Franklintown Farm Solar Project

Franklintown Farm, LLC

Jefferson County, West Virginia

Glare Analysis

August 12, 2024

Capitol Airspace Group
capitolairspace.com
(703) 256 - 2485

Capitol Airspace Group
6350 Walker Lane, Suite 450
Alexandria, VA 22310
703 256 2485
capitolairspace.com

Summary

Franklintown Farm, LLC is proposing to construct photovoltaic (PV) arrays in Jefferson County, West Virginia (*Figure 1*). On behalf of Franklintown Farm, LLC, Capitol Airspace performed an independent glare analysis utilizing ForgeSolar's GlareGauge toolset to identify the potential for glare impacts. Specifically, this analysis considered the potential for glare impacts on High View Farm Airport (61VA) approaches, as well as nearby residences, roadways, and railroads.

The results of this analysis indicate that there are no predicted glare occurrences for High View Farm Airport (61VA) approaches as a result of the proposed single-axis tracking PV arrays. Additionally, it should be noted that the current FAA policy no longer considers the potential for glare impacts on aircraft approach paths resulting from off-airport PV projects. Since High View Farm (61VA) does not have an air traffic control tower (ATCT), an assessment of potential glare impacts on ATCT personnel was not required.

The results of this analysis predict green glare occurrences for a nearby roadway as a result of the proposed single-axis tracking PV panel array. These results are based on the application of FAA glare standards in the absence of non-aviation regulatory guidelines.

Figure 1: Franklintown Farm Solar project PV panel area (gray) with GlareGauge sub-array assessment areas (purple outlines)

Methodology

In cooperation with the Department of Energy (DOE), the FAA developed and validated the Sandia National Laboratories Solar Glare Hazard Analysis Tool (SGHAT), now licensed through ForgeSolar as GlareGauge. ForgeSolar has enhanced GlareGauge for glare hazard analysis beyond the aviation environment. These enhancements include a route module for analyzing roadways as well as an observation point (OP) module for analyzing residences. However, it should be noted that GlareGauge does not automatically account for physical obstructions between reflectors and receptors.

GlareGauge analyzes the potential for glare over the entire calendar year in one-minute intervals from when the sun rises above the horizon until the sun sets below the horizon. The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. When GlareGuage identifies glare, the associated ocular impact is quantified into three categories based on the retinal irradiance and subtended angle (size/distance) of the glare source. These three categories are Green – low potential for after-image, Yellow – potential for after-image, and Red – potential for retinal burn (***Figure 2***).

The FAA policy for *Review of Solar Energy System Projects on Federally Obligated Airports* requires that proposed on-airport solar projects will not result in ocular impacts (no glare of any category) on the airport's ATCT cab. Although not required, the FAA encourages that off-airport solar energy systems in proximity to airports with ATCTs are assessed for potential ocular impact.

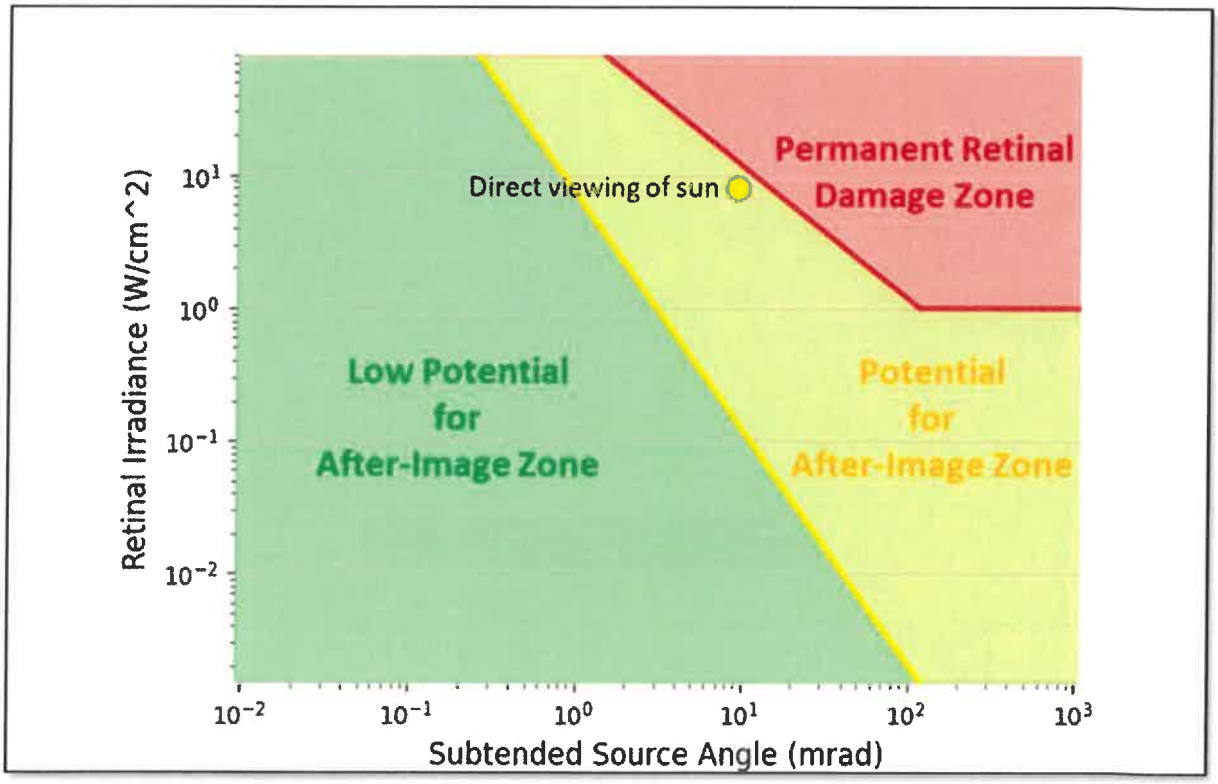

Figure 2: GlareGauge glare hazard plot depicting ocular impact as a function of retinal irradiance and subtended source angle

6350 Walker Lane, Suite 450
Alexandria, VA 22310
703 256 2485
capitolairspace.com

Data

Capitol Airspace conducted this analysis in accordance with industry best practices and, as appropriate, the FAA policy for *Review of Solar Energy System Projects on Federally Obligated Airports (86 FR 25801)*. This included the assessment of impact upon low-level ground receptors (e.g., houses and roads) within one-half statute mile of the study area, as well as airport approach paths within five statute miles of the study area. Aerial imagery was used to determine observation point receptor locations in collaboration with Franklintown Farm, LLC. The USGS 1/3 arc-second Digital Elevation Model (DEM) was used to determine observation point ground elevations.

PV array specifications (***Table 1***) as well as location and height information were provided by Franklintown Farm, LLC. Based on this data, the single-axis tracking arrays will rotate to track the sun through the range of rotation determined by the maximum tracking angle. When the sun's position is outside the range of rotation, the single-axis tracking arrays will use a slope-aware shade backtracking strategy to reduce row-to-row shading (***Figure 3***). Backtracking will begin and end at a 10-degree resting angle as defined by the Resting Angle/Backtracking Limit parameter.

Runway end coordinates, elevations, threshold crossing heights (TCH), and visual glidepath angles (VGPA) were obtained from the FAA National Flight Data Center (NFDC) National Airspace System Resource (NASR) dataset. When the NASR dataset did not contain this data, or contained erroneous data, aerial imagery, the United States Geological Survey (USGS) 1/3 arc-second Digital Elevation Model (DEM), and the FAA approved default settings (TCH: 50 feet, VGPA: 3.00°) were used.

Table 1: Franklintown Farm Solar project PV array specifications

Parameter	Value
Rotation Axis Height	6 feet
Axis Tracking	Single-axis rotation
Tracking Axis Orientation	180°
Max Tracking Angle	±55°
Backtracking Strategy	Shade-slope
Resting Angle/Backtracking Limit	10°
Ground Coverage Ratio (GCR)	0.46
Panel Material	Smooth, With Anti-Reflection Coating

6350 Walker Lane, Suite 450
Alexandria, VA 22310

703-256-2485
capitolairspace.com

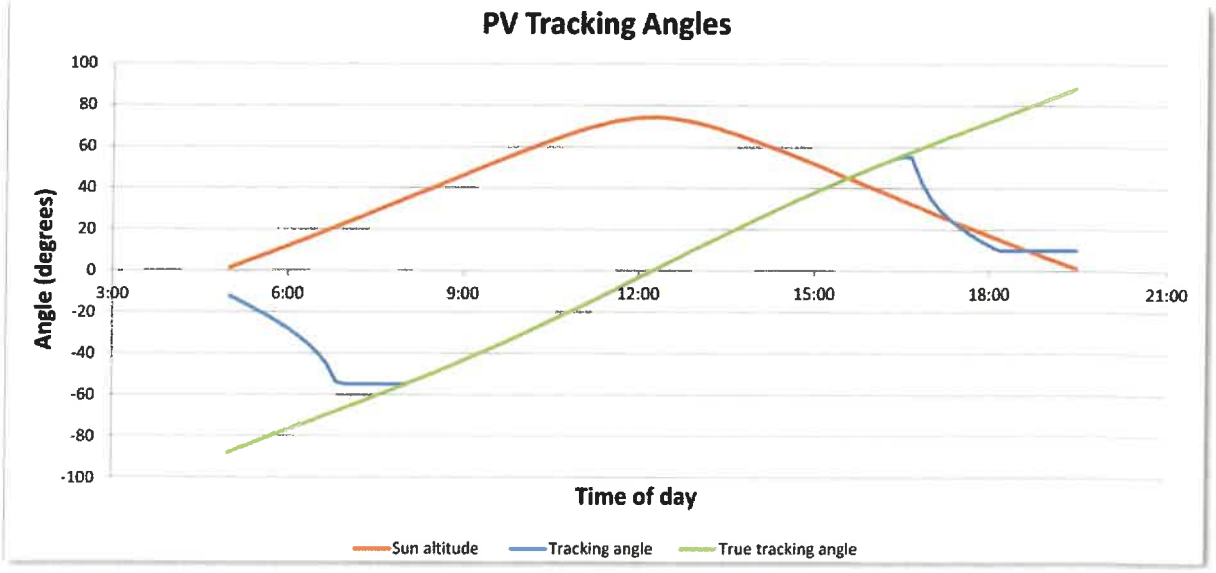

Figure 3: Sample PV panel tracking angle plot for June 21st

6350 Walker Lane, Suite 450
Alexandria, VA 22310
703-256-2485
capitolairspace.com

Results

High View Farm Airport (61VA)

GlareGauge assessed the potential for glare occurrences along two approach path receptors (hashed black lines, *Figure 4*). Each approach path was assessed using a pilot restricted view with a vertical view restriction of 30 degrees downward and an azimuthal view restriction of 50 degrees left and right (100-degree total field-of-view). The GlareGauge results do not predict glare occurrences for any approach paths as a result of single-axis tracking PV arrays.

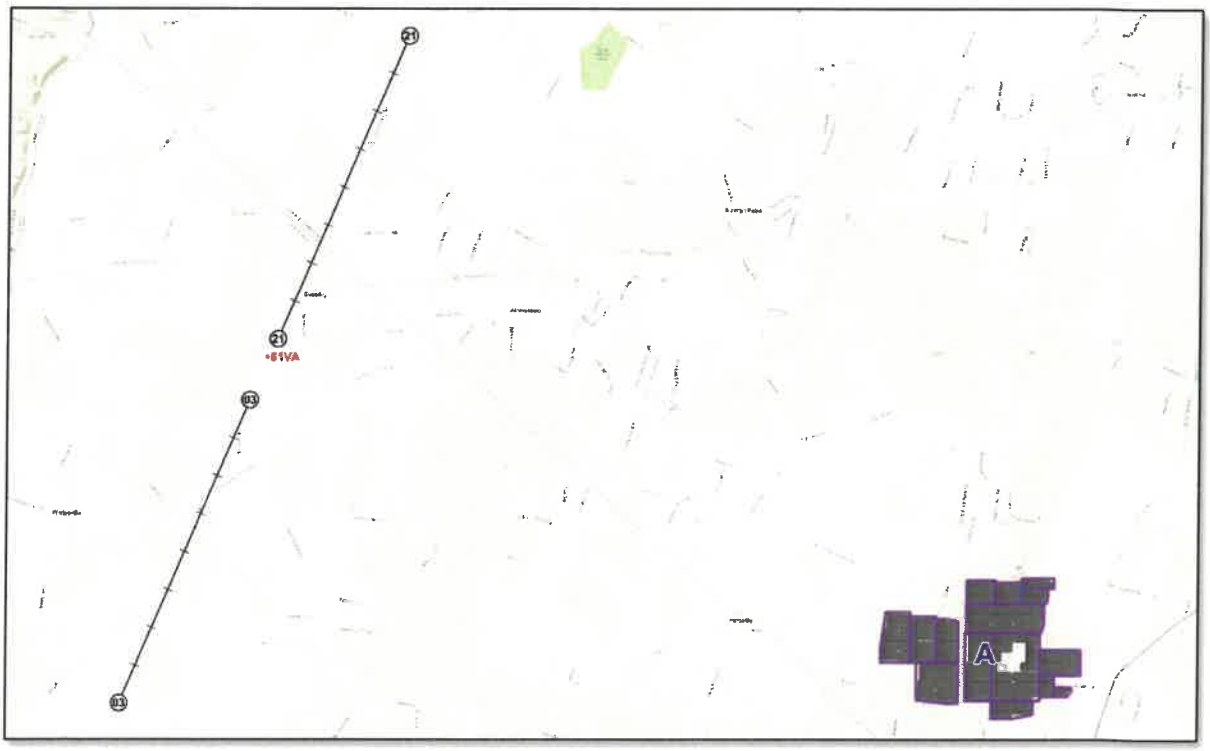

Figure 4: High View Farm Airport (61VA) approach paths (hashed black lines) in proximity to the Franklintown Farm Solar project

Runway 03

The GlareGauge results do not predict glare occurrences along the approach path.

Runway 21[1]

The GlareGauge results do not predict glare occurrences along the approach path.

[1] High View Farm Airport (61VA) contains erroneous runway end location placement provided in NASR for Runway 21. Therefore, Capitol Airspace corrected and assessed this flight path using aerial imagery.

Observation Points

GlareGauge assessed the potential for glare occurrences at 208 discrete observation point receptors (black points, *Figure 5*). Each observation point was assessed at an eight-foot first story viewing height and a 16-foot second story viewing height. The GlareGauge results do not predict glare occurrences for any of the 208 observation points at either viewing height as a result of single-axis tracking PV arrays.

Figure 5: Discrete observation point receptors (black points) in proximity to the Franklintown Farm Solar project

Routes

GlareGauge assessed the potential for glare occurrences along 24 route receptors. Each of the 23 roadways (dashed black lines, *Figure 6*) was assessed at a four-foot car viewing height and an eight-foot truck viewing height. The railroad (hashed black line, *Figure 6*) was assessed at a 12-foot locomotive cab viewing height. The GlareGauge results do not predict glare occurrences for 23 of the 24 route receptors, including the railroad, as a result of single-axis tracking PV arrays.

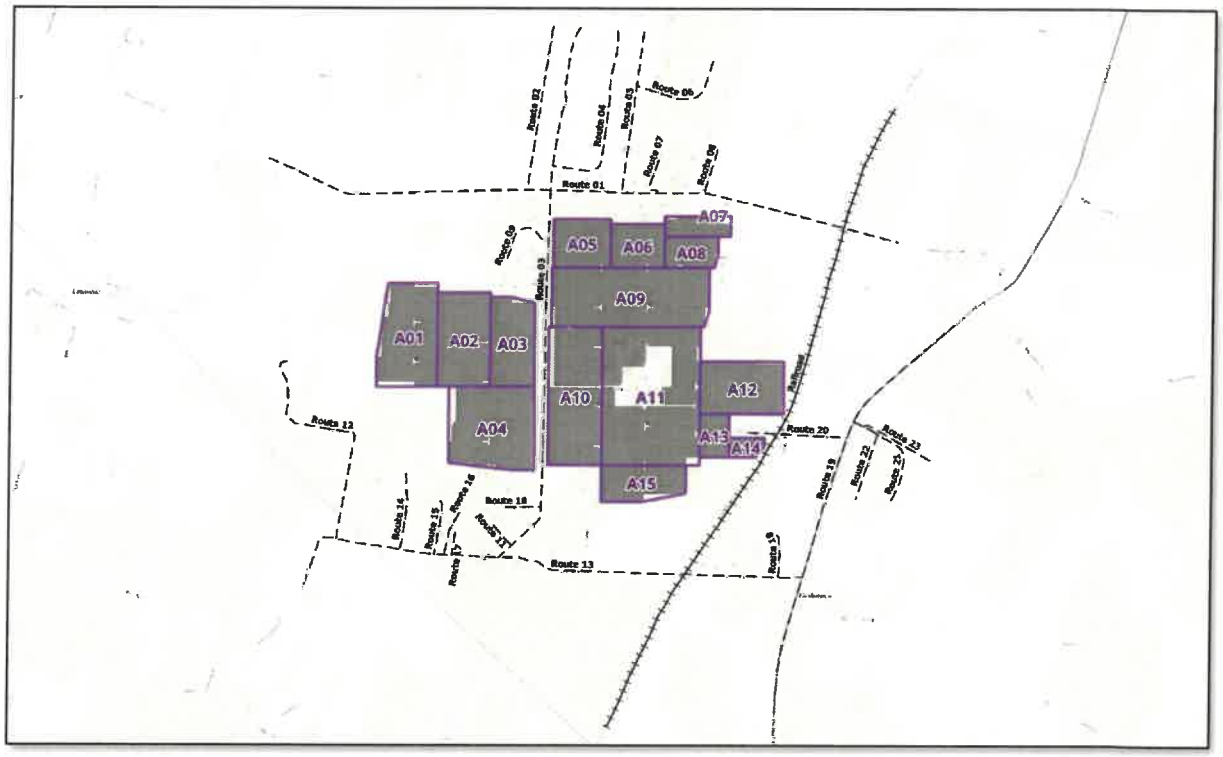

Figure 6: Route receptors (dashed and hashed black lines) in proximity to Franklintown Farm Solar project

The GlareGauge results predict brief green glare occurrences for one of the 24 route receptors in the morning and afternoon from November to January (*Table 2* & *Figure 8*). Specifically, green glare would emanate from sub-array A04 (faded green area, *Figure 7*). Green glare is associated with a low potential for temporary after-image. These results are based on the application of FAA glare standards in the absence of non-aviation regulatory guidelines.

It is important to note that the glare resulting from the proposed single-axis tracking arrays occurs during late-afternoon backtracking when the sun altitude is no greater than 25 degrees above the horizon. Capitol Airspace conducted additional analysis to determine the backtracking limit that would eliminate the identified glare occurrences. The results of the mitigation analysis determined that no backtracking limit would completely eliminate the predicted green glare occurrences.

Table 2: Predicted glare occurrences for route receptors in proximity to the Franklintown Farm Solar project

Receptor	Glare	Date		Monthly Frequency	Time (HH:MM)		Daily Duration (Minutes)	
		Start	End		Earliest	Latest	Longest	Average
Route 01	None	-	-	-	-	-	-	-
Route 02	None	-	-	-	-	-	-	-
Route 03	Green	26-Nov	14-Jan	Contiguous	10:19	16:29	40	25
Route 04	None	-	-	-	-	-	-	-
Route 05	None	-	-	-	-	-	-	-
Route 06	None	-	-	-	-	-	-	-
Route 07	None	-	-	-	-	-	-	-
Route 08	None	-	-	-	-	-	-	-
Route 09	None	-	-	-	-	-	-	-
Route 10	None	-	-	-	-	-	-	-
Route 11	None	-	-	-	-	-	-	-
Route 12	None	-	-	-	-	-	-	-
Route 13	None	-	-	-	-	-	-	-
Route 14	None	-	-	-	-	-	-	-
Route 15	None	-	-	-	-	-	-	-
Route 16	None	-	-	-	-	-	-	-
Route 17	None	-	-	-	-	-	-	-
Route 18	None	-	-	-	-	-	-	-
Route 19	None	-	-	-	-	-	-	-
Route 20	None	-	-	-	-	-	-	-
Route 21	None	-	-	-	-	-	-	-
Route 22	None	-	-	-	-	-	-	-
Route 23	None	-	-	-	-	-	-	-
Railroad	None	-	-	-	-	-	-	-

Figure 7: Route 03 with segments receiving glare (green lines) from Sub-Array A04

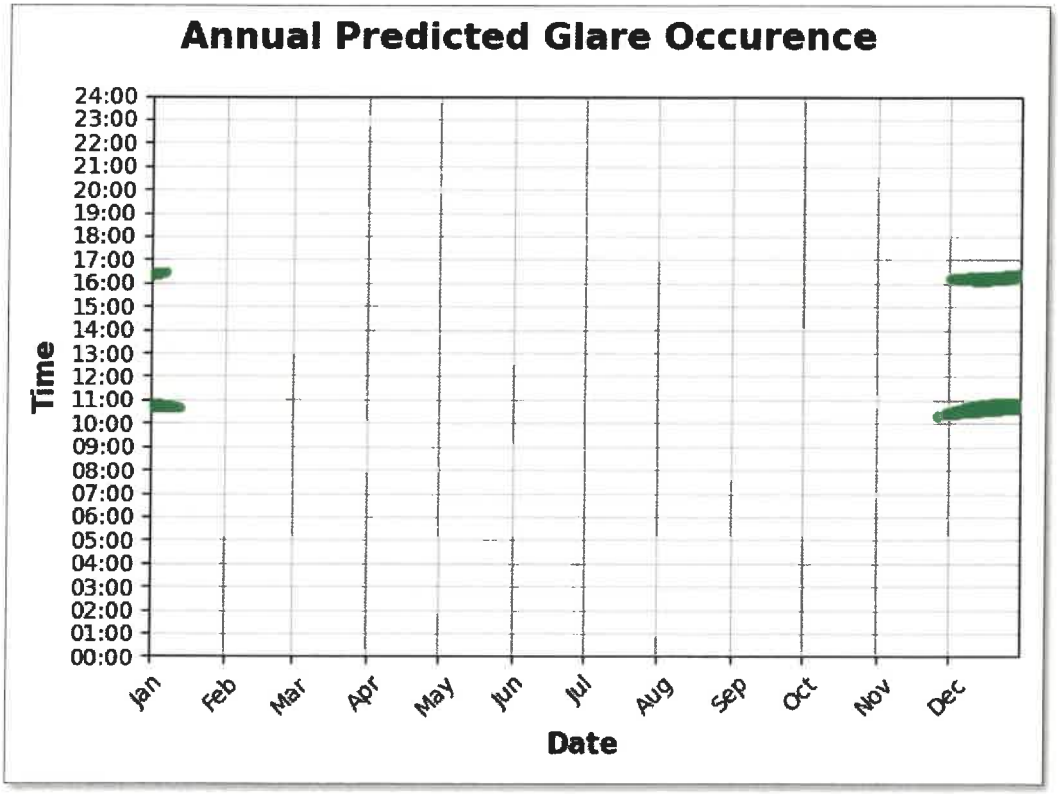

Figure 8: Annual predicted glare occurrence plot for Route 03

6350 Walker Lane, Suite 450
Alexandria, VA 22310
703-256-2485
capitolairspace.com

Conclusion

Capitol Airspace performed a glare analysis utilizing ForgeSolar's GlareGauge toolset to identify the potential for glare impacts resulting from the proposed Franklintown Farm Solar project. Specifically, this analysis considered the potential for glare impacts on High View Farm Airport (61VA) approaches. This analysis also considered the potential for glare impacts on low-level receptors like residences, roadways, and railroads in proximity to the proposed arrays.

Aircraft Approaches

GlareGauge does not predict glare occurrences for aircraft approaching High View Farm Airport (61VA). Additionally, it should be noted that the current FAA policy no longer considers the potential for glare impacts on aircraft approach paths resulting from off-airport PV projects. Since High View Farm Airport (61VA) does not have an ATCT, an assessment of potential glare impacts on ATCT personnel was not required.

Low-Level Receptors

GlareGauge predicts green glare occurrences for a nearby residence and roadways from November to January. The glare resulting from the proposed single-axis tracking array occurs during morning and afternoon backtracking when sun altitude angles are no greater than 25 degrees above the horizon. Capitol Airspace conducted additional analysis to determine the backtracking limit that would eliminate the identified glare occurrences. The results of the mitigation analysis determined that no backtracking limit would completely eliminate the predicted green glare occurrences.

These results are based on the application of FAA glare standards in the absence of non-aviation regulatory guidelines. As noted in the methodology, this glare analysis does not consider vegetation, fencing, or other natural obstructions. This glare analysis takes the most conservative approach in assessing the possibility of glare occurrences.

The GlareGauge component data used to conduct this analysis is available upon request. If you have any questions regarding the findings in this analysis, please contact ***Rick Coles*** or ***Travis Harrison*** at (703) 256-2485.