

IV. TECHNICAL NOTE

How do you monitor over 20 stipulations at the largest permitted event on the US public lands in real-time with volunteer staff from an office trailer on the Black Rock Desert?

This technical note demonstrates the combined power of the GPS-cameras, Trimble GPS devices and ArcGIS to monitor permit stipulations in 'real time' at the Burning Man event. The chosen tools facilitated the completion of 10 monitoring studies, the results and recommendations of which were compiled in the 2008 Monitoring Report. This suite of geospatial tools enabled the monitoring team to justify day-to-day decision-making. Compiled written reports, as well as an accompanying CD of the data and maps served as record for this year's event as well as the basis for future management decisions for this and other permitted events. This real-time knowledge management is an extremely valuable tool for both short and long-term planning.

SUITE OF GPS/GIS TOOLS

Because everything in Black Rock City is temporary, using GPS technology and photo-documentation is key to meeting resource protection goals and managing future events on the desert. Tools were chosen to meet field conditions, staff needs and availability. These included a) extreme temperatures and dust, b) a single computer with supporting software but lacking of internet access, c) a staff of primarily volunteers with minimal training time, and d) available equipment with no new purchases.

A. GPS CAMERAS

Four Ricoh 500SE cameras were used to photo-documentation everything 'good, bad or ugly' at the event. The cameras offered the following advantages that made possible the documentation and management of over 1200 photos compiled to complete the 10 studies detailed in the monitoring report.

1. Minimal training

Training for use of these cameras took less than 15 minutes. This was ideal for our team of mostly volunteers.

2. GPS-record the locations photographs were taken

The accuracy of this location is approximately 2-5 m. While this is not as accurate a location as the Trimble GPS units could record, it is sufficient for the Team's purposes. The cameras do have the ability to record the location of the object photographed rather than the location of where the photograph was taken, however, the Team did not require this capability.



3. Record information about each photograph

Caplio’s List Editor software (which ships free with the camera) was used to create a data dictionary to ensure all information was collected in a standard way. Outlined below are the possible entries accessed via drop-down menus for each of the 5 data fields.

Field	Representative attribute values
Study	Art Project, Perimeter Fence, Trash transects
Stipulation	19 – Art Burn, 32 – Perimeter Fence, 79 – Trash
Status	Good/Stip Met, Bad/Concern, Ugly/Violation, Other
First Digit	1 st digit of trash transect number (0-9)
Second Digit	2 nd digit of trash transect number (0-9)

4. Watermark photos with entered information

GPL-Photo Link generates a watermarked version of the photograph, which can be customized to display items such as:



- Title
- Comment
- Location taken
- File name
- Date and time
- Or any of the 5 entered attributes

5. Transfer data to ArcGIS

GPL-Photo Link also generates a shapefile, a common ArcGIS file format.

6. Field worthy

Despite extreme temperatures and a brutal amount of alkaline playa dust, these cameras have continued to survive multiple Burning Man events, as well a year-round use for other projects including hundreds of miles of route inventories on ATVs.

B. TRIMBLE GPS UNITS

Trimble GeoXT units were used with TerraSync to map city infrastructure and areas of concern such as art burn platforms. Although some training is required to use these units, these efforts represented a small minority of the data collected. This workload was easily covered by those already trained to use these units. The units were also used data loggers to record responses in the visitor use and greywater surveys. Trimble units offered the abilities to:

1. GPS-record locations with a high level of accuracy

Locations were GPS-recorded as distinct points, lines or polygon features with sub-meter level accuracy. These accurate datasets allowed for calculation of area and perimeter values and for the navigation back to selected locations with high levels of confidence.

2. Record information for each location

Most locations captured by GPS simply required only a comment field in which the Team could enter free-form text describing the location being recorded. For example, 'Burn platform at the Man.' Date and time of collection are automatically appended by the software.

For the visitor use and greywater surveys, data dictionaries were created to ensure standardized entries via drop-down menus. The location at which the survey was taken was also recorded by GPS. This could be used to ensure a random sampling of all areas of the city was achieved.

3. Transfer data to ArcGIS

Trimble Pathfinder Office was used to post-process data to ensure sub-meter accuracy of each location. This software was also used to export the data to an ESRI shapefiles (a common ArcGIS format).



4. Navigate to collected features

Long after Black Rock City had been dismantled, the Team was able to navigate the empty desert directly back to sites within the former city.

Art burn platforms and other areas of potential concern, the perimeter fence, and other infrastructure were areas subject to for post-event inspections. Shapefiles for either GPS collected data or the photo locations from the camera could be copied back to the unit for navigation. Coordinates from the watermarked photos could also be manually entered into the Trimble units.

C. ESRI ARCGIS

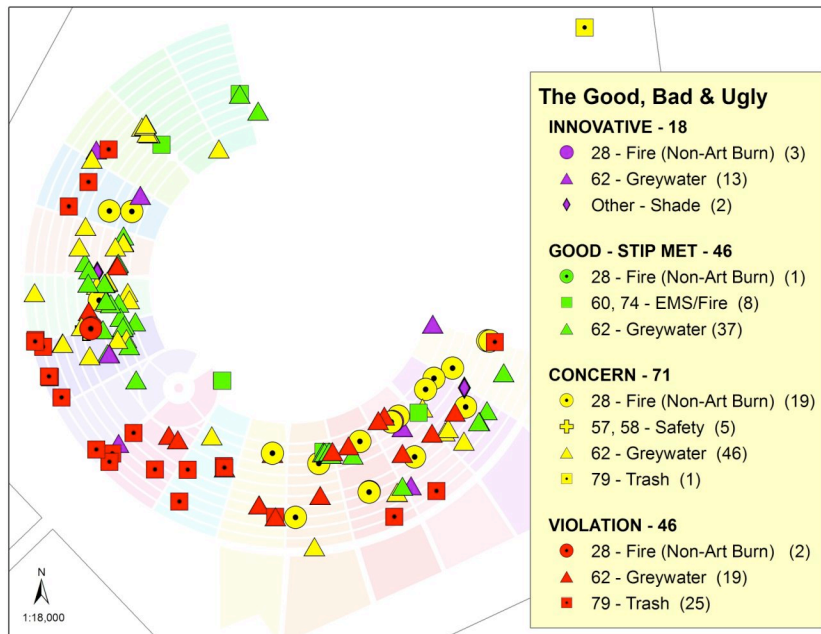
Data collected by both the Ricoh camera and the Trimble GPS devices share these common abilities to:

- a. Capture a GPS location (as a point, line or area)
- b. Record attributes about that location
- c. Export that information to an the ESRI shapefile format

The ESRI shapefile format was key to seamlessly migrate data from the GPS cameras and Trimble devices into ArcGIS for data management and analysis. ArcGIS was used for spatial analysis, data management and mapmaking.

1. Display locations on city grid

The GPS camera data yielded a single shapefile (GIS layer) of point locations at which each photograph was taken. Locations captured by the Trimble GPS units, yielded three distinct point, line and area GIS layers. Team-collected data was combined with the Black Rock City infrastructure layer in ArcGIS. GPS-captured locations of photos and areas of concern could then be displayed in terms of the BRC grid.



2. Query locations based on entered information

Title	Picture	MEMOTITLE2	MEMO2	TimeStamp	East	N
Stipulation Monitoring BM'08	R0010054-1A_tag.jpg	Stipulation	Art project	8/27/2008 20:34	315652.17	45
Stipulation Monitoring BM'08	R0010055-1A_tag.jpg	Stipulation	Art project	8/27/2008 20:38	315492.43	45
Stipulation Monitoring BM'08	R0010056-1A_tag.jpg	Stipulation	Art project	8/27/2008 20:42	315344.78	45
Stipulation Monitoring BM'08	R0010057-1C_tag.jpg	Bad and Ugly	Stipulation	8/28/2008 20:21	166021.44	0
Stipulation Monitoring BM'08	R0010062-3A_tag.jpg	Stipulation	Stip. 79 - Trash Transect No.	8/29/2008 19:33	313774.18	45
Stipulation Monitoring BM'08	R0010090-3A_tag.jpg	Stipulation	Stip. 79 - Trash Transect No.	8/29/2008 20:23	313745.41	45
Stipulation Monitoring BM'08	R0010090-1C_tag.jpg	Stipulation	64 - Community Burn Barrel	8/28/2008 22:16	313617.80	37

Data from the GPS-cameras and Trimble units contains not only location but also the attributes that were entered upon capture. These 5 attributes entered serve as the basis for symbology, queries and spatial analysis in ArcGIS.

3. Perform spatial analysis

ArcGIS was used to summarize documented incidences by stipulation and status and to determine fence lengths, burn platform areas and other city infrastructure calculations.

4. Generate random locations for trash transects

Hawth's tools was in ArcGIS, used to generate random points through 5 main zones in Black Rock City (Art, Residential, Walk-in Camping, Airport and Other) as shown on the map. During the event, the Monitoring Team photographed the appearance at these locations on the chance that if an excessive amount of trash was found during later inspections, a record exists of that area's appearance during the event.

KNOWLEDGE MANAGEMENT

This suite of geospatial tools provided for knowledge management in 3 time frames:

A. Real-time monitoring

Teams patrolled the city with a GPS-camera. If a concern was found, it was photographed and attributes entered such including stipulation and a status of “concern” or “violation” depending on the severity. Data was collected and processed daily. A GIS-query based on the ‘Status’ was made to look for incidents of ‘Concern’ or ‘Violation’. A watermarked image was printed with GPS coordinates and attributes. A GIS map was also generated to show its location in on the Black Rock City grid. These mapping products were distributed to the appropriate authorities for resolution. When resolved, the incident would be re-photographed and its status updated accordingly.

B. Short-term record of Team efforts during the week

The Team shot over 1,200 photographs during the event. Management of such a volume of images would not have been possible without the ability to view and query the photo files by attributes and/or location. This ability was the basis for monitoring efforts while on the playa.

C. Long-term documentation of stipulation monitoring efforts

Team results and recommendations based on the collected data were compiled in a stipulation monitoring report, which was accompanied by a CD of data, maps and analyses. The stipulation monitoring report serves as part of the permanent files for documenting permit compliance. It also is the basis for managers to determine: a) if permit compliance and all stipulations were adequately met for this years event, b) whether to re-issue permit the next year, and if so, with what additional or modified

stipulations, and c) to base decisions for other types of future event permits similar in nature and/or location.