BAUER
associates, inc.
GEOTECHNICAL CONSULTANTS

June 13, 2017
Job No. 911.64

TruAir Hangar
c/o Mr. Mike Cingari
2433 Laguna Road
Santa Rosa, CA 95401

Plan Review
Geotechnical Engineering Services
during Final Design
TruAir Hangar
2335 Becker Blvd.
Sonoma County Airport
Santa Rosa, California

This letter transmits our comments regarding the following project plans:

1. Civil Sheets C-1 through C-6, dated May 2017, prepared by Baechtel Hudis.

2. Structural Sheets S1.0, S2.0, S3.0, S4.0, S4.1, S5.0, S5.2, S5.3 & S6.0, dated May 23, 2017 prepared by Structural Design Group.

We previously performed a Geotechnical Investigation for the project and presented the results in our report dated May 27, 2016. We are performing our plan review as requested by Mr. Del Starrett and in general accordance with our continuing services clause of our agreement dated March 22, 2016.

We have reviewed the soil related portions of the referenced plans and find that the plans are in general conformance with the intent of our recommendations. However, Grading Drainage Note 1, Sheet C-2, should be corrected to indicate our Bauer Associates, Inc. Job Number 911.57, and Geotechnical Investigation report dated May 27, 2017. Further, the slab thickness indicated on the "Typical Section Building Slab", Sheet C-4, is 6 inches, whereas the "Foundation Notes 5", Sheet S1.0, indicates an 8-inch thick slab.

Westside Center
6470 Mirabel Road
Post Office Box 460
Forestville, CA 95436
707.887.2505

We trust this provides the information you require at this time. If you have any questions, please call.

Very truly yours,

BAUER ASSOCIATES, INC.

Bryce Bauer
Geotechnical Engineer – 2139

REGISTERED PROFESSIONAL ENGINEER
BRYCE BAUER
NO. GE 2139
Exp. 6/30/18
GEOTECHNICAL
STATE OF CALIFORNIA

BB/AHG (pr/tru air)
Email only

BAUER associates, inc.
GEOTECHNICAL CONSULTANTS

REPORT
GEOTECHNICAL INVESTIGATION
TruAir Hangar
Charles M. Schultz Airport
Sonoma County, California

Prepared for:

TruAir Hangar
c/o Del Starrett Architect
3663 North Laughlin Road, Suite 207
Santa Rosa, CA 95403

by

BAUER ASSOCIATES, INC.

Job No. 911.57

Arthur H. Graff
Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER ARTHUR H. GRAFF 2319 3/31/17 GEOTECHNICAL STATE OF CALIFORNIA

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REGISTERED PROFESSIONAL ENGINEER BRYCE BAUER NO. GE 2139 Exp. 6/30/18 GEOTECHNICAL STATE OF CALIFORNIA

May 27, 2016

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INTRODUCTION

This report presents the results of our geotechnical investigation for the proposed TruAir Hangar at the Charles M. Schultz Airport in Sonoma County, California. The development is indicated on the preliminary site plan prepared by Mr. Del Starrett, Sheet A1.0, dated February 17, 2016. A portion of the plan is reproduced and presented on Plate 1.

We understand that project will consist of constructing a new hangar building and associated asphalt paved parking and driveway areas. We understand that the building will be a metal structure with a concrete slab-on-grade floor. Foundation loads are expected to be typical for the type of construction indicated. Unretained cuts and fills will be relatively minor and less than about 2 feet high. No retaining walls are planned.

The scope of our investigation, as outlined in our March 22, 2016, agreement included reviewing selected published geologic information from our files, exploring subsurface conditions at the site, and performing laboratory testing on selected samples. Based upon our work, we have developed conclusions and recommendations concerning:

1. Potential geotechnical hazards and mitigation measures, as appropriate.
2. Soil and groundwater conditions observed.
3. Site preparation and grading.
4. Foundation type(s) and design criteria.
5. Subgrade preparation for slabs-on-grade.

6. Pavements based on an assumed Resistance Value.
7. Geotechnical engineering drainage.
8. Supplemental geotechnical engineering services.

Our scope of work summarized in this report did not include an evaluation of any potential hazardous waste contamination or corrosion potential of the soil or groundwater at the site. Further, our scope of services did not include evaluation of areas beyond the planned improvements (i.e. existing structures or pavements).

WORK PERFORMED

We reviewed the published geologic information summarized in the List of References as well as our previous work from other projects in the vicinity.

On April 7, 2016, our geotechnical engineer explored the subsurface conditions in the development area to the extent of 3 test borings. The test borings were drilled with a track-mounted drill rig equipped with 6-inch diameter, solid stem augers. The completed test borings ranged in depth to about 13-1/2 feet.

The test borings were located by our engineer by pacing or estimating distances from features indicated on the plan provided. The approximate test boring locations are shown on Plate 1. Our engineer logged the conditions exposed and obtained samples at selected intervals for visual identification and laboratory testing. Relatively undisturbed samples were obtained with a 2.4-inch, inside-diameter, split-spoon sampler driven with a 140-pound hammer. The stroke during driving was about 30 inches. The blows required to drive the sampler were recorded and converted to equivalent standard penetration blow counts for correlation with other data. Logs of the borings showing the materials encountered, sample depths, and converted blow counts are presented on Plates 2 through 4. The soils are classified in accordance with the Unified Soil Classification System presented on Plate 5.

The logs show our interpretation of the subsurface conditions on the date and locations indicated, and it is not warranted that they are representative of the subsurface conditions at other locations and times. Also, the stratification lines on the logs represent the approximate boundaries between soil types; the transition may be gradual. The test borings were backfilled with excavated materials.

Representative samples of the soils encountered were laboratory tested to determine their moisture content, density, and classification. The test results are generally presented on the logs in the manner described in the Key to Test Data, Plate 5.

SITE AND SOIL CONDITIONS

The site is located northwest of the Becker Boulevard (Goggle Earth coordinates 38.507019°, -122.804031°), as shown on Plate 1. The site is occupied with two, one-story maintenance buildings and associated asphalt paved drive areas.

The remaining portions of the site are covered with a dense growth of weeds. Evidence of old fill (including concrete, asphalt, and metal debris) is occasionally evident on the site. Underground drainage improvements cross the building site.

The published geologic maps indicate that the site is underlain by bedrock of the Glen Ellen Formation which regionally consists of poorly lithified sands, clays, silts, and gravels. The Glen Ellen generally resembles a stiff soil. The poorly lithified and clayey Glen Ellen can erode easily, however, the gravelly and cemented zones are more erosion resistant.

The results of our field exploration and laboratory tests indicate that the site is generally blanketed by about 1 to 5 feet of soft to very stiff sandy clay surface soils. Portions of these surface soils are weak and consist of variable density old fills. Weak soils and variable density old fills may collapse or settle when loaded and saturated. The estimated depth of the weak surface soils are indicated on the right side of the test boring logs. The surface clay soils encountered in our test borings are generally of low expansion potential. However, our previous experience has been that the clay surface soils in the site vicinity (i.e. Reach Hangar and 1995 Hangars/Taxiway Improvements) vary from moderate to high expansion potential. Expansive soils experience volume changes with different moisture contents. Expansive soils can cause shallow foundations and slabs to heave and crack.

The surface soils are underlain to the maximum depth explored, about 13-1/2 feet, by stiff to very stiff sandy clays, and medium dense to very dense sands and gravels. These soils have moderate to high strength, range from low to moderate expansion potential, and are relatively incompressible for the range of anticipated foundation loads. Our previous experience at other nearby development areas, and at other sites underlain by Glen Ellen sediments indicates that these soils tend to grade and interfinger. Therefore, soil conditions are expected to vary laterally and vertically across the site.

No free groundwater was encountered in our test borings. However, we have previously observed in the project vicinity, during and after periods of prolonged rainfall, temporarily perched groundwater can occur within several feet of the ground surface.

Published geologic maps of the area do not show any active faults at the site. The property is not within an Alquist-Priolo Earthquake Fault Zone, which would require a detailed investigation to evaluate the hazard of fault surface rupture. The nearest fault considered seismically active (experiencing surface rupture within about the last 11,000 years) is the Healdsburg/Rodgers Creek Fault located approximately 3 miles to the northeast. The San Andreas fault zone is located about 18 miles to the southwest. Knudsen, et. al., 2000, indicates that the site is located within a zone of 'very low' liquefaction susceptibility.

DISCUSSION & CONCLUSIONS

Based on the results of our investigation, we conclude that from a geotechnical engineering standpoint, the site can be used for the proposed improvements. The most significant geotechnical engineering factors that must be considered in design and construction are the presence of weak surface soils, variable density old fills, and potential for highly expansive natural soils.

Upon saturation, weak/porous soils and variable density old fills will lose strength and consolidate rapidly under loads of new fill and structural elements. Saturation will occur when the natural evaporation of soil moisture is inhibited by new fill and structural elements. Expansive soils experience volume changes with different moisture contents. Expansive soils can cause foundations and slabs to heave and crack. As previously discussed, the test borings did not encounter soils of moderate to high expansive potential in the near surface materials. However, our previous experience has been that the clay soils in the immediate site vicinity are of generally moderate to high expansion potential.

We conclude that the existing surface materials are unsuitable for support of fills, foundations, and concrete slabs in their present condition. Old fill and weak surface soils must be upgraded in building areas (including critical exterior concrete slab-on-grade areas) by removal and recompaction for their full depth.

During the bidding process or initial construction, the building areas should be further evaluated to determine if expansive soils are present in the materials within 30 inches of subgrade. If expansive soils are present in the upper 30 inches, the risk of future structural damage by shrinking and swelling of the expansive clays must be further reduced by covering expansive soils with a 30-inch thick confining and moisture protecting blanket of imported or on-site lime treated, non-expansive fill. Satisfactory foundation support for the proposed structure can then be obtained from spread footings bottomed on properly compacted, non-expansive fill, or on natural soils below the non-expansive fill.

We estimate that about 50 percent of the ultimate settlement will occur during construction. We estimate that the post-construction settlements for various anticipated loading conditions will be less than about 1/2 inch. Estimated settlements are based on the allowable bearing pressures for spread footings presented in the *Recommendations* section of this report. We judge that the post-construction differential settlement between footings will be less than about 1/2 inch. No soil conditions that would cause abrupt differential settlement between similarly loaded foundations were encountered.

Control of surface run-off will significantly enhance the stability of the site. The introduction of water into, or onto, the soils can cause soil instability and must be avoided. The discharge of roof gutter downspouts must be collected into non-perforated pipes. Collected water must be discharged into the storm drain system or onto concrete or asphalt paved areas, which drain well away from the development.

We believe that there are no active faults on the site, and therefore the risk of fault rupture during earthquakes is considered to be low. Like the entire Santa Rosa/Windsor area, the site is subject to severe ground shaking during earthquakes. The published geologic maps indicate that the site is within an area of 'very low' liquefaction susceptibility and our test borings did not encounter soils considered prone to liquefaction or densification. It will be necessary to design and construct the project in strict accordance with current standards for earthquake-resistant construction.

RECOMMENDATIONS

A. Site Preparation and Grading

The site should be cleared of designated brush, rubble and debris. Material generated by the clearing operations should be removed from the site. Well, cesspool, abandoned leach field, septic and gas tank excavations and other voids encountered or generated during clearing should be either backfilled with granular material or compacted soil, or capped with concrete in accordance with Sonoma County Health regulations and as determined by us.

As applicable, areas to be graded should be stripped of the upper soils containing root growth and organic matter. We anticipate that the required depth of stripping will average about 3 to 6 inches. Deeper stripping may be required to remove localized heavy concentrations of root growth. The strippings should be removed from the site, stockpiled for reuse as topsoil, or mixed with at least two parts soil and used as fill in areas 10 feet beyond structures, walks and paved areas.

For the purpose of definition, "select fill areas" referred to in this report are: (1) building areas and the zones extending for a distance of at least 5 feet beyond outside edges of perimeter footings or other footings extending from buildings (including trash enclosures); and (2) within critical exterior concrete slab areas and the zones extending for a distance of 5 feet beyond their edges.

Within the select fill areas, all weak soils and existing, non-compacted fills, should be removed for their full depth. Where expansive soils are present within 30 inches of subgrade, additional excavation should be performed, as necessary, to allow for installation of the 30-inch thick, non-expansive select or lime treated fill where expansive materials are exposed. We should observe the depth and extent of overexcavation in the field.

Within pavement areas, the weak soils and any existing, non-compacted fills should be removed to at least 18-inches below planned subgrade. Additional excavation of expansive soils (if present) should be performed, as necessary, to allow installation of a minimum 12-inch thick, non-expansive select or lime treated fill section in pavement areas. The depth and extent of overexcavaitonl should be observed by us in the field.

All exposed soils should be scarified to a depth of 6 inches, moisture conditioned to at least four percent above optimum moisture content (2 percent for low expansive potential soils), and compacted to at least 90 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil, as determined by ASTM D 1557-12. Optimum moisture content is the water content (percentage by dry weight) corresponding to the maximum dry density. The moisture conditioning and recompaction should extend to the bottom of any shrinkage cracks. If grading is performed during the summer or fall seasons, we anticipate that the shrinkage cracks may extend to several feet below the existing grades.

If isolated deeper zones of soft, saturated, dry (shrinkage cracks), highly porous or organic soils are encountered during excavation and recompaction, the soils should be removed to expose firm soils. The depth and extent of overexcavation should be approved in the field by us.

The on-site soils should generally be suitable for reuse as fill provided that: 1) all rock sizes greater than 6 inches in largest dimension and perishable materials are removed, and 2) the fill materials are approved by us prior to use. However, on-site expansive soils, if encountered, will not be suitable for use as select fill (within 30 inches of planned pad subgrade) unless lime treated.

Imported, non-expansive fill, should be free of organic matter, and should conform to the following requirements:

Sieve Size	Percent Passing
6-Inch	100
4-Inch	90 - 100
No. 200	15 - 60

Liquid Limit - 40 Maximum
Plasticity Index - 15 Maximum
(ASTM D 4318-10 Wet Test Method)

Fill should be placed in thin lifts (normally 6 to 8 inches depending on compaction equipment), moisture conditioned to at least two percent above optimum, and compacted to at least 90 percent relative compaction. Expansive fill materials should be moisture conditioned to at least 4 percent above optimum moisture content. Granular backfill should be vibrated in place. All surfaces should be finished to present a smooth, unyielding subgrade. In vehicle traffic areas including within the building areas, the upper 6 inches (subgrade) should be further compacted to at least 95 percent relative compaction (93 percent for expansive soils).

If lime treatment is planned, the lime treated materials should be prepared with Quicklime, in accordance with Section 24 of Caltrans Standard Specifications, latest edition, in maximum lifts of 15 inches. The percent lime should be determined in accordance with ASTM test procedures. Typically, 4 to 6 percent lime will be required.

Fill and cutslopes should be constructed no steeper than 2:1. Fill and cutslopes should be planted with erosion-resistant vegetation, or protected from erosion by other measures upon completion of grading. Ground cover should be maintained on all slopes.

B. Foundations

Foundation support can be obtained from spread footings excavated into firm non-expansive natural soils, compacted non-expansive fills, or lime treated on-site soils. Wall and column footings should be at least 12 and 18 inches wide, respectively, and at least 12 inches below lowest adjacent grade. Perimeter wall footings should be continuous. If expansive soils are exposed in foundation excavations, the expansive soils should be maintained at least 4 percent above optimum moisture content until concrete is placed.

Spread footings should be designed using allowable bearing pressures of 2000 and 3000 pounds per square foot (psf) for dead plus long-term live loads and total design loads, respectively. We should observe the footing excavations prior to the placement of reinforcing steel and concrete.

The portion of the foundations extending into firm soil may impose a passive equivalent fluid pressure of 350 pounds per cubic feet (pcf) and a friction factor of 0.35 times the net vertical dead load. Passive pressures should be neglected within the upper foot, unless footings are confined by other construction.

C. <u>Seismic Design Criteria</u>

The following criteria is based on 2013 CBC guidelines and the USGS Earthquake Ground Motion Parameters:

Spectral Response Acceleration, S_S (0.2 sec.) – 1.795g
Spectral Response Acceleration, S_1 (1.0 sec.) – 0.716g
Seismic Design Category – D

Title 24, Part 2, Section 1613.3.2, of the 2013 CBC indicates that site categorization for seismic design should be based on the average soil values within the upper 100 feet of the site. Although the scope of our investigation was limited to relatively shallow test holes (ranging to about 13-1/2 feet deep), we estimate that a Site Classification "D" will be appropriate for design. Upon request, we could perform supplemental exploration to determine the actual subsurface conditions ranging to 100 feet.

D. <u>Asphalt Pavement Structural Sections</u>

It appears that the subgrade materials in the pavement areas will vary depending the qualities of the imported soils and the natural surface soils (which can vary from low to high expansive potential). The final pavement section will depend on the subgrade materials which will be exposed.

Based on our experience with similar soils, we have determined that moderately to highly expansive materials have R-Values of less than 5. The minimum R-Value used for design is 5. Using this R-Value and the assumed Traffic Indices (T.I.) below, we recommend the pavement section alternatives provided in the following table. Traffic Indices are typically provided by the

Project Civil Engineer. We would be pleased to evaluate and provide recommended T.I.'s for the project if anticipated traffic loadings are available. Further, we should be contacted if higher T.I.'s are anticipated.

T.I.	Asphalt Concrete (inches)	Class II* Aggregate Base (inches)	Class IV** Aggregate Subbase (inches)
3.5	3.0	8	---
3.5	3.0	6	12
4.5	3.0	10	---
4.5	3.0	6	12
5.5	3.0	12	---
5.5	3.0	6	12
6.5	3.5	15	---
6.5	3.5	8	12
7.5	4.5	17	---
7.5	4.5	12	12

*R-Value = 78 minimum
**R-Value = 30 minimum

If the upper 12 inches of subgrade soils are lime treated soils or import materials with R-Values on the order of 30, then the reduced Class 2 Aggregate Base sections for each T.I. may be used and the Class 4 Aggregate Subbase can be eliminated.

The flexible pavement materials and construction methods should conform to the quality requirements of the State of California, Caltrans Standard Specifications, current edition, and that of Sonoma County.

Where the soils at the pavement edges are subject to wetting and drying, edge cracking should be anticipated. Periodic patching should be performed to prevent water from entering the cracks. Edge cracking can be reduced by installation of a perimeter moisture vapor cutoff. The cutoff could consist of a compacted select fill dike 36 inches deep and 8 feet wide; or a concrete curb 4 inches wide and at least 30 inches deep. Conventional curb and sidewalk also provides some protection.

Prior to preparation of the subgrade, all underground utilities in the paved areas should be installed and properly backfilled, and the concrete curbs and gutters or header-boards should be in place. Subgrade soil should be uniformly moisture conditioned to 2 percent above optimum moisture content (4 percent for expansive soils) and compacted to at least 95 percent relative compaction (93 percent for expansive soils), providing a firm and unyielding surface. This may require scarifying and recompacting to achieve uniformity. The aggregate base materials should be placed in thin lifts in a manner to prevent segregation, uniformly moisture conditioned, and compacted to at least 95 percent relative compaction to provide a smooth, unyielding surface.

E. Concrete Slab-on-Grade

Provided surface materials are prepared as recommended in the "Site Preparation and Grading" section of this report, slabs-on-grade can be used. Slab-on-grade subgrades should be smooth and uniform. During foundation installation and utility trench excavation and backfilling, previously compacted subgrade soils may become disturbed. Where this is the case, these soils should be uniformly moisture conditioned to above optimum moisture content and rerolled to provide a smooth, unyielding surface compacted to at least 90 percent relative compaction (95 percent for slabs subject to vehicle traffic). Subgrade should be maintained at a uniform moisture, at least 2 percent above optimum moisture content.

A capillary moisture break and cushion layer consisting of at least four inches of clean, free-draining crushed rock should be provided below the slabs. The crushed rock should be at least 1/4-inch, and no larger than 3/4-inch, in size. Outlets should be provided in the slab rock to reduce the risk of water build up in the slab rock. Moisture will condense on the underside of slabs. Where moisture migration through slabs is detrimental, waterproofing methods and specifications should be determined by others for incorporation into the project plans. Slabs should be at least 4 inches thick and reinforced to reduce cracking. Slabs should be at least 4 inches thick and reinforced to reduce cracking. Utility room and exterior slabs should be separated from foundations with felt paper, mastic, or other positive and low friction material.

Some cracking of slabs must be anticipated considering concrete shrinkage and the anticipated differential settlement. Reinforcing must be carefully installed in accordance with the structural engineer's recommendations to minimize the potential of cracking. We typically recommend the use rebar reinforcement, placed on blocks at the center of the slab. We have commonly observed that welded wire mesh is not properly located in the slabs.

F. <u>Geotechnical Engineering Drainage</u>

The site should be graded to provide positive drainage away from the building foundations, pavements and finished cut and fill slopes. Ponding water will be detrimental to foundations. Roofs should be provided with gutters and downspouts which discharge into storm drains, or onto pavements or slabs that drain well away from the foundations.

Trench subdrains should be constructed beneath the slab rock to reduce the risk of water build up in the slab rock. The subdrains should consist of 12-inch deep by 12-inch wide trenches that cross the slab area, as directed by us. These subdrains are typically located 15 to 20 feet apart. Specific locations should be determined after plans, including utility locations beneath the slab, are substantially completed. The slab rock should be connected to the subdrain rock. The subdrain pipe should consist of PVC Schedule 40 or ABS with a SDR of 35 or better. The trench should be backfilled with clean, free-draining, 3/4 or 1-1/2-inch crushed drain rock separated from adjacent soil/rock by a non-woven filter fabric (Mirafi 140NC or equivalent). As an alternative, Class II permeable material complying with Section 68, "Caltrans" may be used without fabric. Underground utility trenches could also be used as subdrains if properly designed. We should be consulted to incorporate the utility trenches into the drainage system.

G. <u>Supplemental Services</u>

We should be contacted to discuss further test pit exploration prior to the bidding process to better define the depth of weak and expansive soils. We should review the final plans for conformance with the intent of our recommendations.

During grading and foundation construction, we should provide intermittent geotechnical engineering observations, along with necessary field and laboratory testing, during: 1) removal of weak soil and old fills; 2) fill placement and compaction; 3) subdrainage placement; 4) preparation and compaction of subgrade; 5) placement and compaction of Class II Aggregate Base and 6) excavation of foundations. These observations and tests would allow us to check that the contractor's work conforms with the intent of our recommendations and the project plans and specifications. These observations also permit us to check that conditions encountered are as anticipated, and modify our recommendations, as necessary.

These supplemental services are performed on an as-requested basis, and we can accept absolutely no responsibility for items that we are not notified to observe. These supplemental services are in addition to this investigation, and are charged for on an hourly basis in accordance with our Schedule of Charges. We must be provided with at least 48 hours notice for scheduling our initial site visit, and 24 hours thereafter.

MAINTENANCE

Periodic land maintenance will be required. Surface and subsurface drains should be checked frequently, and cleaned and maintained as necessary. Sloughing or erosion that occurs should be repaired before it can enlarge.

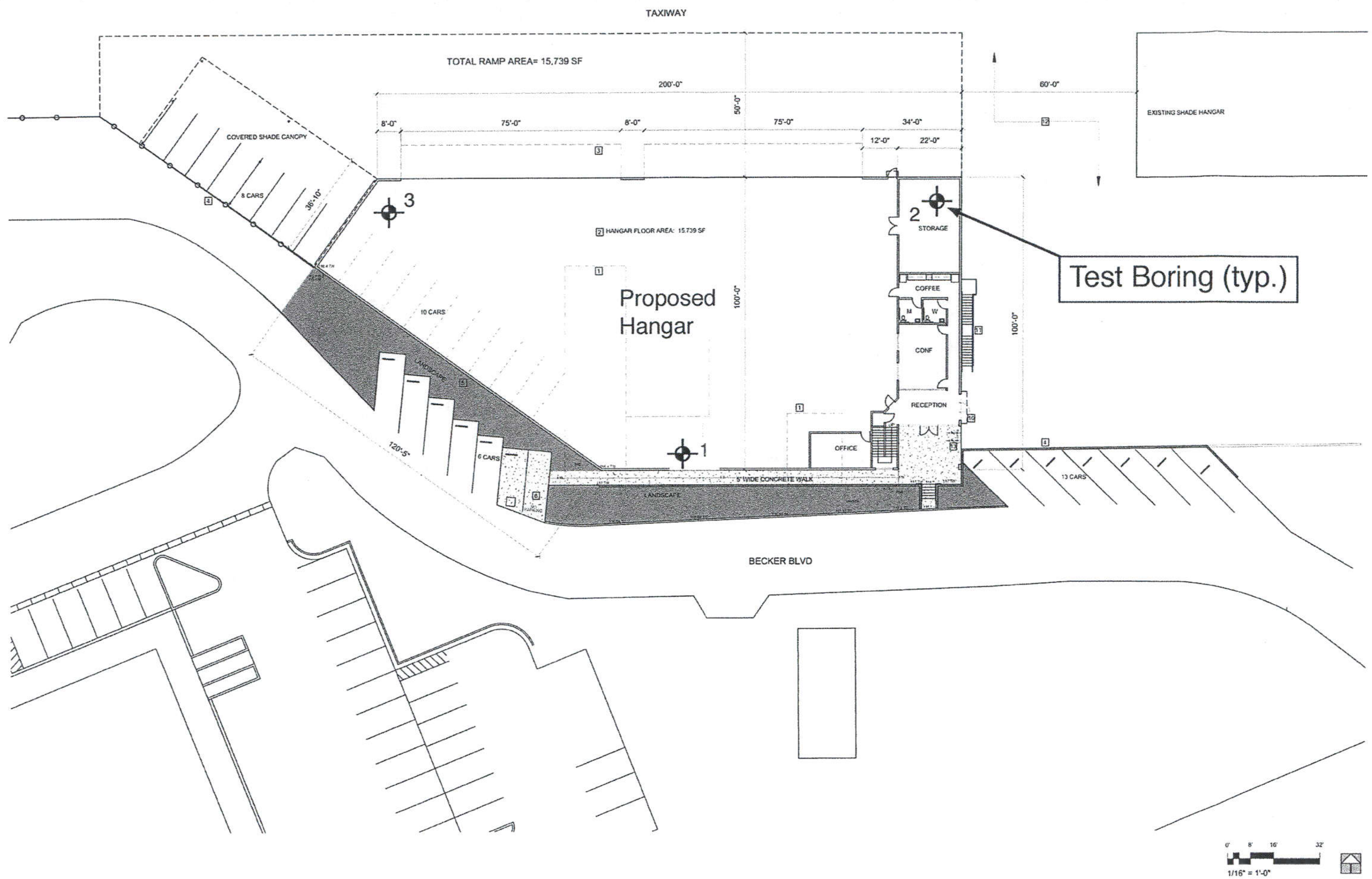
LIMITATIONS

We performed the investigation and prepared this report in accordance with generally accepted standards of the geotechnical engineering profession. No other warranty, either expresses or implied, is given.

If the project is revised, or if conditions different from those described in this report are encountered during construction, we should be notified immediately so that we can take timely action to modify our recommendations, if warranted.

Site conditions and standards of practice change. Therefore, we should be notified to update this report if construction is not performed within 24 months of the submittal date.

ILLUSTRATIONS



Reference: Site Plan, Sheet A1.0, dated February 17, 2016, prepared by Del Starrett Architect.
Note: The locations of all features are approximate and may vary.

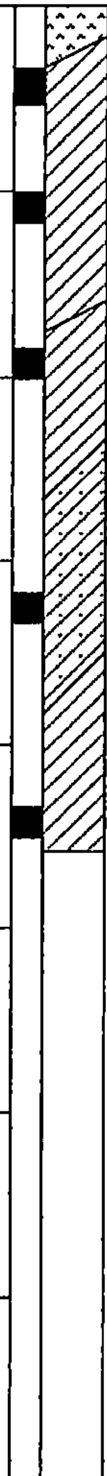
BAUER ASSOCIATES, INC. GEOTECHNICAL CONSULTANTS	Job No: 911.57 Date: 5/16 By: AHG	SITE PLAN TruAir Hangar Sonoma County Airport Sonoma County, California	PLATE 1

Equipment: 6" Flight Auger

Date: April 7, 2016

Elevation: Not Available

Laboratory Tests	Blows/Foot*	Moisture Content (%)	Dry Density (pcf)	Depth	Description
					Asphaltic Concrete
					BROWN & GRAY SANDY CLAY (CL) stiff to very stiff, moist to wet
	32/9"	28.1	60		
				3	
	32/9"	35.1	81		
					GRAY SILTY CLAY (CL) stiff to very stiff, wet
	30			6	
					BROWN CLAYEY SAND (SC) medium dense, saturated with gravel lense
				9	
	20	24.1	95		
					BROWN SANDY CLAY (CL) stiff to very stiff, wet
				12	
	32/9"				
				15	No Free Water Encountered
				18	
				21	



*Blows converted to Standard Penetration Resistance Values

BAUER ASSOCIATES

GEOTECHNICAL CONSULTANTS

Job No: 911.57

Date: 5/16

By: AHG

LOG OF TEST BORING 1

TruAir Hangar
Sonoma County Airport
Sonoma County, California

PLATE 2

Equipment: 6" Flight Auger

Date: April 7, 2016

Elevation: Not Available

Laboratory Tests	Blows/Foot*	Moisture Content (%)	Dry Density (pcf)	Depth	Description
					BROWN SANDY GRAVELLY CLAY (CL) medium stiff, wet, Fill
LL = 39 PL = 24 PI = 15	29	18.7	103		BROWN ORANGE & GRAY SANDY GRAVELLY CLAY (CL) very stiff, wet
				3	
	32/9"	35.1	81		LIGHT BROWN SANDY CLAYEY GRAVEL (GC) dense, wet
				6	LIGHT BROWN SANDY GRAVELLY CLAY (CL) very stiff, wet
	34/9"				
				9	BROWN CLAYEY SAND (SC) medium dense, saturated
	28			12	BROWN SANDY CLAYEY GRAVEL (GC) dense, wet to saturated
					No Free Water Encountered
	16/3"			15	
				18	
				21	

Weak Soils

BAUER ASSOCIATES

GEOTECHNICAL CONSULTANTS

Job No: 911.57

Date: 5/16

By: AHG

LOG OF TEST BORING 2

TruAir Hangar
Sonoma County Airport
Sonoma County, California

PLATE 3

Laboratory Tests	Blows/Foot*	Moisture Content (%)	Dry Density (pcf)	Depth
	19/3"			
				3
	43/9"	30.4	91	
				6
	36/9"			
				9
				12
	26/5"			
				15
				18
				21

Equipment: 6" Flight Auger

Date: April 7, 2016

Elevation: Not Available

DARK BROWN SANDY CLAY (CL)
soft, wet, porous

BROWN CLAYEY SAND (SC)
very dense, moist

GRAY & ORANGE SANDY CLAY (CL)
very stiff, wet

BROWN & GRAY SANDY CLAYEY GRAVEL (GC)
very dense, wet to saturated

BROWN & GRAY CLAYEY SAND (SC)
very dense, saturated

No Free Water Encountered

Weak Soils

BAUER ASSOCIATES GEOTECHNICAL CONSULTANTS	Job No: 911.57 Date: 5/16 By: AHG	LOG OF TEST BORING 3 TruAir Hangar Sonoma County Airport Sonoma County, California	PLATE 4

MAJOR DIVISIONS					TYPICAL NAMES
COARSE GRAINED SOILS (More than half is larger than #200 sieve)	GRAVELS more than half coarse fraction is larger than no. 4 sieve size	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM		SILTY GRAVELS, POORLY GRADED GRAVEL-SAND MIXTURES
			GC		CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND MIXTURES
	SANDS more than half coarse fraction is smaller than no. 4 sieve size	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS
			SP		POORLY GRADED SANDS, GRAVEL-SAND MIXTURES
		SANDS WITH OVER 12% FINES	SM		SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC		CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS (More than half is smaller than #200 sieve)	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML		INORGANIC SILTS, SILTY OR CLAYEY FINE SANDS, VERY FINE SANDS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS OR LEAN CLAYS
			OL		ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS

KEY TO TEST DATA

LL — Liquid Limit (in %)
PL — Plastic Limit (in %)
G — Specific Gravity
SA — Sieve Analysis
Consol — Consolidation
■ "Undisturbed" Sample
☒ Bulk or Disturbed Sample
☐ No Sample Recovery

	Shear Strength, psf	Confining Pressure, psf	
*Tx	320	(2600)	Unconsolidated Undrained Triaxial
Tx CU	320	(2600)	Consolidated Undrained Triaxial
DS	2750	(2000)	Consolidated Drained Direct Shear
FVS	470		Field Vane Shear
*UC	2000		Unconfined Compression
LVS	700		Laboratory Vane Shear

Notes: (1) All strength tests on 2.8" or 2.4" diameter sample unless otherwise indicated
(2) * Indicates 1.4" diameter sample

BAUER ASSOCIATES GEOTECHNICAL CONSULTANTS	Job No: 911.57 Date: 5/16 By: AHG	SOIL CLASSIFICATION CHART & KEY TO TEST DATA TruAir Hangar Sonoma County Airport Sonoma County, California	PLATE 5

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DISTRIBUTION

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August 29, 2017

Job No. 878.1.13

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Report
Soil Engineering Consultation
and Review of Grading Plans
Carriage Lane Subdivision
Santa Rosa, California

This report presents the results of our soil engineering consultation and review of grading plans for the Carriage Lane Subdivision in Santa Rosa, California. We performed a soil investigation for the project, and the results were submitted in our report dated February 3, 2017. Our general recommendations for site preparation and grading included criteria for moisture conditioning and compaction of fill to accommodate drilled pier and grade beams, post-tensioned or mat slab foundation systems for the proposed residences.

Grading plans reviewed were prepared by BKF, Civil Engineers, and are dated June 2017 with a preliminary stamp date of June 12, 2017. Plans indicate that the improvements will consist of 12 parcels for single-family residential construction served by a new public roadway (street and cul-de-sac) and underground utilities. New curb, gutter and adjacent sidewalks will also be provided. An existing storage building, club house, asphalt-paved parking lot and tennis court are located in the north portion of the site that will be demolished as part of the planned improvements. A portion of an existing sanitary sewer main line located near the west property line of Lots 10, 11 and 12 will also be removed. Improvements to existing city streets will include a new asphalt pavement section on the south side of Carriage Lane as well as new curb, gutter and sidewalk areas.

Site grading to develop level building areas, the planned public right-of-way and provide drainage is generally indicated to involve cuts and fills on the order of about 1 foot to 8½ feet, respectively. The deepest fills are located on the southern portion of Lots 3, 10 and 11. The deepest fills within the roadway are indicated on Misty Court at approximately station 2+75 and are shown to be about 4½ to 5 feet in thickness.

6 more

As noted above, the grading plans indicate that up to about 8 to 9 feet of fill will be needed on the south side of Lots 3 and 11. As discussed in the soil investigation report, where existing weak upper soils are not removed for their full depth prior to the placement of fill, drilled piers (if used for foundation support of the planned residences) should be deepened by the amount equivalent to the thickness of the fill. Where mat- or post-tensioned slab-on-grade foundations are used, total and/or differential settlement would be anticipated to be relatively uniform and within an acceptable range given the site grading recommendations and foundation design parameters provided in the soil investigation report. However, to reduce the risk of differential settlement, we recommend that differential fill thickness under mat- or post-tensioned slab-on-grade foundation areas be limited to 6 feet or less. This could result in the need for overexcavation within planned cut or fill areas and refilling with compacted fill.

An existing sanitary sewer main is shown on the south side of Lots 4 and 10 and is indicated to be about 15 feet below planned pad grade elevation. To help provide lateral stability and maintain support for new structures in close proximity to the sewer main should service be needed in the future, we recommend that mat- or post-tensioned slab-on-grade foundations on Lots 4 and 10 be strengthened to tolerate increased cantilever distances or larger differential settlements, respectively. As an alternative, foundation support for the residences constructed on Lots 4 and 10 could be provided by a system of drilled piers and grade beams. Drilled piers, if used, would likely be at least 14 inches in diameter and would be anticipated to extend at least 5 feet below an imaginary 1:1 line extended up from the bottom of the utility trench backfill.

We should be consulted to provide more specific recommendations concerning design of foundations on Lots 3, 4, 10 and 11 as planning progresses.

Ponding water will cause softening and swelling of site soils and would be detrimental to foundations. It is important that the pads be sloped to drain away from foundations. A gradient of at least 1/2-inch per foot extending at least 4 feet out should be provided and maintained. The roofs should be provided with gutters, and the downspouts should be discharge on to paved areas or splash blocks draining at least 30 inches away from foundations or be connected to nonperforated, rigid, plastic pipelines (with watertight joints) that discharge into planned or existing draining facilities.

Careful attention to fine (finish) grading around residences should be provided. No loose or poorly compacted materials should be allowed adjacent to foundations or grade beams. With a drilled pier and grade beam system, there is a potential for outside water to seep under grade beams and collect in underfloor areas. Careful attention to fine (finish) grading around all building/residence areas should be provided. No loose or poorly compacted materials should be allowed adjacent to grade beams, and the installation of underfloor drainage inlets, pipelines, swales and/or subdrains should be considered.

WBR LLC
c/o BKF Engineers
August 29, 2017
Page Three

Based on our plan review and previous work at the site, we believe that provided the site is graded as recommended in the soil investigation report and included herein, the materials and methods indicated on the plans are in general conformance with our recommendations. We recommend that site grading operations be observed and tested by the soil engineer to verify that the actual conditions encountered are as anticipated and to modify our recommendations, if warranted. Field and laboratory tests should be performed to ascertain that the specified moisture content and degree of compaction are attained.

We trust this provides the information needed at this time. If you have questions or wish to discuss this in more detail, please do not hesitate to contact us.

Yours very truly,

REESE & ASSOCIATES

Dan J. Figoni
Project Manager

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DF/JKR:nay/ra/Job No. 878.1.13
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cc: Tony Korman
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