3.1	0.93	0.29	0.09	0.64	1.12	335	4,086	4,026	28	4,058	0.09	2.43
26	130	2.17	4.2	1.26	0.29	0.13	0.97	1.70	509	4,567	4,248	30	4,537	0.10	2.54
27	135	2.25	5.0	1.50	0.29	0.15	1.21	2.12	635	5,172	4,528	31	5,141	0.12	2.69
28	140	2.33	3.5	1.05	0.29	0.11	0.76	1.33	398	5,539	4,698	33	5,507	0.13	2.78
29	145	2.42	6.8	2.04	0.29	0.20	1.75	3.06	919	6,426	5,106	35	6,391	0.15	3.00
30	150	2.50	7.3	2.19	0.29	0.22	1.90	3.33	998	7,389	5,475	38	7,351	0.17	3.15
31	155	2.58	8.2	2.46	0.29	0.25	2.17	3.80	1,141	8,492	5,898	41	8,451	0.19	3.33
32	160	2.67	5.9	1.77	0.29	0.18	1.48	2.59	777	9,228	6,180	43	9,185	0.21	3.44
33	165	2.75	2.0	0.60	0.29	0.06	0.31	0.54	162	9,348	6,225	43	9,303	0.21	3.46
34	170	2.83	1.8	0.54	0.29	0.05	0.25	0.43	130	9,433	6,259	43	9,390	0.22	3.48
35	175	2.92	1.8	0.54	0.29	0.05	0.25	0.43	130	9,520	6,292	44	9,476	0.22	3.49
36	180	3.00	0.6	0.18	0.29	0.02	0.16	0.28	85	9,561	6,308	44	9,517	0.22	3.50

EFFECTIVE RAIN & FLOOD VOLUMES SUMMARY

EFFECTIVE RAIN	1.64 in
FLOOD VOLUME	0.24 ac-ft
FLOOD VOLUME	10,380 cu-ft
REQUIRED STORAGE	0.22 ac-ft
REQUIRED STORAGE	9,517 cu-ft
MAX WSEL	3.50 ft
PEAK FLOW RATE	3.80 cfs
AVERAGE PERCOLATION RATE	4.79 cuft/min

RCFC & WCD
HYDROLOGY
MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

6-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.74
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN (In)	3.00
CONSTANT LOSS RATE (In/hr)	0.29
LOW LOSS RATE - PERCENT	10.00%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern	Storm Rain	Loss Rate in/hr		Effective Rain	Flood Hydrograph Flow	Volume In	Basin Volume	Percolation Area	Percolation Out	Total In Basin		Basin WSEL
	Minutes	Hours	Percent (Plate E-5.9)	in/hr	Max	Low	in/hr	cfs	cu-ft	cu-ft	sf	cu-ft	cu-ft	ac-ft	ft
1	5	0.08	0.5	0.18	0.29	0.02	0.16	0.28	85	85	1,563	11	74	0.00	1.03
2	10	0.17	0.6	0.22	0.29	0.02	0.19	0.34	102	177	1,631	11	165	0.00	1.07
3	15	0.25	0.6	0.22	0.29	0.02	0.19	0.34	102	268	1,698	12	256	0.01	1.11
4	20	0.33	0.6	0.22	0.29	0.02	0.19	0.34	102	358	1,765	12	346	0.01	1.15
5	25	0.42	0.6	0.22	0.29	0.02	0.19	0.34	102	448	1,832	13	436	0.01	1.19
6	30	0.50	0.7	0.25	0.29	0.03	0.23	0.40	119	555	1,911	13	542	0.01	1.24
7	35	0.58	0.7	0.25	0.29	0.03	0.23	0.40	119	681	1,989	14	667	0.01	1.28
8	40	0.67	0.7	0.25	0.29	0.03	0.23	0.40	119	787	2,067	14	752	0.02	1.33
9	45	0.75	0.7	0.25	0.29	0.03	0.23	0.40	119	872	2,145	15	857	0.02	1.37
10	50	0.83	0.7	0.25	0.29	0.03	0.23	0.40	119	976	2,222	15	961	0.02	1.42
11	55	0.92	0.7	0.25	0.29	0.03	0.23	0.40	119	1,080	2,299	16	1,064	0.02	1.46
12	60	1.00	0.8	0.29	0.29	0.03	0.26	0.45	136	1,201	2,389	17	1,184	0.03	1.52
13	65	1.08	0.8	0.29	0.29	0.03	0.26	0.45	136	1,320	2,477	17	1,303	0.03	1.57
14	70	1.17	0.8	0.29	0.29	0.03	0.26	0.45	136	1,440	2,565	18	1,422	0.03	1.62
15	75	1.25	0.8	0.29	0.29	0.03	0.26	0.45	136	1,558	2,653	18	1,540	0.04	1.67
16	80	1.33	0.8	0.29	0.29	0.03	0.26	0.45	136	1,676	2,741	19	1,657	0.04	1.72
17	85	1.42	0.8	0.29	0.29	0.03	0.26	0.45	136	1,794	2,827	20	1,774	0.04	1.77
18	90	1.50	0.8	0.29	0.29	0.03	0.26	0.45	136	1,910	2,914	20	1,890	0.04	1.82
19	95	1.58	0.8	0.29	0.29	0.03	0.26	0.45	136	2,027	3,000	21	2,006	0.05	1.87
20	100	1.67	0.8	0.29	0.29	0.03	0.26	0.45	136	2,142	3,085	21	2,121	0.05	1.92
21	105	1.75	0.8	0.29	0.29	0.03	0.26	0.45	136	2,257	3,171	22	2,235	0.05	1.97
22	110	1.83	0.8	0.29	0.29	0.03	0.26	0.45	136	2,372	3,235	22	2,349	0.05	2.01
23	115	1.92	0.8	0.29	0.29	0.03	0.26	0.45	136	2,486	3,287	23	2,463	0.06	2.04
24	120	2.00	0.9	0.32	0.29	0.03	0.03	0.05	16	2,479	3,284	23	2,456	0.06	2.04
25	125	2.08	0.8	0.29	0.29	0.03	0.26	0.45	136	2,593	3,337	23	2,569	0.06	2.07
26	130	2.17	0.9	0.32	0.29	0.03	0.03	0.05	16	2,586	3,333	23	2,563	0.06	2.06
27	135	2.25	0.9	0.32	0.29	0.03	0.03	0.05	16	2,579	3,330	23	2,556	0.06	2.06
28	140	2.33	0.9	0.32	0.29	0.03	0.03	0.05	16	2,572	3,327	23	2,549	0.06	2.06
29	145	2.42	0.9	0.32	0.29	0.03	0.03	0.05	16	2,565	3,324	23	2,542	0.06	2.06
30	150	2.50	0.9	0.32	0.29	0.03	0.03	0.05	16	2,558	3,321	23	2,535	0.06	2.06
31	155	2.58	0.9	0.32	0.29	0.03	0.03	0.05	16	2,551	3,318	23	2,528	0.06	2.06
32	160	2.67	0.9	0.32	0.29	0.03	0.03	0.05	16	2,545	3,314	23	2,522	0.06	2.05
33	165	2.75	1.0	0.36	0.29	0.04	0.07	0.12	35	2,557	3,320	23	2,534	0.06	2.06
34	170	2.83	1.0	0.36	0.29	0.04	0.07	0.12	35	2,569	3,326	23	2,546	0.06	2.06

RCFC & WCD HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

6-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.74
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN (in)	3.00
CONSTANT LOSS RATE (in/hr)	0.29
LOW LOSS RATE - PERCENT	10.00%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern Percent	Storm Rain in/hr	Loss Rate in/hr		Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume In cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total In Basin		Basin WSEL ft
	Minutes	Hours	(Plate E-5.9)		Max	Low							cu-ft	ac-ft	
35	175	2.92	1.0	0.36	0.29	0.04	0.07	0.12	35	2,581	3,331	23	2,558	0.06	2.06
36	180	3.00	1.0	0.36	0.29	0.04	0.07	0.12	35	2,593	3,337	23	2,570	0.06	2.07
37	185	3.08	1.0	0.36	0.29	0.04	0.07	0.12	35	2,605	3,342	23	2,582	0.06	2.07
38	190	3.17	1.1	0.40	0.29	0.04	0.10	0.18	54	2,636	3,357	23	2,613	0.06	2.08
39	195	3.25	1.1	0.40	0.29	0.04	0.10	0.18	54	2,667	3,371	23	2,643	0.06	2.08
40	200	3.33	1.1	0.40	0.29	0.04	0.10	0.18	54	2,697	3,385	24	2,674	0.06	2.09
41	205	3.42	1.2	0.43	0.29	0.04	0.14	0.24	73	2,747	3,408	24	2,723	0.06	2.10
42	210	3.50	1.3	0.47	0.29	0.05	0.17	0.31	92	2,815	3,439	24	2,791	0.06	2.12
43	215	3.58	1.4	0.50	0.29	0.05	0.21	0.37	111	2,902	3,480	24	2,878	0.07	2.14
44	220	3.67	1.4	0.50	0.29	0.05	0.21	0.37	111	2,989	3,520	24	2,965	0.07	2.16
45	225	3.75	1.5	0.54	0.29	0.05	0.25	0.43	130	3,095	3,569	25	3,070	0.07	2.19
46	230	3.83	1.5	0.54	0.29	0.05	0.25	0.43	130	3,200	3,617	25	3,175	0.07	2.21
47	235	3.92	1.6	0.58	0.29	0.06	0.28	0.50	149	3,324	3,674	26	3,298	0.08	2.24
48	240	4.00	1.6	0.58	0.29	0.06	0.28	0.50	149	3,447	3,731	26	3,421	0.08	2.27
49	245	4.08	1.7	0.61	0.29	0.06	0.32	0.56	168	3,589	3,797	26	3,563	0.08	2.31
50	250	4.17	1.8	0.65	0.29	0.06	0.35	0.62	187	3,749	3,871	27	3,722	0.09	2.35
51	255	4.25	1.9	0.68	0.29	0.07	0.39	0.69	206	3,928	3,953	27	3,901	0.09	2.39
52	260	4.33	2.0	0.72	0.29	0.07	0.43	0.75	225	4,125	4,045	28	4,097	0.09	2.44
53	265	4.42	2.1	0.76	0.29	0.08	0.46	0.81	244	4,341	4,144	29	4,312	0.10	2.49
54	270	4.50	2.1	0.76	0.29	0.08	0.46	0.81	244	4,556	4,243	29	4,526	0.10	2.54
55	275	4.58	2.2	0.79	0.29	0.08	0.50	0.88	263	4,789	4,351	30	4,759	0.11	2.60
56	280	4.67	2.3	0.83	0.29	0.08	0.53	0.94	282	5,040	4,467	31	5,009	0.11	2.66
57	285	4.75	2.4	0.86	0.29	0.09	0.57	1.00	300	5,310	4,592	32	5,278	0.12	2.72
58	290	4.83	2.4	0.86	0.29	0.09	0.57	1.00	300	5,578	4,716	33	5,545	0.13	2.79
59	295	4.92	2.5	0.90	0.29	0.09	0.61	1.06	319	5,865	4,848	34	5,831	0.13	2.86
60	300	5.00	2.6	0.94	0.29	0.09	0.64	1.13	338	6,169	4,989	35	6,135	0.14	2.93
61	305	5.08	3.1	1.12	0.29	0.11	0.82	1.44	433	6,568	5,160	36	6,532	0.15	3.02
62	310	5.17	3.6	1.30	0.29	0.13	1.00	1.76	528	7,060	5,349	37	7,023	0.16	3.10
63	315	5.25	3.9	1.40	0.29	0.14	1.11	1.95	585	7,608	5,559	39	7,569	0.17	3.19
64	320	5.33	4.2	1.51	0.29	0.15	1.22	2.14	642	8,210	5,790	40	8,170	0.19	3.28
65	325	5.42	4.7	1.69	0.29	0.17	1.40	2.45	736	8,907	6,057	42	8,864	0.20	3.39
66	330	5.50	5.6	2.02	0.29	0.20	1.72	3.02	907	9,771	6,388	44	9,727	0.22	3.53
67	335	5.58	1.9	0.68	0.29	0.07	0.39	0.69	206	9,933	6,450	45	9,888	0.23	3.56
68	340	5.67	0.9	0.32	0.29	0.03	0.03	0.05	16	9,904	6,439	45	9,859	0.23	3.55

RCFC & WCD
HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

6-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.74
UNIT TIME-MINUTES	5
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	355.9
TOTAL ADJUSTED STORM RAIN (in)	3.00
CONSTANT LOSS RATE (in/hr)	0.29
LOW LOSS RATE - PERCENT	10.00%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time		Pattern Percent	Storm Rain	Loss Rate in/hr		Effective Rain	Flood Hydrograph Flow	Volume In	Basin Volume	Percolation Area	Percolation Out	Total In Basin		Basin WSEL
	Minutes	Hours	(Plate E-5.9)	In/hr	Max	Low	in/hr	cfs	cu-ft	cu-ft	sf	cu-ft	cu-ft	ac-ft	ft
69	345	5.75	0.6	0.22	0.29	0.02	0.19	0.34	102	9,962	6,461	45	9,917	0.23	3.56
70	350	5.83	0.5	0.18	0.29	0.02	0.16	0.28	85	10,002	6,477	45	9,957	0.23	3.57
71	355	5.92	0.3	0.11	0.29	0.01	0.10	0.17	51	10,008	6,479	45	9,963	0.23	3.57
72	360	6.00	0.2	0.07	0.29	0.01	0.06	0.11	34	9,997	6,475	45	9,952	0.23	3.57

EFFECTIVE RAIN & FLOOD VOLUMES SUMMARY

EFFECTIVE RAIN	1.87 in
FLOOD VOLUME	0.27 ac-ft
FLOOD VOLUME	11,797 cu-ft
REQUIRED STORAGE	0.23 ac-ft
REQUIRED STORAGE	9,963 cu-ft
MAX WSEL	3.57 ft
PEAK FLOW RATE	3.02 cfs
AVERAGE PERCOLATION RATE	5.12 cuft/min

RCFC & WCD
HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

24-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.74	VARIABLE LOSS RATE (AVG) IN/HR		Basin Percolation Rate	1.0 in/hr
UNIT TIME-MINUTES	15	Fm = Minimum value on loss curve (in/hr)	0.15		
LAG TIME - MINUTES	1.40	C	0.00271	Maxwell Drywells	
UNIT TIME-PERCENT OF LAG	1068%	Low Loss Rate (percent)	10.00%	Number	0
TOTAL ADJUSTED STORM RAIN (in)	3.50			Drywell Percolation Rate	0.15 cfs 0.00 cfm

Unit Time Period	Time Minutes	Hours	Pattern Percent (Plate E-5.9)	Storm Rain in/hr	Loss Rate in/hr Max	Loss Rate in/hr Low	Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume In cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total In Basin cu-ft	Total In Basin ac-ft	Basin WSEL ft
1	15	0.25	0.2	0.028	0.518	0.003	0.03	0.04	40	40	1,529	32	8	0.00	1.00
2	30	0.50	0.3	0.042	0.512	0.004	0.04	0.07	60	68	1,550	32	35	0.00	1.02
3	45	0.75	0.3	0.042	0.506	0.004	0.04	0.07	60	95	1,570	33	62	0.00	1.03
4	60	1.00	0.4	0.056	0.500	0.006	0.05	0.09	80	142	1,605	33	108	0.00	1.05
5	75	1.25	0.3	0.042	0.494	0.004	0.04	0.07	60	168	1,624	34	134	0.00	1.06
6	90	1.50	0.3	0.042	0.488	0.004	0.04	0.07	60	194	1,644	34	160	0.00	1.07
7	105	1.75	0.3	0.042	0.482	0.004	0.04	0.07	60	219	1,662	35	185	0.00	1.08
8	120	2.00	0.4	0.056	0.476	0.006	0.05	0.09	80	264	1,696	35	229	0.01	1.10
9	135	2.25	0.4	0.056	0.471	0.006	0.05	0.09	80	309	1,728	36	273	0.01	1.12
10	150	2.50	0.4	0.056	0.465	0.006	0.05	0.09	80	352	1,761	37	316	0.01	1.14
11	165	2.75	0.5	0.070	0.459	0.007	0.06	0.11	99	415	1,807	38	377	0.01	1.16
12	180	3.00	0.5	0.070	0.454	0.007	0.06	0.11	99	477	1,853	39	438	0.01	1.18
13	195	3.25	0.5	0.070	0.448	0.007	0.06	0.11	99	538	1,898	40	498	0.01	1.22
14	210	3.50	0.5	0.070	0.442	0.007	0.06	0.11	99	598	1,942	40	557	0.01	1.24
15	225	3.75	0.5	0.070	0.437	0.007	0.06	0.11	99	657	1,986	41	615	0.01	1.27
16	240	4.00	0.8	0.084	0.431	0.008	0.08	0.13	119	735	2,044	43	692	0.02	1.30
17	255	4.25	0.8	0.084	0.426	0.008	0.08	0.13	119	811	2,101	44	768	0.02	1.33
18	270	4.50	0.7	0.098	0.420	0.010	0.09	0.15	139	907	2,171	45	862	0.02	1.38
19	285	4.75	0.7	0.098	0.415	0.010	0.09	0.15	139	1,001	2,241	47	954	0.02	1.42
20	300	5.00	0.8	0.112	0.410	0.011	0.10	0.18	159	1,114	2,324	48	1,065	0.02	1.46
21	315	5.25	0.8	0.084	0.404	0.008	0.08	0.13	119	1,184	2,377	50	1,135	0.03	1.49
22	330	5.50	0.7	0.098	0.399	0.010	0.09	0.15	139	1,274	2,443	51	1,223	0.03	1.53
23	345	5.75	0.8	0.112	0.394	0.011	0.10	0.18	159	1,382	2,523	53	1,330	0.03	1.58
24	360	6.00	0.8	0.112	0.389	0.011	0.10	0.18	159	1,489	2,602	54	1,435	0.03	1.62
25	375	6.25	0.9	0.126	0.384	0.013	0.11	0.20	179	1,614	2,694	56	1,558	0.04	1.68
26	390	6.50	0.9	0.126	0.378	0.013	0.11	0.20	179	1,737	2,785	58	1,679	0.04	1.73
27	405	6.75	1.0	0.140	0.373	0.014	0.13	0.22	199	1,876	2,890	60	1,816	0.04	1.79
28	420	7.00	1.0	0.140	0.368	0.014	0.13	0.22	199	2,017	2,992	62	1,954	0.04	1.85
29	435	7.25	1.0	0.140	0.363	0.014	0.13	0.22	199	2,153	3,094	64	2,089	0.05	1.91
30	450	7.50	1.1	0.154	0.358	0.015	0.14	0.24	219	2,308	3,205	67	2,241	0.05	1.98
31	465	7.75	1.2	0.168	0.353	0.017	0.15	0.27	239	2,480	3,284	68	2,411	0.06	2.03
32	480	8.00	1.3	0.182	0.349	0.018	0.16	0.29	259	2,670	3,372	70	2,600	0.06	2.07
33	495	8.25	1.5	0.210	0.344	0.021	0.19	0.33	298	2,898	3,478	72	2,826	0.06	2.13
34	510	8.50	1.5	0.210	0.339	0.021	0.19	0.33	298	3,124	3,582	75	3,049	0.07	2.18
35	525	8.75	1.6	0.224	0.334	0.022	0.20	0.35	318	3,368	3,695	77	3,291	0.08	2.24
36	540	9.00	1.7	0.238	0.329	0.024	0.21	0.38	338	3,629	3,815	79	3,549	0.08	2.30
37	555	9.25	1.9	0.266	0.325	0.027	0.24	0.42	378	3,928	3,953	82	3,845	0.09	2.38
38	570	9.50	2.0	0.280	0.320	0.028	0.25	0.44	398	4,243	4,099	85	4,158	0.10	2.45
39	585	9.75	2.1	0.294	0.316	0.029	0.26	0.46	418	4,575	4,252	89	4,487	0.10	2.53
40	600	10.00	2.2	0.308	0.311	0.031	0.28	0.49	438	4,925	4,414	92	4,833	0.11	2.62
41	615	10.25	1.5	0.210	0.307	0.021	0.19	0.33	298	5,131	4,509	94	5,037	0.12	2.67
42	630	10.50	1.5	0.210	0.302	0.021	0.19	0.33	298	5,336	4,604	96	5,240	0.12	2.72

RCFC & WCD HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

24-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.74	VARIABLE LOSS RATE (AVG) IN/HR	
UNIT TIME-MINUTES	15	Fm = Minimum value on loss curve (in/hr)	0.15
LAG TIME - MINUTES	1.40	C	0.00271
UNIT TIME-PERCENT OF LAG	1068%	Low Loss Rate (percent)	10.00%
TOTAL ADJUSTED STORM RAIN (in)	3.50		

Basin Percolation Rate 1.0 in/hr

Maxwell Drywells
Number 0
Drywell Percolation Rate 0.15 cfs 0.00 cfm

Unit Time Period	Time Minutes	Hours	Pattern Percent (Plate E-5.9)	Storm Rain In/hr	Loss Rate In/hr Max	Loss Rate In/hr Low	Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume In cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total In Basin cu-ft	Total In Basin ac-ft	Basin WSEL ft
43	645	10.75	2.0	0.280	0.298	0.028	0.25	0.44	398	5,638	4,743	99	5,539	0.13	2.79
44	660	11.00	2.0	0.280	0.293	0.028	0.25	0.44	398	5,937	4,881	102	5,835	0.13	2.86
45	675	11.25	1.9	0.266	0.289	0.027	0.24	0.42	378	6,213	5,009	104	6,109	0.14	2.93
46	690	11.50	1.9	0.266	0.285	0.027	0.24	0.42	378	6,487	5,129	107	6,380	0.15	2.99
47	705	11.75	1.7	0.238	0.281	0.024	0.21	0.38	338	6,718	5,218	109	6,609	0.15	3.03
48	720	12.00	1.8	0.252	0.276	0.025	0.23	0.40	358	6,968	5,314	111	6,857	0.16	3.07
49	735	12.25	2.5	0.350	0.272	0.035	0.08	0.14	123	6,980	5,318	111	6,869	0.16	3.07
50	750	12.50	2.6	0.364	0.268	0.036	0.10	0.17	151	7,020	5,334	111	6,909	0.16	3.08
51	765	12.75	2.8	0.392	0.264	0.039	0.13	0.22	202	7,111	5,368	112	6,999	0.16	3.09
52	780	13.00	2.9	0.406	0.260	0.041	0.15	0.26	230	7,229	5,414	113	7,116	0.16	3.11
53	795	13.25	3.4	0.476	0.256	0.048	0.22	0.39	347	7,463	5,504	115	7,349	0.17	3.15
54	810	13.50	3.4	0.476	0.252	0.048	0.22	0.39	353	7,702	5,595	117	7,585	0.17	3.19
55	825	13.75	2.3	0.322	0.249	0.032	0.07	0.13	118	7,701	5,595	117	7,585	0.17	3.19
56	840	14.00	2.3	0.322	0.245	0.032	0.08	0.14	122	7,707	5,597	117	7,590	0.17	3.19
57	855	14.25	2.7	0.378	0.241	0.038	0.14	0.24	218	7,806	5,635	117	7,689	0.18	3.20
58	870	14.50	2.8	0.364	0.237	0.036	0.13	0.22	200	7,889	5,667	118	7,771	0.18	3.22
59	885	14.75	2.8	0.364	0.234	0.036	0.13	0.23	208	7,976	5,700	119	7,858	0.18	3.23
60	900	15.00	2.5	0.350	0.230	0.035	0.12	0.21	189	8,047	5,727	119	7,928	0.18	3.24
61	915	15.25	2.4	0.336	0.227	0.034	0.11	0.19	173	8,100	5,748	120	7,981	0.18	3.25
62	930	15.50	2.3	0.322	0.223	0.032	0.10	0.17	158	8,137	5,762	120	8,017	0.18	3.26
63	945	15.75	1.9	0.266	0.220	0.027	0.05	0.08	73	8,090	5,744	120	7,970	0.18	3.25
64	960	16.00	1.9	0.266	0.216	0.027	0.05	0.09	78	8,048	5,728	119	7,929	0.18	3.24
65	975	16.25	0.4	0.056	0.213	0.006	0.05	0.09	80	8,009	5,713	119	7,890	0.18	3.24
66	990	16.50	0.4	0.056	0.210	0.006	0.05	0.09	80	7,969	5,698	119	7,850	0.18	3.23
67	1005	16.75	0.3	0.042	0.207	0.004	0.04	0.07	60	7,910	5,675	118	7,792	0.18	3.22
68	1020	17.00	0.3	0.042	0.204	0.004	0.04	0.07	60	7,852	5,652	118	7,734	0.18	3.21
69	1035	17.25	0.5	0.070	0.200	0.007	0.06	0.11	99	7,833	5,645	118	7,716	0.18	3.21
70	1050	17.50	0.5	0.070	0.197	0.007	0.06	0.11	99	7,815	5,639	117	7,698	0.18	3.21
71	1065	17.75	0.5	0.070	0.195	0.007	0.06	0.11	99	7,797	5,632	117	7,680	0.18	3.20
72	1080	18.00	0.4	0.056	0.192	0.006	0.05	0.09	80	7,759	5,617	117	7,642	0.18	3.20
73	1095	18.25	0.4	0.056	0.189	0.006	0.05	0.09	80	7,722	5,603	117	7,605	0.17	3.19
74	1110	18.50	0.4	0.056	0.186	0.006	0.05	0.09	80	7,685	5,589	116	7,568	0.17	3.18
75	1125	18.75	0.3	0.042	0.183	0.004	0.04	0.07	60	7,628	5,567	116	7,512	0.17	3.18
76	1140	19.00	0.2	0.028	0.181	0.003	0.03	0.04	40	7,552	5,538	115	7,437	0.17	3.16
77	1155	19.25	0.3	0.042	0.178	0.004	0.04	0.07	60	7,496	5,516	115	7,381	0.17	3.16
78	1170	19.50	0.4	0.056	0.176	0.006	0.05	0.09	80	7,461	5,503	115	7,346	0.17	3.15
79	1185	19.75	0.3	0.042	0.173	0.004	0.04	0.07	60	7,408	5,482	114	7,292	0.17	3.14
80	1200	20.00	0.2	0.028	0.171	0.003	0.03	0.04	40	7,332	5,453	114	7,218	0.17	3.13
81	1215	20.25	0.3	0.042	0.169	0.004	0.04	0.07	60	7,278	5,432	113	7,164	0.16	3.12
82	1230	20.50	0.3	0.042	0.167	0.004	0.04	0.07	60	7,224	5,412	113	7,111	0.16	3.11
83	1245	20.75	0.3	0.042	0.164	0.004	0.04	0.07	60	7,171	5,392	112	7,059	0.16	3.10
84	1260	21.00	0.2	0.028	0.162	0.003	0.03	0.04	40	7,099	5,364	112	6,987	0.16	3.09

RCFC & WCD HYDROLOGY MANUAL

SYNTHETIC UNIT HYDROGRAPH METHOD

SHORTCUT METHOD

24-HOUR STORM

UNIT HYDROGRAPH and EFFECTIVE RAIN CALCULATION FORM

PROJECT: Blythe LCNG
Job No.:
BY: N.O. DATE 7/16/12

DRAINAGE AREA-ACRES	1.74
UNIT TIME-MINUTES	15
LAG TIME - MINUTES	1.40
UNIT TIME-PERCENT OF LAG	1068%
TOTAL ADJUSTED STORM RAIN (in)	3.50

VARIABLE LOSS RATE (AVG) IN/HR	
Fm = Minimum value on loss curve (in/hr)	0.15
C	0.00271
Low Loss Rate (percent)	10.00%

Basin Percolation Rate	1.0 in/hr	
Maxwell Drywells		
Number	0	
Drywell Percolation Rate	0.15 cfs	0.00 cfm

Unit Time Period	Time Minutes	Hours	Pattern Percent (Plate E-5.9)	Storm Rain in/hr	Loss Rate in/hr Max	Loss Rate in/hr Low	Effective Rain in/hr	Flood Hydrograph Flow cfs	Volume In cu-ft	Basin Volume cu-ft	Percolation Area sf	Percolation Out cu-ft	Total In Basin cu-ft	Total In Basin ac-ft	Basin WSEL ft
85	1275	21.25	0.3	0.042	0.161	0.004	0.04	0.07	60	7,047	5,344	111	6,935	0.16	3.08
86	1290	21.50	0.2	0.028	0.159	0.003	0.03	0.04	40	6,975	5,318	111	6,864	0.16	3.07
87	1305	21.75	0.3	0.042	0.157	0.004	0.04	0.07	60	6,924	5,297	110	6,814	0.16	3.06
88	1320	22.00	0.2	0.028	0.155	0.003	0.03	0.04	40	6,853	5,270	110	6,744	0.15	3.05
89	1335	22.25	0.3	0.042	0.154	0.004	0.04	0.07	60	6,803	5,251	109	6,694	0.15	3.05
90	1350	22.50	0.2	0.028	0.152	0.003	0.03	0.04	40	6,734	5,224	109	6,625	0.15	3.03
91	1365	22.75	0.2	0.028	0.151	0.003	0.03	0.04	40	6,685	5,198	108	6,556	0.15	3.02
92	1380	23.00	0.2	0.028	0.150	0.003	0.03	0.04	40	6,596	5,171	108	6,488	0.15	3.01
93	1395	23.25	0.2	0.028	0.149	0.003	0.03	0.04	40	6,528	5,145	107	6,421	0.15	3.00
94	1410	23.50	0.2	0.028	0.148	0.003	0.03	0.04	40	6,461	5,119	107	6,354	0.15	2.99
95	1425	23.75	0.2	0.028	0.147	0.003	0.03	0.04	40	6,394	5,092	106	6,288	0.14	2.97
96	1440	24.00	0.2	0.028	0.147	0.003	0.03	0.04	40	6,328	5,062	105	6,222	0.14	2.95

EFFECTIVE RAIN & FLOOD VOLUMES SUMMARY

EFFECTIVE RAIN	2.32	in
FLOOD VOLUME	0.34	ac-ft
FLOOD VOLUME	14,654	cu-ft
REQUIRED STORAGE	0.18	ac-ft
REQUIRED STORAGE	8,017	cu-ft
MAX WSEL	3.26	ft
PEAK FLOW RATE	0.49	cfs
AVERAGE PERCOLATION RATE	5.86	cuft/min

BASIN VOLUME WORKSHEET

PROECT Blythe LCNG
JOB No.
BASIN DESIGNATION:

BASIN CHARACTERISTICS

CONTOUR ELEVATION	DEPTH		AREA		VOLUME		
	INCR (ft)	TOTAL (ft)	INCR (sf)	TOTAL (sf)	INCR (cuft)	TOTAL (cuft)	(acre-ft)
1	0	0		1,500	0	0	0.00
2	1	1	1,700	3,200	2,297	2,297	0.05
3	1	2	1,900	5,100	4,113	6,410	0.15
4	1	3	2,400	7,500	6,262	12,672	0.29

WHERE: $$V = \frac{1}{3}(E_1 - E_2)\left(A_1 + A_2 + \sqrt{A_1 A_2}\right)$$