

Municipal Intelligence Office

ANALYTICAL REPORT OF FIREARM DISCHARGES

– ShotSpotter System 2025 –

1. Executive Overview

This report was developed to meet the technical, operational, and strategic needs of municipal public safety leadership and frontline teams. It preserves the analytical rigor and the visual products already consolidated, while using clear, accessible language to enable fast reading, territorial understanding, and practical day-to-day application.

Its objective is to present an accurate, objective, and human-centered analysis of firearm discharge events detected by the ShotSpotter system throughout 2025. This is the first annual consolidation of the dataset, built from georeferenced events categorized by date, time, neighborhood, and number of rounds fired.

The approach is designed to speak directly to public safety and intelligence professionals, prioritizing evidence-based analysis, a territorial lens, and practical insights that support planning, prevention, and executive decision-making.

2. Institutional Context and Operational Integration

This report supports the municipality's ongoing commitment to strengthening data-driven public safety, aligned with directives for integrated action across municipal security and public order agencies.

The analyses are aligned with the Integrated Public Safety Center (CISP), municipal operational logs, and indicators produced by state agencies—enabling a shared understanding of the territory, strategic alignment, and coordinated operational response.

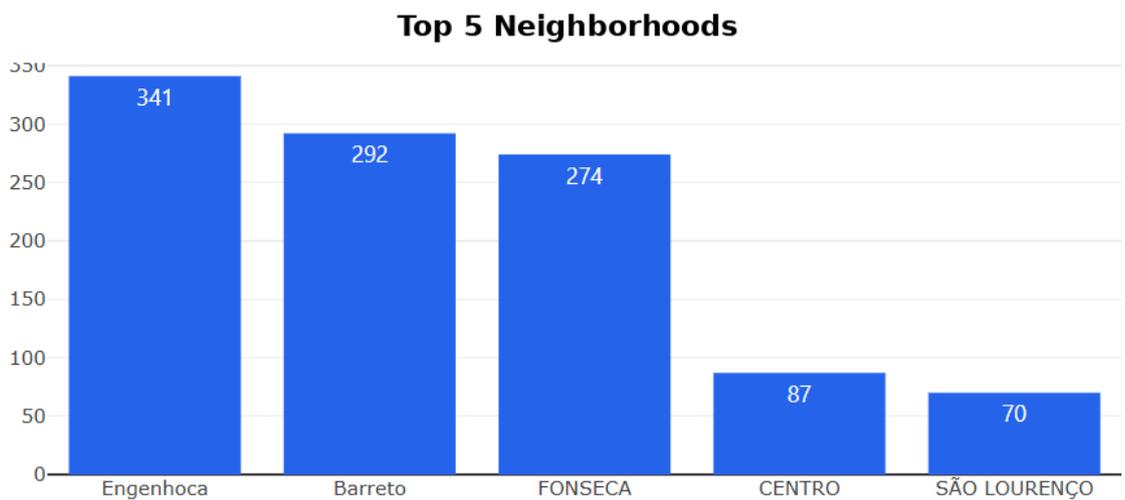
The systematic incorporation of ShotSpotter data into planning, execution, and performance review strengthens evidence-based operations, improves anticipation of critical scenarios, and supports higher-quality tactical and strategic decisions.

3. Data Overview

Total de Disparos	Total de Ocorrências	Bairro mais crítico
1290	314	Engenhoca

3.1 Spatial Analysis – Distribution by Neighborhood

The territorial analysis shows that firearm discharges are not evenly distributed across the municipality. Instead, incidents are concentrated in specific neighborhoods, forming persistent high-risk areas.



3.1.1 Neighborhoods with the Highest Volume of Discharges

Engenhoca: 341 discharges

Barreto: 292 discharges

Fonseca: 274 discharges

Centro: 87 discharges

São Lourenço: 86 discharges

Santa Rosa: 55 discharges

Icaraí: 49 discharges

Other: 41 discharges

Discharges by Neighborhood

The concentration of incidents in a small number of areas reinforces the need for focused interventions—optimizing resources, applying data-driven policing, and tailoring strategies to the realities of each territory.

4. Temporal Analysis – Day of Week

Temporal analysis highlights recurring weekly patterns in when firearm discharges intensify.

4.1. Discharges by Day of Week

Tuesday: 288 discharges

Friday: 269 discharges

Sunday: 172 discharges

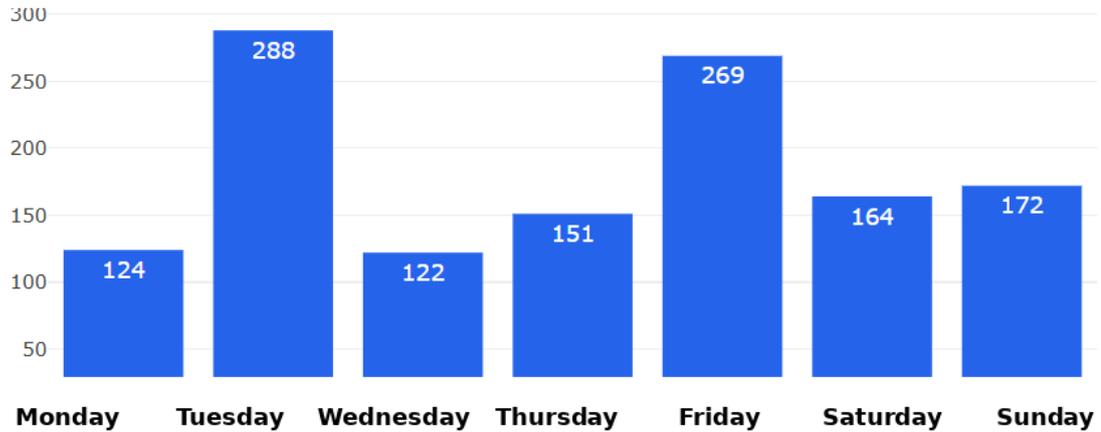
Saturday: 164 discharges

Thursday: 151 discharges

Monday: 124 discharges

Wednesday: 122 discharges

Discharges by Day of Week



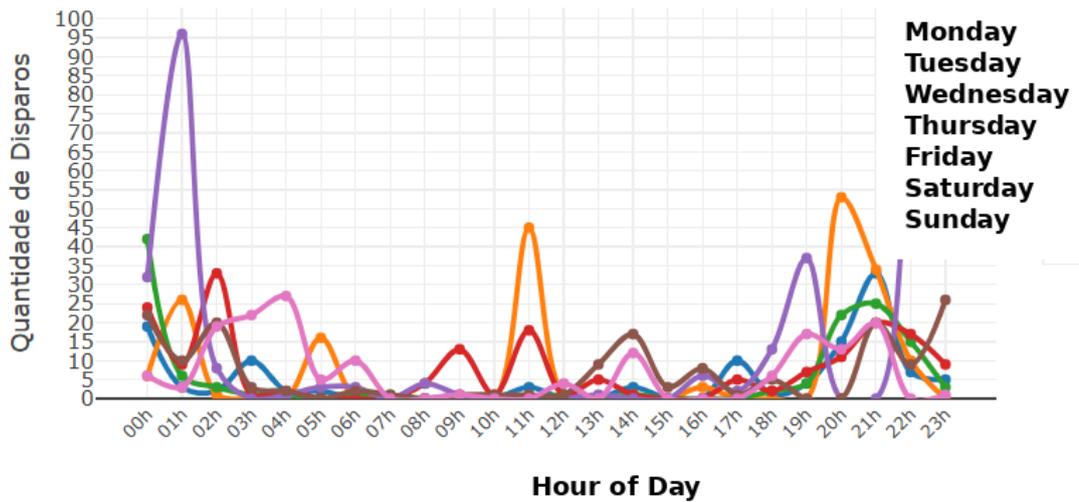
Incidents increase progressively from mid-week onward, with clear peaks on Fridays and during the weekend—suggesting correlation with higher movement of people, nighttime activity, and recurring criminal dynamics during these periods.

Heatmap – Day of Week × Hour of Day

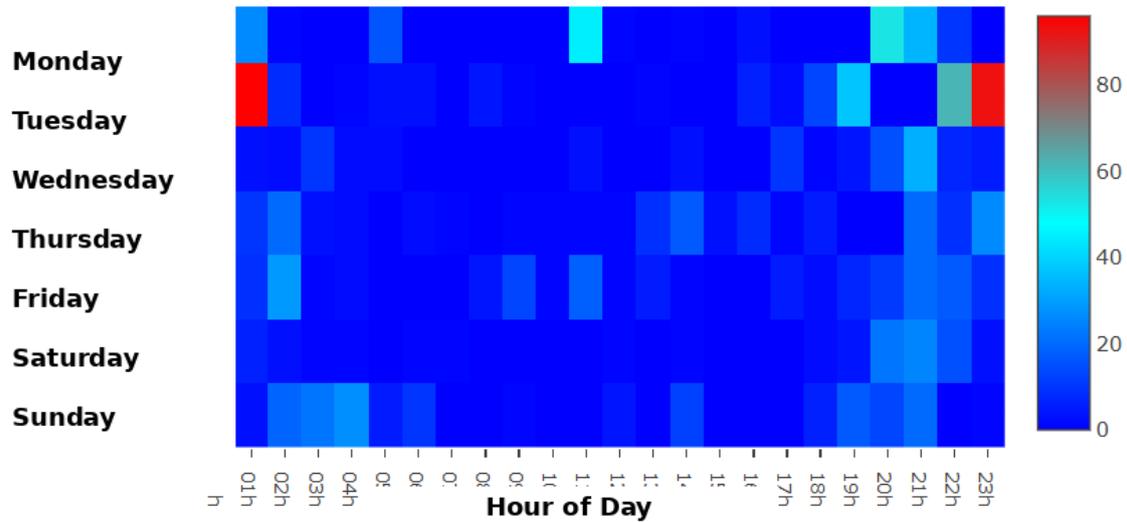
Beyond aggregated counts by day, a heatmap was produced by cross-referencing weekdays and time bands, enabling a simultaneous view of when—and at what times—discharges intensify.

Number of Discharges

Discharges Trend by Hour



Heatmap — Day of Week × Hour of Day



Each cell represents the number of discharges for a specific day-of-week and time-band combination;

Darker colors indicate higher concentrations of discharges, while lighter colors indicate lower occurrence;

The color gradient makes combined temporal peaks easy to identify—patterns that may not be visible from daily totals alone.

In addition to day-of-week totals, an hourly trend analysis segmented by weekday was developed to pinpoint the specific hours when incidents intensify throughout the week.

The horizontal axis represents hours of the day (00:00 to 23:00);

The vertical axis indicates the number of recorded discharges;

Each colored line corresponds to a weekday, enabling direct comparison of different hourly patterns;

Peaks in the curves indicate critical hours with higher concentrations of discharges.

This format highlights not only total volume but also the temporal dynamics of events—revealing within-day variations that aggregated views can miss.

Key Patterns Observed

The hourly trend analysis indicates that:

The most significant peaks occur at night and in the early morning hours, particularly on Fridays, which show the highest absolute volumes;

Across multiple weekdays, incidents rise consistently starting in the early evening—indicating a recurring high-risk time window;

During daytime hours (morning and afternoon), discharge activity is materially lower and more irregular, with no clearly defined peak patterns;

Certain hours show weekly recurrence of increases, demonstrating temporal regularity rather than random occurrence.

Operational Applications

The combined day-of-week and time-of-day analysis enables:

Targeted planning of preventive and visible policing actions during critical time windows;

Optimized staffing allocation by concentrating resources during higher-risk periods;

Proactive anticipation of sensitive operational scenarios based on consistent, predictable historical patterns.

5. Temporal Analysis – Time-of-Day Segments

Time-of-day analysis shows a strong concentration of discharges during lower-visibility hours and periods of heightened territorial vulnerability.

5.1. Distribution by Time of Day

Night: 621 discharges

Early Morning: 458 discharges

Morning: 115 discharges

Afternoon: 96 discharges

More than 83% of discharges occur between night and early morning, reinforcing the need for strengthened operations, high-quality preventive actions, and visible presence strategies during these critical periods.

6. Integrated View – Day of Week × Time of Day

Cross-referencing weekdays with time bands—through heatmaps and trend charts—shows predictable temporal patterns:

- Peaks concentrated at night and early morning, especially on Fridays and weekends;
- Lower incidence and greater dispersion during daytime;
- Weekly recurrence of critical hours, indicating consistent patterns of activity.

These patterns enable proactive planning, optimized staffing, and preventive action grounded in historical evidence.

Advanced Spatial Analysis (Heatmaps and Clusters)

The advanced geospatial analysis combines two complementary approaches: spatial clusters and heatmaps.

Persistent Risk Nodes (Clusters)

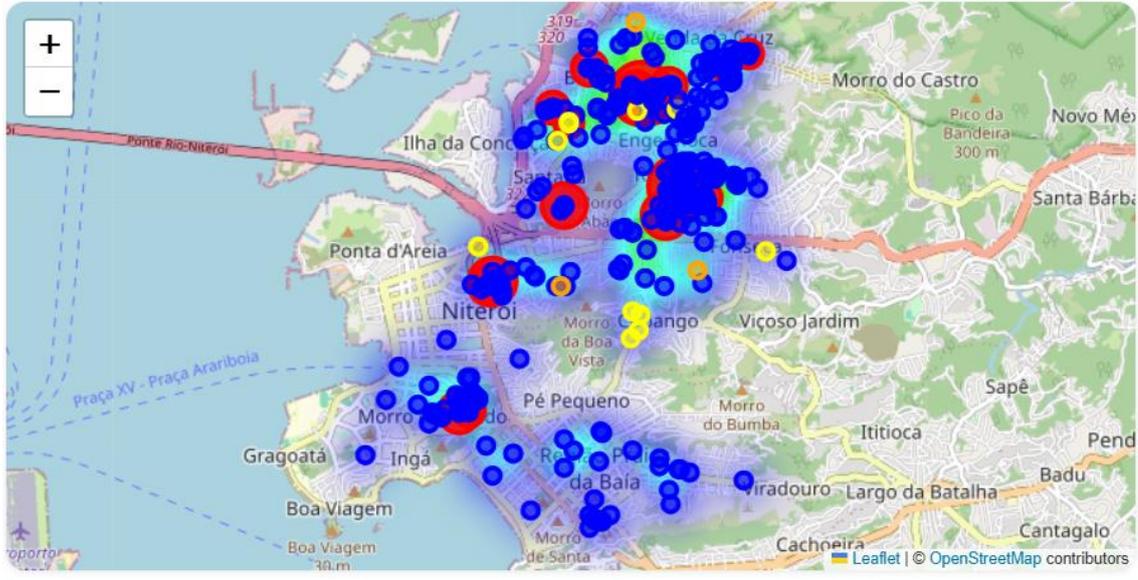
Clusters represent areas where discharges repeatedly concentrate over time, demonstrating that incidents are structural—not random. These areas require priority attention, continuous monitoring, and high-quality enforcement actions.

Density and Area of Influence (Heatmaps)

Heatmaps show the spatial density of discharges and their territorial influence, highlighting areas potentially affected directly and indirectly by armed violence.

Integrated Interpretation

Overlaying clusters and heatmaps shows that repeat-incident nodes sit within broader influence zones—reinforcing the need for integrated territorial strategies rather than isolated actions.



Legend:

- Confirmed events
- Unconfirmed discharges
- Not heard
- Clusters (high recurrence)

Blue shading (heatmap): spatial density of discharges, indicating areas of higher recurrence.

8. Data Quality

Confirmed discharges: 1,249 (96.8%)

Unconfirmed / not heard: 41

The high confirmation rate indicates a strong level of reliability of the ShotSpotter system as a tool to support intelligence and operational planning.

9. Operational and Strategic Recommendations

Based on the spatial, temporal, and predictive analyses presented, the following recommendations are proposed, organized by implementation horizon:

Short Term (Immediate Actions)

Increase visible and preventive policing in the neighborhoods of Engenhoca, Barreto and Fonseca, especially at night and in the early morning;

Adjust duty schedules with focus on Fridays, weekends e early mornings, based on the recurring patterns identified;

Use ShotSpotter alerts systematically for rapid dispatch, field validation, and high-quality incident reporting; e

Share heatmaps and cluster outputs with operational teams to strengthen territorial awareness.

Medium Term (Structural Improvements)

Consolidate priority operational zones by integrating ShotSpotter data with other sources (CISP, ISP, and other operational records);

Plan integrated operations and high-visibility presence actions in persistent risk nodes;

Provide ongoing training in basic crime analysis and interpretation of geospatial products, strengthening a culture of data-driven policing;

Standardize response protocols for automatically detected events.

Long Term (Strategy and Intelligence)

Permanently incorporate predictive analysis to support monthly and quarterly planning;

Continuously monitor cluster evolution to assess the impact of adopted actions; e

Use the data to inform territorial public policy and cross-sector interventions.

Monitoring and Evaluation Metrics

To track the effectiveness of the actions derived from this report, we propose a set of simple, objective, and operational metrics:

Monthly percentage reduction of discharges in priority neighborhoods (Engenhoca, Barreto and Fonseca);

Average operational response time to confirmed ShotSpotter alerts;

Quarterly change in cluster density identified in geospatial maps;

Share of night/early-morning events with a logged response, as an indicator of operational coverage.

These metrics support continuous impact evaluation, fast tactical adjustments, and accountability grounded in reliable data.

Final Considerations

In 2025, the system recorded 314 events with 1,249 confirmed discharges and 41 unconfirmed, with clear territorial concentration in Engenhoca, Barreto, and Fonseca, and strong temporal concentration during nighttime and early-morning periods.

The analyses demonstrate that armed violence follows recurring, predictable patterns—enabling proactive planning, rational allocation of resources, and strengthened preventive operations. The integrated use of ShotSpotter is consolidating as a strategic tool for modern public safety: evidence-led, territorially informed, and continuously focused on preserving life.

Spatial and temporal analyses confirm that armed violence follows predictable patterns, supporting preventive action, strategic resource deployment, and stronger territorial intelligence. The integrated use of ShotSpotter continues to prove essential for data-driven public safety focused on protecting life.