To: Burning Man 2009 File

From: Roger Farschon, NCA Ecologist

Subject: Post-Event Inspection

Summary

A total of 65 plots were read in four areas associated with the 2,906 acre 2009 Burning Man Event area. There were a total of 1,197 debris items covering 2.56 ft^2. Averaged across all the plots, there were 184.2 items/ acre that averaged 0.394 ft^2/ac. Thirty of the 65 plots were read in 878 acre Black Rock City with 275 debris items/acre averaging 0.514 ft^2/ac. Twenty plots were read in the 1,134 acre Open Playa with 158.5 items/acre covering 0.396 ft^2 /ac. Eight plots were read in the 312 acre Walk-in Camping Area adjacent to Black Rock City with 48.8 items/acre covering 0.212 ft^2/ac. Seven plots were read in the remaining 582 acres within the perimeter fence with 22.9 items/acre covering 0.080 ft^2/ac. The measured debris levels were below the maximum standard of 1.0 ft^2/ac.

There were statistically significant differences between Residential Area samples and The Playa and the other sampling areas. Levels of debris evaluated in the 2009 inspection were lower than those found in 2008 and more than 2007 within similar parts of the event site. When comparing debris levels for the three events held at the same site, 2006, 2007 and 2009, there was statistically significant increase in debris area between 2006 and 2009 for plots in Black Rock City. There were no statistically significant differences between years for the other sampling areas.

Background

The location of the 2009 event was moved about 0.75 miles southwest of the 2008 location to the location for the 2006 and 2007 event. This year 65 randomly located one-tenth acre plots were read on four areas within the event perimeter. The protocol used for the 2003 – 2008 events was used for the 2008 inspection. All plots were read on October 6, 2009. Map 1 show the sampling areas and plot locations for the post-event plots.

Sampling

A total of 65 plots were randomly established prior to the event. The plots were stratified within four areas inside the event perimeter fence: the City which includes the street grid or residential areas, the Playa inside the Esplanade where all the art projects are found, the area south of the City where walk-in camping is permitted, and the remaining area within the fence (e.g. the other areas).

The inspection took place on October 6, 2009. The day before the inspection, BLM located each plot location using GPS receivers and marked the plot centers with flags. On inspection day BLM staff, volunteers, and members of the BRC Playa Restoration crew (the Burning Man event staff responsible for event site cleanup) met onsite and

were given a briefing on the inspection including the purpose, methods, and standards. The group was divided into teams and each team was assigned 5 or 6 plots. Each team then visited their assigned plots. At each plot, a pin attached to a long cord was placed at the plot center. The cord was marked at 37.23 ft from the pin and this mark delineated the circumference of a 0.1 acre circle. Each team then used the cord to systematically search the plot area. All debris items found within the circle were placed into a plastic bag labeled with the plot number. Back in the office, the debris within each bag was then sorted into classes that represented the type of material (e.g. wood, plastic, paper, etc.). For each type of material the number of individual debris items and surface area covered by the debris items were recorded for each plot.

A total of 1,197 items of debris were collected that covered 2.56 ft^2 of area. This represents average residual debris levels of 0.394 ft^2 and 184.2 debris items per acre. On a plot basis, this corresponds to 5.57 in^2 of debris area and 18.42 debris items per plot. The average debris item covered an area of 0.31 in^2.

Extrapolating the data to the entire 2,906 acre area within the perimeter fence and weighting by sampling area, there are an estimated 449,743 debris items covering 1,013 ft^2 remaining on the playa after the event cleanup. In contrast, background surveys conducted using the same methodology predicts 125,417 debris items covering 561ft^2.

Map 2 shows the relative amount of area covered by debris at each plot. Map 3 shows the relative number of debris items at each plot. Map 4 shows the average size of debris items at each plot.

Black Rock City

Thirty plots were read within 878 acre Black Rock City. Table 1 shows the summary information for these plots.

Table 1: Summary of 2008 BRC Plots

	Number of Plots:	30
	# of Items	Surface area of Collected Items
Total for all plots	825 items	1.54 (ft^2)
Average/acre	275 items/ac	0.514 (ft^2/ac)

The average level of residual debris from these plots was 0.514 ft^2/ac or about half of the allowable standard of 1.0 ft^2/ac (down from 0.60 ft^2/ac in 2008 and up from 0.40 in 2007). Therefore the cleanup effort met the standard. The median value of the 30 plots was 0.44 ft^2/ac (up from 0. 39 ft^2/ac in 2008). Three plots exceeded the standard (1.03, 1.26 and 1.70 ft^2/ac) versus three plots in 2008 and two plot in 2007. The average number of individual debris items per plot was 27.5 (275 per acre; down from 416 per acre in 2007 and up from 202 in 2007) and the average size of each item of debris was 027. $inch^2$ (up from 0.22 $inch^2$ in 2007and down slightly from 0. 28 ft^2/ac in 2007). The decrease in debris area per plot was statistically significant between 2006 and 2009. Extrapolation

of the samples to the 878 acre City, there were 241,450 debris items covering 451.3 ft^2 remaining after the event cleanup.

Open Playa

Twenty plots were read the 1,134 acre Playa where the art projects were located. Table 2 shows the summary data for these plots. This area includes the location of the "Man" and other art projects.

Table 2: Summary of 2008 BRC Art Area Plots

	Number of Plots:	20
	# of Items	Surface area of Collected Items
Total for all plots	317 Items	0.792 (ft^2)
Average/acre	158.5 Items/ac	0.396 (ft^2/ac)

The average level of residual debris from these plots was 0.396 ft^2/ac (up from 029. ft^2/ac in 2008 and down from 0. 42 in 2007) which is about 40% of the standard. The median value of the 20 plots was 026. ft^2/ac (up slightly from 0. 25 ft^2/ac in 2008 and down from 0. 35 ft^2/ac in 2007). No individual plot exceeded the standard. In 2007 and 2008 one plot exceeded the standard in each year. The average number of individual debris items per plot was 15.85 (158.5per acre, down from 203 per acre in 2008 and 181 per acre in 2007) and the average size of each item of debris was 0.36 $inch^2$ (up from 0. 25 in^2 measured in 2008 and 0.31 in^2 in 2007). The change in debris area per acre between 2006 and 2009 was not statistically significant. Extrapolation of the samples to the 1,34 acre Playa, there were 179,739 debris items covering 449.1 ft^2 remaining after the event cleanup.

Walk-in Camping Area

Eight plots were read within the 312 acre Walk-in Camping Area. Table 3 shows the summary data for these plots. The average residual debris from these plots was 0.212 ft^2/ac (down from 0. 28 ft^2/ac in 2008 and up from 0.15 ft^2/ac in 2007) which is a little more than 20% of the standard of 1.0 ft^2/ac. No individual plots exceeded the standard. The average number of individual debris items per plot was 4.88 (48.8 per acre, down from 46 items per acre in 2008 and up from 84 items per acre in 2007) and the average size of each item of debris was 0.63 in^2 (down from 0.87 in^2in 2008 and up from 0.25 in^2 in 2007). When compared to 2007 and 2008, the average amount of debris was between the 2007 and 2008 measurements, the number of items per plot decreased over 2008 but was greater than 2007. Item size was between the 2007 and 2008 measurements. However none of these differences was statistically significant. Extrapolation of the samples to the 312 acre Walk-in Camping area, there were 15,226 debris items covering 66.1 ft^2 remaining after the event cleanup.

Table 3: Summary of 2008 BRC Walk-in Camping Area Plots

	Number of Plots:	8
	# of Items	Surface area of Collected Items
Total for all plots	39 Items	0.17 (ft^2)
Average/acre	48.8 Items/ac	0.212 (ft^2/ac)

Other Areas

Seven plots were read in the remaining 582 acres within the perimeter fence as shown on Map 1. Table 4 shows the summary data for these plots. The average residual debris from these plots was 0.080 ft^2/ac or less than 10% of the standard of 1.0 ft^2/ac (down from 0.16 ft^2/ac in 2007 and 0.11 ft^2/ac in 2007). No individual plots exceeded the standard. One plots contained no debris. The average number of individual debris items per plot was 2.28 (22.8 per acre; down from 73 per acre in 2008 and 68 per acre in 2007) and the average size of each item of debris was 0.50 in^2 (up from 0.22 in^2 in 2008 and 0.24 in^2 in 2007). However none of these differences was statistically significant. When compared to the past two years, average debris area and number of items decrease, and the average item size increased. Extrapolation of the samples to the remaining 582 acres, there were 13,328 debris items covering 46.6 ft^2 remaining after the event cleanup.

Table 4: Summary of 2008 BRC Other Areas Plots

	Number of Plots:	7
	# of Items	Surface area of Collected Items
Total for all plots	16 Items	0.056 (ft^2)
Average/acre	22.8 Items/ac	0.08(ft^2/ac)

Debris Type

Debris items were classified into one of 15 categories of debris. Table 6 summarizes the debris data for all plots read. Wood and plastic items were most common combining for 52.5 and 46.6 percent of the number of items and the surface area respectively. The next most common items were items of paper and textile (which included cloth, fiber and rope) which together represented 27.9 and 31.0 percent of the number of items and the surface area respectively. These four item types represented 80.4 and 77.6 percent of the number of items and the surface area respectively. The remaining 11 types of debris included metals, glass, rubber,

Table 6: Summary of all 2009 BRC Plots

	Number of Plots:			65
Debris Type	# of Items	% of Items	Surface area of Items (in^2)	% of Area
Ammunition	1	0.08%	0.2	0.1%
Bone	3	0.3%	0..85	0.2%
Textile	245	20.5%	61.4	16.7%
Coin	6	0.1%	3.1	0.8%
Multi-composition	19	1.6%	5.75	4.9%
Glass	16	0.1%	4.2	1.6%
Ferrous metals	73	6.1%	22.45	6.1%
Non-ferrous metals	12	0.1%	3.3	0.9%
Organics	36	3.0%	11.05	3.0%
Other	2	0.01%	1.3	0.4%
Paper	89	7.4%	52.8	14.3%
Plastic	275	23.0%	83.3	22.6%
Rubber	14	1.2%	7.9	2.1%
Tobacco Products	53	4.4%	22.6	6.1%
Wood	353	29.5%	88.3	24.0%
Total for all Plots	1,197	100%	368.35(in^2)	100%
Averages	158.2 Items/ac		0.317 (ft^2/ac)	

coins, bone, organic materials, and items constructed from multiple materials. This distribution of item types was very similar to the 2004 through 2007 inspection results. One debris type stands out as increasing over 2007 and 2008, cigarette filters. They represented 4.4% of the items and 6.1% of the debris area.

Comparison among Sampling Areas

The area occupied by debris and the number of items for each sample area was compared. Table 7 summarizes the average number of items and area of the collected debris for each sampling area.

Table 7: Comparison of Sampling Areas

Sampling Area	# of Items (ac)	Debris Area (ft^2/ac)	Item Size (in^2)
Black Rock City	**275.0[ab]**	**0.514[12]**	**0.27**
Open Playa	**158.5[cd]**	**0.396[3]**	**0.36**
Walk-in Camping	**48.75[ace]**	**0.212[1]**	**0.63**
Other Areas	**22.9b[bde]**	**0.080[23]**	**0.50**
All Areas	**184.2**	**0.394**	**0.31**

The results of the statistical comparisons for number of debris items indicated there were statistically significant differences between the samples from all the sampling areas except for Black Rock City and the Open Playa. The significant differences are identified in the table above with shared letters in superscript (e.g. [a], [b], [c] etc.).

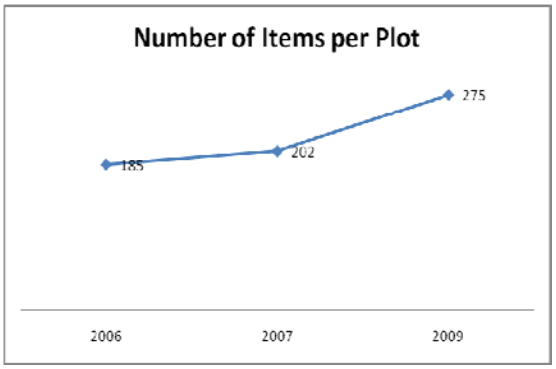
The results of the statistical comparisons for area covered by debris indicated there were significant differences between the samples from the City and the Walk-in Camping and Other areas. There was also a statistically significant difference between the Open Playa and the other areas. There were no statistically significant differences between samples from the Walk-in Camping and Other areas or between the City and the Walk-in Camping areas. The significant differences are identified in the table above with shared numbers in superscript (e.g. [1], [2], [3] etc.).

This analysis was consistent with the premise that where people are concentrated at the event, the highest levels of debris was created and then measured in the inspection.

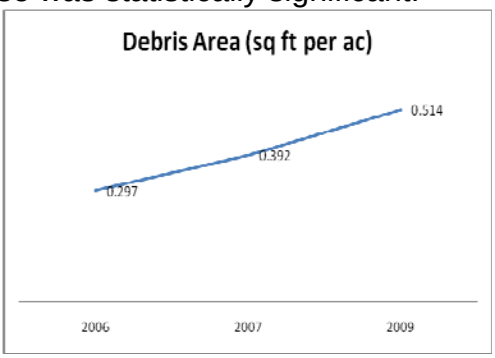
Comparison to Previous Inspections

The 2009 event was held on a new site approximately 0.75 miles southwest of the 2008 and at the same location as the 2006 and 2007 events. The 2008 site overlapped a portion of the 2008 site. Because of the direct overlap between 2006, 2007 and 2008, the number of items measured and the area covered by residual debris were compared within sampling areas using one-way analysis of variance to see if there were meaningful differences. Due to changing sample sizes and relative low debris levels, there were no significant differences between years for the Open Playa, Walk-in Camping or Other Areas. There were statistically significant trends for debris area in the City samples.

The number of items per plot in the City consistently increased over the 2006 to 2009 period as shown in the figure to the right. Although the observed trend was not statistically significant, regression analysis indicated that the predicted trend explained over 97% of the variance in the data (R^2=0.972).



Debris levels within the City plots also consistently increased during the 2006 to 2009 period as shown in the figure to the right. This increase was statistically significant.



The likely reason this occurs is that the 2009 event marked the 3rd time the event has been held at this location. Debris remaining after the 2006 and 2007 cleanups was on site prior to the 2009 event. The 2009 cleanup crew was charged with cleanup of the 2009 debris and any 2006 or 2007 debris they encountered.

A small study of background debris levels on the Black Rock Desert playa was conducted in 2003 and 2004. A total of 81 plots were evaluated using the same methodology as this inspection. There was an average of 38.3 debris items per acre covering 0.17 ft^2/ac. Thirty-eight of the 81 plots had no debris.

One measure of the effectiveness of the cleanup effort is the average item size. The average item size for 2009 was 0.31 in^2, while the average item sizes for the 2004-2008 samples were 0.24 in^2, 0.25 in^2, 0.27 in^2, 0.33 in^2 and 0.31in^2 respectively. For reference this box represents 0.25 in^2. The average item sizes for the 2004-2009 events were statistically analyzed. No statistically significant differences were found in item size among years. This indicates that although the size of the cleanup effort has increased, the effectiveness of the search effort remains the same. However there were differences between the sampling areas related to item size. These differences are shown in Table 7 and graphically on Map 4. There is an inverse relationship between participant density and item size. This is probably a measure of relative cleanup effort. The average item size encountered in background surveys of the playa using the same methodology found an average item size of 0.644 in^2 or about twice as large as the items found in this inspection indicating that the Burning Man cleanup is relatively effective in finding debris within the event sites.

Conclusions

The 2009 Burning Man cleanup effort met the standard of less than 1.0 ft^2/ac. None of the four inspection areas within the event site exceeded 52% of the standard.

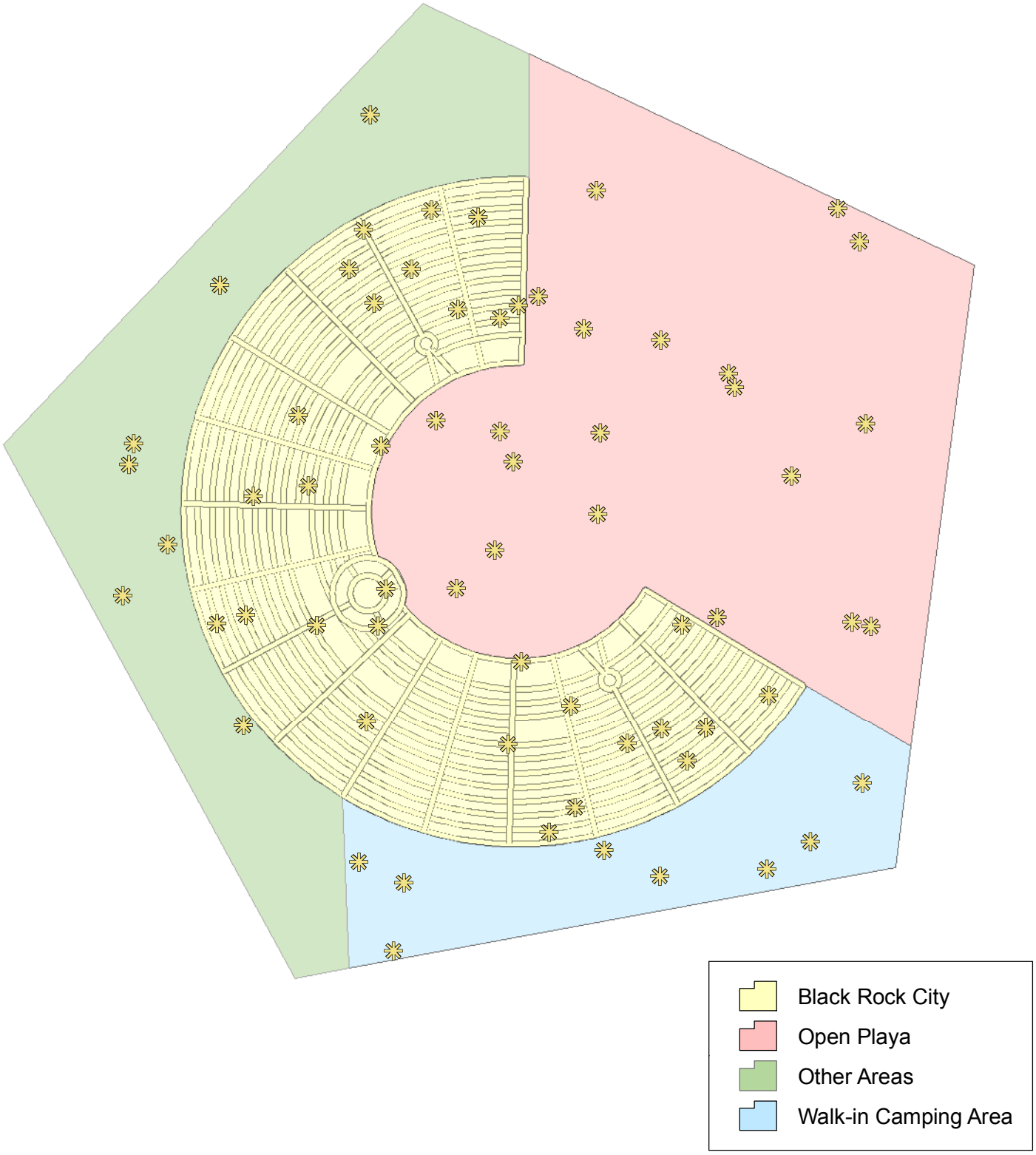
However there were some aspects of the 2009 cleanup effort that raises concerns about the 2010 event and future events. Specifically:

- The size of the event both in population and footprint decreased this year and the cleanup was more effective when compared to 2008. If population and event footprint trends upward again, at some point there is a risk that the cleanup effort becomes too large and the standard would be exceeded.
- For the past two years tobacco related items were classified separately. The vast majority of the items found are cigarette filters and they are resistant to natural degradation. Between 2007 and 2008 the percentage of items in this category has almost doubled.

Recommendations:

- Continue using the current inspection protocol for future events.
- Maintain distinct samples for each portion of the event area.
- Encourage BRC to maintain high levels of support to the “Playa Restoration” crew to ensure that future event do not lead to a failure to meet the cleanup standard.
- Increase education among participants about not “letting it hit the ground” with increased emphasis on cigarette butts. Discarding of cigarette filters is a conscious action at the event and should be considered a target for BRC participant education.

Burning Man 2009
Cleanup Evaluation--Sample Locations



N

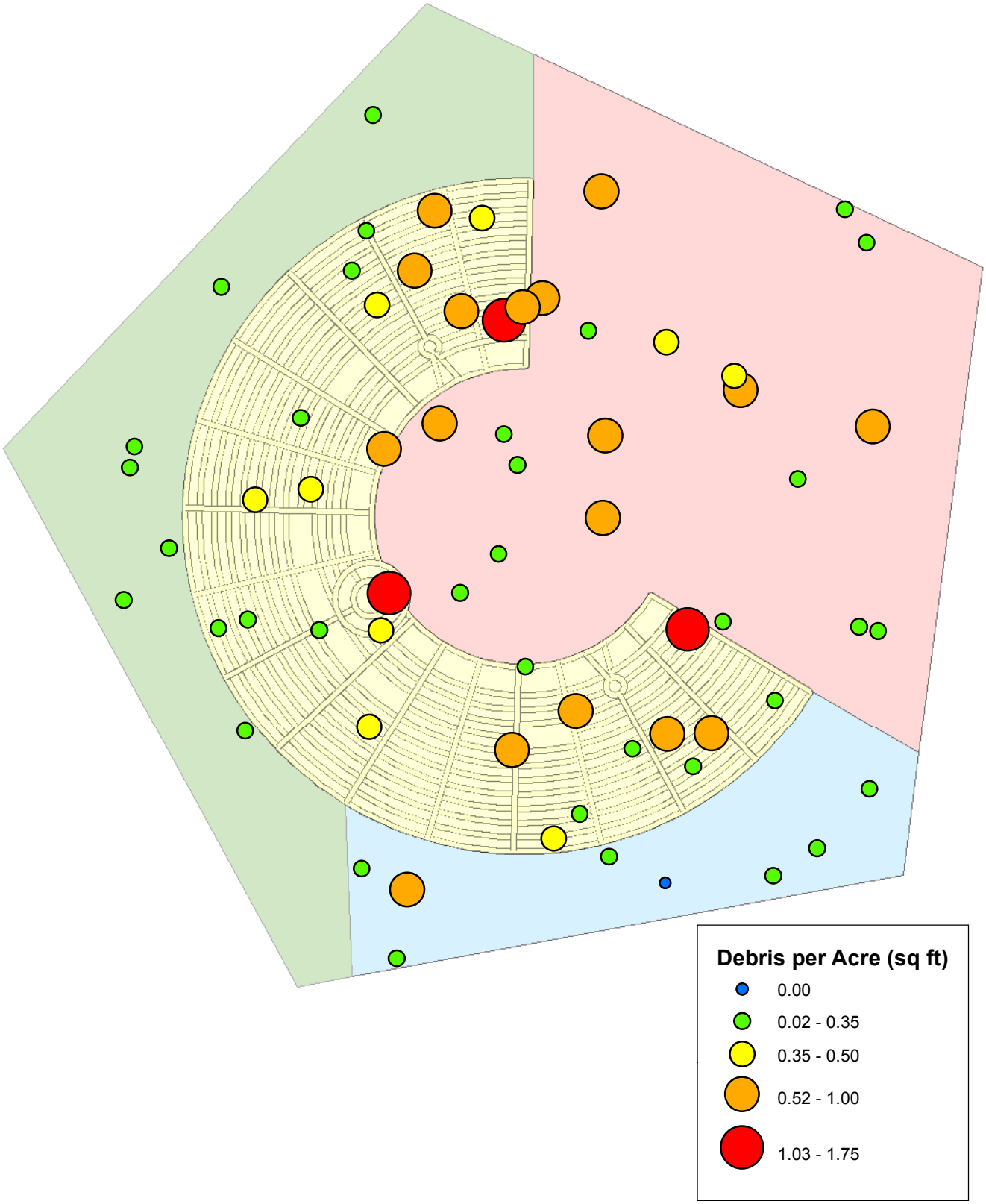
0 0.1 0.2 0.4 0.6 0.8 Miles

1 inch = 2,000 feet

No warranty is made by the BLM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Map 1

Burning Man 2009
Cleanup Evaluation--Area Covered by Debris



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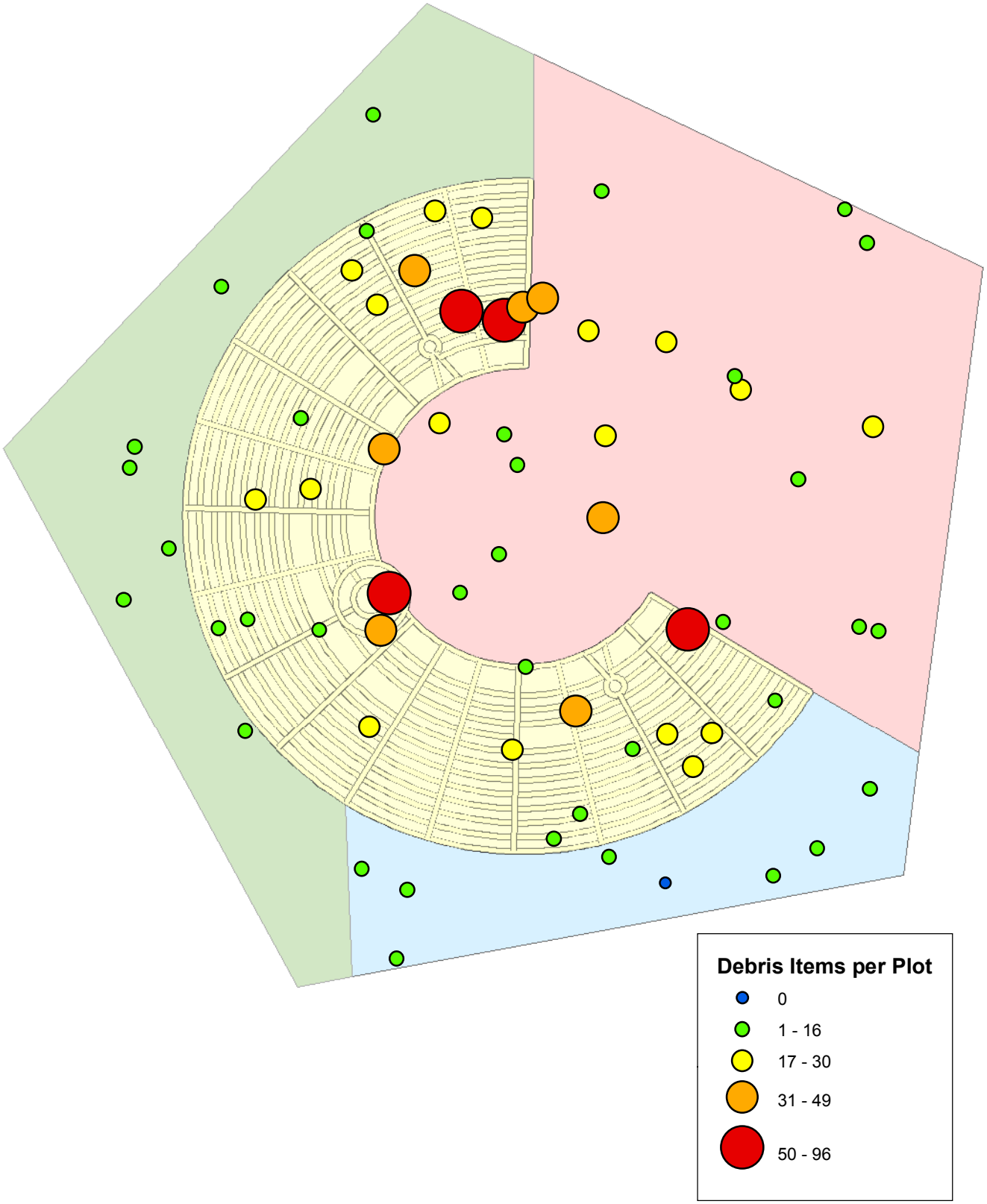
1 inch = 2,000 feet

No warranty is made by the BLM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Map 2

Burning Man 2009
Cleanup Evaluation--Number of Debris Items



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1 inch = 2,000 feet

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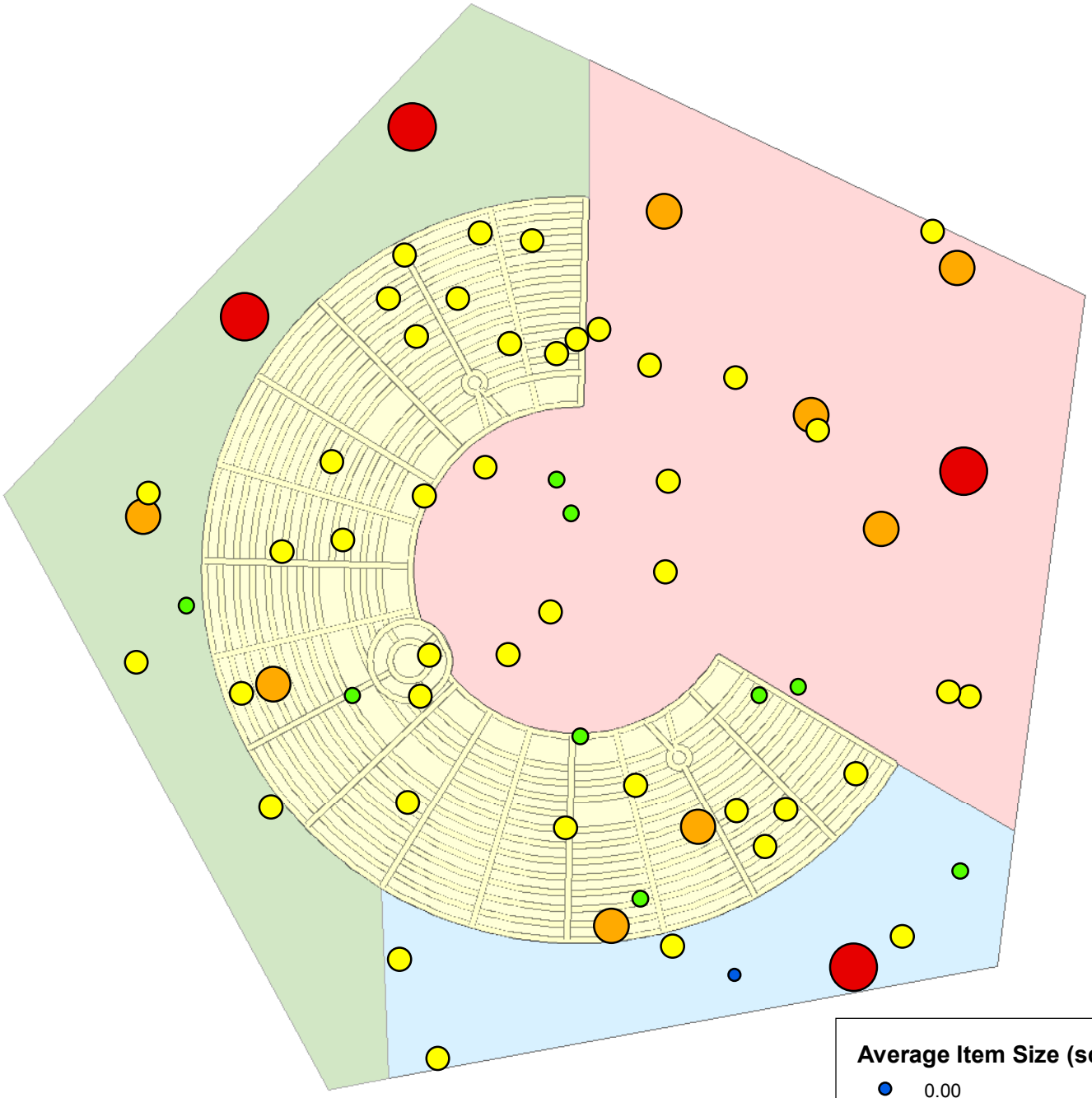
Map 3

Burning Man 2009
Cleanup Evaluation--Debris Item Size



Average Item Size (sq in)

- 0.00
- 0.01 - 0.25
- 0.26 - 0.50
- 0.51 - 0.75
- 0.76 - 1.28

N

0 0.1 0.2 0.4 0.6 0.8 Miles

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Map 4