



# Report on the Results of the CDCR Two-Piece GPS System Field Test

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## EXECUTIVE SUMMARY

In August of 2007, the California Department of Corrections and Rehabilitation (CDCR), Division of Adult Parole Operations (DAPO) initiated a 60 day field test of two-piece Global Positioning System (GPS) units for parolee monitoring. The field test was designed to answer the question: How does a two-piece GPS system perform relative to a one-piece GPS system?

The Center for Evidence-Based Corrections was asked by DAPO to report on the results of the field test. The Center analyzed data provided by the GPS vendors and DAPO on GPS alert activity, unit replacement, and workload impact. The Center also gathered qualitative information on two-piece GPS performance through interviews with parole agents and DAPO staff involved with the field test, as well as focus groups of parolees. The degree to which results of the field test can be generalized is limited by the small number of GPS units included in the field test and the fact that the performance of two-piece GPS units deployed solely for the field test period was compared to the performance of one-piece units that DAPO had been using in the field for two years prior to the field test.

The findings of this field test report are summarized in the table to the right.

It is important to note that parole agent satisfaction with the two-piece systems was as much the product of *non-hardware*

elements of the two-piece GPS package, particularly the quality of each vendor’s tracking software, as of differences between one and two-piece GPS *equipment*. The

	One-Piece System	Two-Piece Systems
Ease of Installation	◇	Δ
Unit Size	‡	‡
Battery Life/Ease of Charging	◇	Δ
Text Messaging Capability	◇	Δ
Location-Fixing Accuracy	‡	‡
Tracking Unit Attached to Parolee	Δ	◇
Total Alert Volume	Δ	◇
Priority Alert Volume	Δ	◇
Strap Tamper Alerts	◇	Δ
Low Battery Alerts	‡	‡
Inclusion Zone Alerts	◇	Δ
Message Gap Alerts	‡	‡
No GPS Status	‡	‡
Workload Impact	‡	‡
Unit Replacement	Δ	◇
Parolee Preference	◇	Δ
Agent/DAPO Staff Preference	Δ	◇

Δ System advantage  
◇ System disadvantage  
‡ No clear system advantage

quality of a GPS technology package is a combination of three elements: the GPS unit hardware, the offender tracking software, and the service provided by the GPS monitoring center. This study was designed to examine the relative merits of two types of GPS unit hardware. It is not clear, however, that GPS unit hardware is the most important of the three elements, so the relative desirability of two-piece and one-piece units is only one consideration among several in evaluating different GPS vendors and their technology packages.

As the summary table suggests, neither the two-piece nor the one-piece systems clearly outperformed the other in the field test. A definitive recommendation of one GPS system over the other is not warranted by the results of the field test. Rather, each type of equipment had advantages and disadvantages. Based on the importance assigned to them in the interviews with parole agents and DAPO staff, the primary issue with regard to utilizing a two-piece system as opposed to a one-piece system appears to be the trade-off between the longer battery life and relative ease of charging with the two-piece unit and the greater confidence that agents and supervisors feel having all the GPS equipment physically attached to the parolee through the one-piece unit. Policymakers need to consider the relative advantages of each type of system in evaluating whether it is appropriate to the risk level and living situation of specific parolees or types of parolee.

## INTRODUCTION

In June 2005, the California Department of Corrections and Rehabilitation (CDCR), Division of Adult Parole Operations (DAPO) launched a pilot program to monitor the whereabouts of high-risk sex offender parolees using Global Positioning System (GPS) technology. Over the subsequent two years, CDCR moved from the pilot program to a statewide implementation of GPS monitoring for High Risk Sex Offender (HRSO) parolees. As a result of the passage of Proposition 83 (popularly known as “Jessica’s Law”) in November of 2006, the CDCR will increase the scale of its GPS program to include all parolees required to register as sex offenders pursuant to PC 290.

As it expands its GPS program, DAPO continues to examine different GPS technology packages to determine which best meet the department’s supervision needs. A question has emerged as to whether a two-piece GPS system might be preferable to a one-piece system of the type that DAPO is currently employing. In order to inform future procurement decisions, DAPO initiated a 60-day field test to evaluate the advantages and disadvantages of utilizing a two-piece GPS system. The Center for Evidence-Based Corrections agreed to produce this report on the results of the field test.

DAPO designed the field test to include 80 two-piece GPS units, provided by four vendors. DAPO issued an RFI to elicit vendor participation and selected four field test vendors from those who responded. Each vendor agreed to provide 20 two-piece GPS units for the same

daily per unit rate that DAPO was paying to its one-piece vendor. DAPO constructed the field test to compare two-piece and one-piece GPS systems on unit performance criteria. Cost criteria were not part of the field test.

DAPO selected four parole agents supervising HRSO GPS caseloads to employ the two-piece systems, one agent for each vendor’s equipment. The caseloads were chosen for geographical diversity (one each in Fresno, Santa Clara, Los Angeles and San Diego Counties),<sup>1</sup> and agents who had demonstrated particular skill in using GPS were chosen. The field test agents had to remove one-piece GPS units from all parolees on their caseloads and substitute two-piece units starting August 13, 2007, with all substitutions completed by August 24, 2007. The field test period ended on October 10, 2007, after which the parolees on the field test caseloads returned to wearing one-piece GPS units.

DAPO removed the participating vendors for Los Angeles and San Diego Counties from the field test within the first two weeks of the two-piece units being deployed.<sup>2</sup> One of the vendors was removed because DAPO deemed its equipment unsafe for use on parolees because the ankle cuff could be removed without generating a strap tamper alarm. The other vendor was removed from the study during the second week due to a failure to meet the terms of the contract for the field test. DAPO staff involved in the design of the field test reported that neither of the exclusions was due to issues that were related to their being two-piece units. The exclusions resulted in the field test consisting of half the number of two-piece units originally envisioned, reducing the robustness of the conclusions that can be drawn from the results.

The vendors providing the two-piece GPS systems for the field test conducted a two-phase training for the participating parole agents and their parole unit supervisors. There was a separate training session for each agent and vendor. The first phase of the training was held on August 9 and 10, 2007, in Sacramento for the Fresno and Santa Clara County agents and in Diamond Bar for the Los Angeles and San Diego County agents. This training covered the use of the two-piece GPS equipment and the vendor’s internet-based software, and was intended to be sufficient to begin parolee monitoring. The second phase training took place on August 28, 2007, in Sacramento.<sup>3</sup> The second phase training covered the use of inclusion and exclusion zones.

## HOW TWO-PIECE AND ONE-PIECE GPS SYSTEMS WORK

A one-piece GPS system consists of a tracking unit attached to a parolee’s ankle, which cannot be removed without triggering an alert notification to the parolee

<sup>1</sup> The counties participating in the field test are referred to by anonymous identifiers throughout this report.

<sup>2</sup> The remaining vendors are referred to as Vendors A and B in this report. The one-piece vendor providing equipment to DAPO is referred to as Vendor C.

<sup>3</sup> There was no corresponding training session in Diamond Bar because the Los Angeles and San Diego County vendors had been removed from the field test.

agent. The tracking unit fixes its position using signals from GPS satellites, and then transmits location information and other data on the status of the GPS unit to a vendor-operated monitoring center via the cellular network used by the vendor. The one-piece unit utilized by DAPO must be charged twice daily for an hour by plugging the unit into a wall charger (much like a cell phone charger).

A two-piece GPS system works similarly, but the functions of the one-piece unit are divided between two components. Like the one-piece unit, the two-piece tracking unit fixes its position using signals from the GPS satellites and transmits that location to a monitoring center via a cellular network. The two-piece tracking unit is not attached to the offender in any way. A second component, an ankle cuff, is attached to the parolee's ankle in the same manner as the one-piece GPS unit. The ankle cuff, which is much smaller than the one-piece unit, is a transmitter that is "married" to the tracking unit. The ankle cuff sends a signal to the tracking unit, confirming that the tracking unit and the ankle cuff (and the parolee) are in the same location. The parolee is required to carry the tracking unit with him at all times. If the ankle cuff and the tracking unit get too far away from one another, an alert notification is generated. The tracking unit must be charged regularly by placing it in a charging base; the ankle cuff has a battery that will last for a year, after which the cuff must be replaced. (For detail on the GPS systems provided by the field test vendors and the DAPO one-piece vendor, see Appendix A.)

Information from the GPS units is provided to parole agents in several ways. Each vendor provides internet-based software. By logging into the software, the agent can view the GPS points for each offender over time (referred to as viewing the parolee's tracks), check the status of each GPS unit, and review any alerts generated by the units. In addition, the GPS units generate alerts under certain circumstances, designed to inform the parole agents of potentially problematic parolee behavior, problems with the GPS unit, or interruptions in GPS signal or unit ability to transmit information. DAPO and each GPS vendor work out a protocol for how the vendor monitoring center will inform agents of these alerts. Some result in a phone call to the parole agent, others a text message. All GPS alert activity from Vendors A and C was sent to the agent daily in a summary e-mail. Vendor B sent an individual e-mail message for each alert.

In order to understand the discussion of the field test that follows, it is important to know the definitions of the alerts generated by both two-piece and one-piece GPS systems. They are as follows:

- **Strap Tamper:** An alert triggered by a break in the fiber-optic connection running through the bracelet strap attaching the ankle unit to the parolee. The purpose of the strap tamper alert is to detect any attempt by the parolee to remove the two-piece ankle cuff or the one-piece GPS tracking

unit from his ankle. This alert is frequently triggered by wear on the bracelet strap.

- **Cuff Leave:** An alert occurring when the two-piece tracking unit and the ankle cuff are too far away from one another, meaning that the location of the tracking unit no longer indicates the location of the parolee. This alert does not exist for one-piece systems.
- **Inclusion Zone:** Inclusion zones are placed around an area at which a parolee is supposed to be at a certain time of day. For example, a parolee with a curfew of 7:00PM to 6:00AM might have an inclusion zone around his home for those hours. This alert would be generated if he left the zone during that time period. Inclusion zone alerts are sometimes generated when a parolee's GPS points appear outside the inclusion zone although the parolee is still within it, a phenomenon known as "drift." Drift results from the position of the GPS satellites, and the parolee's GPS point generally returns to his actual location within a few minutes.
- **Exclusion Zone:** Exclusion zones are placed around areas that parolees are not allowed to enter, such as the residence of a past victim. If a parolee enters an area with an exclusion zone placed around it, this alert is generated.
- **Low Battery:** An alert generated when the parolee's one-piece GPS unit or two-piece tracking unit has very little charge remaining. It indicates that the tracking unit's battery must be charged soon, or the unit will shut down.
- **Message Gap:** An alert generated when the GPS unit is not calling in to the monitoring center. It most commonly occurs when the unit is not getting reception from the cellular provider utilized by the GPS vendor for this purpose.
- **Tracking Unit Tamper:** An alert generated when the two-piece tracking unit is opened. A light sensor inside the tracking unit detects any opening of the tracking unit housing. This alert does not exist for one-piece units.

The priority alerts,<sup>4</sup> alerts that result in a call or a text message to the parole agent, differ slightly for the two-piece GPS vendors and the one-piece vendor. These differences are summarized in Table 1. Non-priority alerts are sent to parole agents by e-mail only. (Priority alerts are sent by e-mail as well.) Agents have the ability to designate inclusion and exclusion zones as 911 zones. Alerts generated by zones designated as 911 inclusion and exclusion zones are priority alerts; other zone alerts are non-priority alerts.

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<sup>4</sup> This definition of "priority alert" was developed for this report. It is not equivalent to the term as used internally by DAPO.

**Table 1: Priority Alerts by GPS Vendor**

	Two-Piece System		One-Piece System
	Vendor A—County 1	Vendor B—County 2	Vendor C
Call	<ul style="list-style-type: none"> <li>• Strap Tamper</li> <li>• Exclusion Zone</li> </ul>	<ul style="list-style-type: none"> <li>• Strap Tamper</li> <li>• Strap Tamper Clear</li> <li>• 911 Exclusion Zone</li> </ul>	<ul style="list-style-type: none"> <li>• 911 Inclusion Zone</li> <li>• 911 Exclusion Zone</li> <li>• Strap Tamper</li> </ul>
Text Message	<ul style="list-style-type: none"> <li>• Strap Tamper</li> <li>• Cuff Leave</li> </ul>	<ul style="list-style-type: none"> <li>• Cuff Leave</li> <li>• Cuff Leave Clear</li> <li>• Strap Tamper</li> <li>• Tracking Unit Tamper</li> <li>• Exclusion Zone</li> <li>• Low Battery*</li> </ul>	<ul style="list-style-type: none"> <li>• Strap Tamper</li> <li>• Low Battery</li> <li>• On Charger (after Low Battery alert)</li> <li>• Message Gap</li> </ul>

\* DAPO has arranged with Vendors B and C to restrict priority Low Battery alerts to those that do not clear immediately. Low Battery alerts that clear quickly are provided to parole agents by e-mail, but are not priority alerts.

**METHODOLOGY**

Both vendors providing two-piece units for the field test supplied data from their central information systems on GPS alerts and unit assignment. DAPO identified a comparison one-piece GPS caseload in each county participating in the field test, creating a two caseload, 40 GPS unit comparison group. DAPO’s one-piece vendor provided GPS alert and unit assignment data for the comparison caseloads. In addition to the vendor data, the two agents utilizing the two-piece equipment and the two comparison caseload agents kept logs of all instances in which they initiated an investigative response to alert information generated by GPS units and the amount of time they devoted to resolving the issue.

Qualitative data on the field test was collected through interviews with the parole agents utilizing the two-piece units and their unit supervisors, as well as DAPO staff involved in the design and execution of the field test. A total of seven interviews were conducted between September 27 and October 5, 2007. Focus groups of parolees monitored by the two-piece GPS units were conducted in both parole offices participating in the field test. The focus group in County 1 had five participants, and the focus group in County 2 had seven. All focus group participants had been monitored with a one-piece unit prior to the start of the field test. Members of the Center study team also observed all two-piece training sessions and visited the field test sites.

**STUDY LIMITATIONS**

There are four important caveats to this analysis of the field test in terms of determining how two-piece GPS units perform relative to one-piece units.

1. Four caseloads and 80 GPS units is not a very large study sample. In a sample of this size, variation across caseloads unrelated to the type of GPS system employed may affect the results in ways that could not be accounted for.
2. DAPO has deployed one-piece units in the field since July of 2005, and since that time many

technical issues relating to unit performance have been identified and addressed, and parole agents and parolees have become familiar with the one-piece system. Parole agent and parolee unfamiliarity with the two-piece units in the field test, as well as technical issues of the kind common to the implementation of any new technology package,<sup>5</sup> may have placed the two-piece system at a disadvantage relative to the one-piece system.

3. GPS is a supervision tool that is utilized differently by each parole agent. Some of the variation in field test results may be due to these differences rather than differences between two-piece and one-piece GPS systems. This is particularly relevant given that DAPO chose agents they identified as the most experienced and technologically-proficient agents to utilize the two-piece systems.
4. The performance of a GPS system is a combination of the hardware, software and monitoring center services provided by a given GPS vendor. The purpose of this report is to examine a question regarding the hardware aspect of GPS systems, but the other elements will also affect the performance of and agent satisfaction with the GPS systems. We were not always able to disentangle the contribution of hardware to unit performance and agent satisfaction from that of the other components.

These caveats do not mean that the conclusions regarding the value of two-piece GPS systems relative to one-piece systems drawn from this report are invalid, but they do suggest that findings may be the result of causes other than differences between one and two-piece GPS systems.

<sup>5</sup> See Turner, S. and Jannetta, J. (2007, forthcoming). *Implementation and Early Outcomes for the San Diego High Risk Sex Offender GPS Pilot Program*. Irvine, CA: Center for Evidence-Based Corrections.



## EASE OF USE AND RELIABILITY IN THE FIELD

### Initial Training and Placement of Two-Piece Units on Parolees

The parole agents utilizing the two-piece GPS systems reported that the training session provided by the vendor was adequate for their needs. One DAPO staffer who attended the trainings noted that they were “out of the box” training sessions, meaning that they were not specifically tailored to the supervision of any particular population. This is consistent with the observations of the study team members who attended the training sessions. The format of the training did not appear to be a problem for the agents utilizing the two-piece systems, who were already very familiar with how GPS systems work.

As they moved to substitute the two-piece units for the one-piece units, both two-piece parole agents reported that the two-piece ankle cuff was easier to install on a parolee’s ankle than the one-piece GPS unit. They said they could complete the placement of a parolee on their respective two-piece systems in ten minutes or less. Interview subjects other than the parole agents had mixed opinions on the ease of placing the two-piece units on parolees. Some felt that at least one of the vendor’s bracelet straps was harder to use, and another that the additional installation step of syncing the tracking unit and the ankle cuff made installing the two-piece unit more difficult. As the two-piece parole agents had the most experience in installing the two-piece units on parolees during the field test, based on their opinions it appears that the two-piece units had an advantage in terms of ease of installation during the field test.

### Unit Size

There was a substantial difference in size and shape between the tracking units provided by Vendor A and Vendor B. Vendor A’s tracking unit is a black rectangular box that parolees, parole agents, and other DAPO staff found to be large and heavy. Vendor B’s tracking unit is smaller than Vendor A’s, and looks roughly like a walkie-talkie. The shape and size of Vendor B’s tracking unit made it much easier to carry than Vendor A’s, and parolees reported being able to purchase a carrying case that fit it. The size and shape of Vendor A’s tracking unit resulted in concern among parolees using it that carrying the tracking unit made them more conspicuous than wearing the one-piece unit, which might result in their being noticed and “marked” as sex offenders. By contrast parolees using Vendor B’s equipment found it to be less conspicuous than wearing the one-piece unit.

In general, parolees appreciated that the two-piece ankle cuff is much smaller than the one-piece unit, and parolees appreciated that they could cover it with their socks. Some parolees felt that the smaller ankle cuff looks more like other forms of electronic monitoring worn by non-sex offender probationers, and as a result made them less identifiable as sex offenders. Parolees in County 2 mentioned that the one-piece unit “tears up your ankles,”

and can’t be worn with safety boots. This was not an issue with the two-piece ankle cuff.

On balance, it appeared that the size of the ankle cuff was an advantage of the two-piece equipment, but that the size of the tracking unit was a positive aspect of one vendor’s equipment relative to the one-piece equipment, but a negative for the other vendor’s equipment. Therefore it is not clear from the evidence of the field test whether the size of two-piece GPS units is an advantage of two-piece GPS equipment.

### Battery Life and Charging

Longer battery life and ease of charging were consistently mentioned by parolees, parole agents, and other DAPO staff as major advantage of the two-piece systems. DAPO requires parolees to charge the one-piece unit every twelve hours for an hour, which necessitates parolees plugging the unit into the wall while they are wearing it and waiting until charging is complete. Parolees participating in the focus groups reported having to stay nearly still in order to ensure that the one-piece unit was taking the charge for the entire hour. Parolees said that this charging process was a major inconvenience for them, and greatly appreciated the ease of charging and longer battery life of both two-piece systems in the field test.

Charging the two-piece tracking unit is done by placing the tracking unit into a charging base that is plugged into the wall. Because the tracking unit is not physically attached to the parolee, the parolee can move around freely (within approximately 150 feet of the charging base) while the tracking unit is charging. The parolees can also charge it while they are sleeping. Parolees reported trying to charge the one-piece unit while sleeping as well, but said that this can often result in the unit failing to charge fully if they move and break the connection between the GPS unit and the charger. Once fully charged, parolees report that the two-piece tracking unit does not need to be charged again for up to a full day.

Parole agents using the one-piece system provided by Vendor C can monitor parolee compliance with charging requirements through the software, which indicates when a parolee starts and stops charging. Vendor A’s software does not show charging history, but Vendor B’s does. The agent using Vendor B’s equipment reports that parolee compliance with the two-piece system’s charging requirement is similar to that for the one-piece. One of the regional GPS coordinators interviewed believed that parolee compliance with GPS unit charging requirements was better for the two-piece units because of the greater convenience. Parole agents using GPS consider charging compliance to be very important and strictly enforce charging requirements because GPS signal is lost completely if the tracking unit battery dies.

There was a strong consensus that longer battery life and greater ease of charging was an important advantage of two-piece GPS equipment relative to one-piece equipment.

## **Text Messaging Capability**

Another feature included in the two-piece system but lacking in the one-piece system is text messaging. The text messaging feature is possible because of the larger size of the two-piece tracking unit. Agents using the two-piece systems could send text messages to a parolee's tracking unit. Both two-piece agents made use of this feature during the field test. Although they cannot send text messages to parolees, agents using the one-piece system can communicate with parolees through it. Parole agents can "buzz" the parolee wearing the one-piece unit, causing it to either vibrate or emit a tone, which indicates to the parolee that he should call his parole agent, but no message can be left. The one-piece unit occasionally engages in a self-diagnostic test that generates a similar buzz, leading parolees to call the agent in the middle of the night. This issue was not present with the two-piece systems.

The text messaging capability of the two-piece equipment in the field test was something that agents found useful, and a feature that one-piece units lack. They did not mention it as an important consideration in whether or not they preferred two-piece to one-piece equipment, but it is an advantage of the two-piece system.

## **Tracking Software and Monitoring Center Services**

One of the parole agents preferred the web-based software interface of the two-piece GPS system to that of the one-piece, saying that it was faster and made it easier to view parolee tracks. The other agent had the opposite experience, finding that two-piece vendor's software slower and more difficult to use for checking parolee tracks than the one-piece software. One of the agents also expressed frustration with interactions with the two-piece vendor's monitoring center, feeling that monitoring center staff did not seem to understand that some activity recorded by the GPS units could be the result of problems with a unit, and not parolee behavior.

The field test was designed to answer a question about hardware: how does a two-piece unit perform relative to a one-piece unit? Differences in software and monitoring center quality are not related to whether a GPS technology package includes two-piece or one-piece GPS equipment. These are differences between specific vendors, but it is worth noting that agent perception of the performance of the two-piece and one-piece systems they utilized was informed by the hardware, the software, and the monitoring center services that constitute a vendor's GPS technology package. The views of agents in the interviews suggests that software and monitoring center performance may be as important, if not more important, than hardware in determining how well an entire GPS package performs in the field.

## **Parolee Tracking**

The two-piece systems in the field test performed similarly to the one-piece system in the fundamental GPS

function of accurately fixing parolee location. Parole agents and DAPO staff did not believe that the two-piece system fixed the location of parolees either more or less accurately than the one-piece system. Neither system was better able to track parolee movements within a building, where both frequently lost GPS signal.

Parole agents and DAPO staff regard the fact that the tracking unit in a two-piece system is not physically attached to the parolee as the biggest problem with a two-piece system. Some expressed this concern in terms of the parolee exercising a measure of control over whether or not they were being monitored. Some parolees were leaving the tracking units, usually at home when they left for work. It was not necessarily clear how to distinguish between parolees who were legitimately forgetting the tracking unit and those who might be attempting to thwart supervision. One parolee in a focus group said he had a condition that impaired his memory, making it difficult for him to remember his tracking unit. Other parolees described adopting various strategies to help them remember their tracking unit (putting it near their keys, for example).

Parole agents and DAPO staff consistently raised the possibility that a parolee monitored with a two-piece unit could leave his home without the tracking unit, assert that he had forgotten it, and commit a crime before he returned to collect the tracking unit. They felt more confident with a one-piece unit on a parolee because the tracking unit is attached to the parolee's ankle, particularly for parolees they regard as high-risk to re-offend.

## **GPS ALERT VOLUME**

A challenge of utilizing GPS systems for parolee supervision is that GPS units produce a daunting amount of information. This information makes GPS a valuable tool for parolee supervision, but it also requires parole agents to process and sort through the information to determine what is relevant for parolee supervision. The volume of alerts generated by the GPS equipment is significant because it impacts how much time and difficulty will be involved in sorting through the GPS information.

An individual GPS alert may be generated by either parolee behavior or GPS unit issues. An alert generated by parolee behavior provides accurate information about something a parolee has done. Examples of alerts generated by parolee behavior are a "cuff leave" alert occurring because a parolee forgot to carry his two-piece transmitter with him when he left his home for work, or a strap tamper alert triggered by the parolee cutting the bracelet strap attaching his one-piece unit or ankle cuff to his ankle.

Alerts generated by unit issues do not reflect parolee behavior. Some alerts arising from GPS unit issues require parole agent action, such as strap tamper alerts caused by wear on the bracelet strap, indicating that it needs to be replaced. (Note that a given type of alert can be the result of either parolee behavior or a GPS issue.) Others, such as message gap alerts, apprise the parole agent of potentially useful information about the GPS

**Table 2: GPS Alerts per Caseload Day**

	Two-Piece System		One-Piece System		Total	
	Vendor A County 1	Vendor B County 2	Vendor C County 1	Vendor C County 2	Two-Piece	One-Piece
Priority	2.13	6.56	0.29	0.61	4.35	0.44
Non-Priority	2.97	5.36	9.39	3.63	4.14	6.34
Total Alerts	5.10	11.92	9.68	4.24	8.49	6.78

unit’s status. Still others, such as inclusion zone alerts due to “drift,” are not useful to parole agents and act as “background noise” that must be screened out for parole agents to focus on important GPS information.

As they become increasingly familiar with GPS, agents learn to distinguish between alerts that are likely to be the result of GPS unit issues rather than parolee behavior, and between GPS unit information that is useful and that which is not. The higher the overall volume of alert activity, the more difficult and time-consuming this work is for parole agents. More GPS alerts due to parolee behavior indicate less parolee compliance with GPS monitoring requirements. Therefore, this report assumes as a general principle that the fewer alerts generated by a GPS system, the better.

Table 2 shows the number of GPS alerts produced for each two-piece and comparison one-piece caseload. For this report, we classified alerts as priority or non-priority alerts. Priority alerts are those that result in a call and/or text message sent immediately to agents. Non-priority alerts are all other alerts, which come to GPS agents via e-mail. For a list of the alerts counted as priority alerts for each vendor, refer to Table 1. None of the inclusion zones utilized by the comparison one-piece caseloads during the field test was designated as a 911 zone, so all inclusion zone alerts were classified as non-priority alerts.

The total number of alerts was converted to a rate per caseload day. A caseload day is a caseload measure, equivalent to a 24-hour period of GPS monitoring for 20

parolees (the size of DAPO high-risk sex offender GPS caseloads).<sup>6</sup>

As a whole, two-piece units in the field test generated slightly more alerts per caseload day than did the comparison one-piece caseloads, with the two-piece caseloads experiencing 8.49 alerts per caseload day, compared to 6.78 for the comparison one-piece caseloads.<sup>7</sup> The two-piece caseloads also experienced many more priority alerts per caseload day than did the comparison one-piece caseloads. This means that the agents supervising the two-piece caseloads received more calls and text messages from their vendor monitoring centers than did the agents supervising the comparison caseloads, and presumably that the alerts generated by the two-piece units were more serious.

The total volume of GPS alerts, both priority and

<sup>6</sup> The number of caseload days for each of the four caseloads in the field test was calculated by totaling the aggregate hours parolees on that caseload were GPS-monitored over the field test period, then dividing that number of hours by 24 (to convert it into days) and by 20 (to scale it to standard HRSO GPS caseload size).

<sup>7</sup> The study team conducted a logistic regression to enhance the analysis of GPS alert volume. The difference in number of alerts between the two-piece and the one-piece caseloads was not statistically significant (see Appendix C for complete regression results). A regression model with the same independent variables was conducted with the number of GPS alerts of each specific type as the dependent variable. Statistically-significant results were obtained for inclusion zone alerts (placement on two-piece equipment associated with fewer alerts) and message gap alerts (placement on two-piece equipment associated with more alerts).

**Table 3: Alerts per Caseload Day, by Alert Type**

	Two-Piece System		One-Piece System		Total	
	Vendor A County 1	Vendor B County 2	Vendor C County 1	Vendor C County 2	Two-Piece	One-Piece
Low Battery	0.00	0.72	0.11	0.42	0.36	0.27
Cuff Leave	1.74	5.91	n/a	n/a	3.82	n/a
Strap Tamper	0.39	0.35	0.54	0.68	0.37	0.61
Inclusion Zone*	2.95	4.05	8.95	2.83	3.48	5.76
Exclusion Zone	0.00	0.00	0.00	0.00	0.00	0.00
Message Gap	0.00	0.89	0.07	0.14	0.45	0.10
Tracking Unit Tamper	0.02*	0.00	n/a	n/a	0.01	n/a

\* GPS days for the two-piece caseloads were calculated using time from 8/29 forward, because the two-piece agents were not employing any zones prior to receiving zone training in Sacramento on 8/28.

non-priority, obscures important differences by alert type. These differences are summarized in Table 3. Each alert type is discussed in turn below.

### Low Battery

Despite the longer battery life of the two-piece tracking units, the number of low battery alerts per caseload day was similar between the one-piece and two-piece caseloads in the study, although one two-piece caseload did not have a single low battery alert over the course of the field test. It may be that parolee and parole agent familiarity with the charging requirements of the one-piece unit prior to the field test period was sufficient to negate any advantage for the two-piece due to relative ease of charging.

### Cuff Leave

The two-piece caseloads generated 3.82 cuff leave alerts per caseload day over the course of the field test. This is a high volume for an alert that was a particular concern of parole agents and DAPO staff, and parole agents and DAPO staff noted it as a major weakness of the two-piece system. There was a considerable difference between the County 1 and County 2 two-piece caseloads in cuff leave alerts per caseload day (1.74 per caseload day in County 1, 5.91 per caseload day in County 2). This is partly the result of the fact that Vendor A, the County 1 vendor, had a five-minute grace period for cuff leave alerts, which could not be modified. Vendor B had no grace period on cuff leave alerts. Interview subjects also noted that cuff leave alerts were more common in County 2 during the early stages of the field test as a result of the tracking unit and ankle cuff “losing synch” after a period of operating properly.

The agents thought that parolees might be testing how far the tracking unit can be from the ankle cuff, or how tolerant the agents would be about parolees forgetting the tracking unit, but they couldn’t be certain. Several interview subjects felt that it would be necessary to employ a sanctions structure to promote and enforce parolee compliance with carrying their tracking units, similar to the way in which unit charging compliance is enforced.

One parolee had his parole revoked as a consequence of having ten cuff leave alerts over a 30 day period.

### Strap Tamper

Strap tamper alerts were more prevalent in the one-piece caseloads during the field test than on the two-piece caseloads. There were 0.61 strap tamper alerts per caseload day for the comparison one-piece caseloads, or roughly one alert every other day. There were 0.37 strap tamper alerts per caseload day for the two-piece caseloads, or roughly one every three days. This was consistent with parole agent and parolee perceptions that there were fewer strap tamper alerts generated by the two-piece units due to the two-piece ankle cuff being smaller than the one-piece unit, which resulted in less wear on the bracelet straps. It is important to remember that parolees on the one-piece comparison caseloads had been wearing their GPS units prior to the start of the field test, in some cases for many months, giving their bracelet straps longer to wear out. Parole agents and DAPO staff noted that 60 days, the length of the field test, was less time than it takes the average bracelet strap used with one-piece units to wear out. This may have biased the results in favor of the two-piece systems.

### Zone Alerts

There were approximately two more inclusion zone alerts per caseload day for the comparison one-piece caseloads as for the two-piece caseloads. This may be the result of differences in the prevalence of drift, which one parole agent said was less common for the two-piece unit, although also more challenging to recognize. Differences in inclusion zone alarms may also be the result of differing agent use of zones. In the interviews, parole agents said that they did not necessarily place inclusion zones on all parolees. Interestingly, inclusion zone alerts were more common for parolees on the County 2 two-piece caseload than for those on the County 1 two-piece caseload, despite all the parolees on the County 1 two-piece caseload having an inclusion zone placed on them, while there were six parolees on the County 2 two-piece caseload who had no

**Table 4: Inclusion Zone Alerts**

	Two-Piece System		One-Piece System		Total	
	Vendor A County 1	Vendor B County 2	Vendor C County 1	Vendor C County 2	Two-Piece	One-Piece
Alerts per Caseload Day*	2.95	4.05	8.95	2.83	3.48	5.76
Average Duration (in minutes)	66	188	22	137	123	80
Median Duration (in minutes)	21	64	2	3	43	22
Maximum Duration (in minutes)	450	660	695	689	660	695

\* GPS days for the two-piece caseloads were calculated using time from 8/29 forward, because the two-piece agents were not employing any zones prior to receiving zone training in Sacramento on 8/28.



inclusion zone. (Two parolees on the County 2 two-piece caseload had multiple inclusion zones.)

As shown in Table 4, the profile of inclusion zone alerts is different for the two-piece caseloads and the one-piece comparison caseloads. The average duration of inclusion zone alerts (the time between the beginning of an alert and the time at which it cleared) was longer for the two-piece caseloads. The median duration of inclusion zone alerts for the two-piece caseloads was 43 minutes; for the one-piece caseloads it was 22 minutes. This means that while the one-piece caseloads are generating more inclusion zone alerts per caseload day, most of those alerts clear much more quickly on average than those for the two-piece caseloads. Many alerts that clear quickly is a pattern suggestive of drift.

Complicating the picture further, Vendor B’s two-piece system is configured such that the tracking unit does not take GPS points when it is in the charging base (unless the tracking unit is moving). Rather, it functions like a radio frequency unit, determining only whether the unit is within 250 feet of the base. While in this mode, it is not possible for the unit to register drift. It also appears from parole agent notes included with the one-piece vendor data that on three occasions one of the agents supervising a one-piece comparison caseload waited several days to remove inclusion zones on old residences after a parolee moved, generating inclusion zone alarms lasting the entirety of the parolee’s curfew period.

As the comparison one-piece caseloads had much more frequent inclusion zone alarms, and the evidence from the field test suggests that drift may be more prevalent in the one-piece system, it appears that the two-piece units had the advantage in terms of inclusion zone alerts.

Neither the County 1 nor the County 2 two-piece agent utilized exclusion zones during the field test, although they had the capability to do so. Both agents had exclusion zones in place for their parolees prior to the field test, so this is presumably not an accurate reflection of how a two-piece system would be utilized if adopted by

DAPO. However, there were no exclusion zone alerts registered for either of the one-piece comparison caseloads, so this does not appear to be a major concern in evaluating the performance of the two-piece systems in the field test.

### Message Gap

“Message gap” alerts inform the parole agent that the GPS unit is not calling in its information, usually due to a lack of cellular coverage. When a parolee’s unit is in message gap status, the agent may not know where the parolee is at that moment because the unit is not calling in its information, but the GPS unit will transmit the location information it recorded while in message gap status when it is once again able to receive cellular reception.

Message gap alerts were infrequent, with the exception of the two-piece caseload in County 2, which generated nearly one per caseload day. The other two-piece caseload did not generate any message gap alerts throughout the entire field test period.

The duration of message gap alerts is as important as their number. If interruptions in a unit receiving GPS signal or calling out its information are short, the overall integrity of the GPS supervision is minimally impacted. As Table 5 shows, the number of minutes GPS units were in message gap status per caseload day over the course of the field test was almost the same for the two-piece and one-piece caseloads. This number was the result of frequent but relatively short periods of message gap status in one of the two-piece caseloads, and a small number of lengthy periods of message gap status in the comparison one-piece caseloads.

Given the variance in message gap alerts across the two two-piece systems in the field test, and the different profile of message gap alerts in the two-piece and one-piece caseloads (longer but more infrequent alerts for the one-piece, briefer but more frequent alerts for one of the two-piece caseloads), it is not clear that either type of equipment had an advantage during the field test.

**Table 5: Time in Message Gap Status**

	Two-Piece System		One-Piece System		Total	
	Vendor A County 1	Vendor B County 2	Vendor C County 1	Vendor C County 2	Two-Piece	One-Piece
Total Caseload Time in Message Gap Status (Minutes/ Caseload Day)	0	322	142	182	161	163
Average Duration of Message Gap (in hours)	0	6.0	33.1	22.4	6.0	26.0
Maximum Duration (in hours)	0	162.2*	129.6	50.5	162.2	129.6
Minimum Duration (in hours)	0.0	0.1	6.6	7.7	0.1	6.6

\* This lengthy message gap alert was the result of an improper unit start-up.

**TABLE 6: TIME IN NO GPS STATUS**

	Two-Piece System		One-Piece System		Total	
	Vendor A County 1*	Vendor B County 2	Vendor C County 1	Vendor C County 2	Two-Piece	One-Piece
Total Caseload Time in No GPS Status (Minutes/Caseload Day)	430	1,452	1,886	455	1,163	1,152
Instances of No GPS Status per Caseload Day	12.22	18.86	2.48	1.29	16.99	1.87
Average Duration of No GPS Status (in minutes)	35	77	760**	353***	68	616
Maximum Duration (in minutes)	237	2,081	10,674	10,665	2,081	10,674
Minimum Duration (in minutes)	0	1	365	0	0	0

\* Vendor A provided data on “no GPS” status for the period of 8/13/2007 unit 9/5/2007. All minutes per caseload day figures were calculated for that period only.

\*\* This average includes a period of “no GPS” status lasting seven days resulting from a technical problem experienced by Vendor C that affected a portion of the GPS units used by DAPO throughout California. Excluding that period, the average duration of “no GPS” status in during the field test was 688 minutes.

\*\*\* This average includes a period of “no GPS” status lasting seven days resulting from a technical problem experienced by Vendor C that affected a portion of the GPS units used by DAPO throughout California. Excluding that period, the average duration of “no GPS” status in during the field test was 215 minutes.

### Tracking Unit Tamper

There was only one tracking unit tamper alert over the course of the field test, resulting from a parolee dropping his tracking unit while riding a bicycle. This alert does not appear to figure meaningfully in the overall performance of the two-piece units in the field test.

### NO GPS STATUS

“No GPS” is a GPS unit status occurring then the GPS tracking unit is not receiving sufficient signal from GPS satellites to fix its position. This generally happens when a parolee is indoors. It seems reasonable to assume that the less time a GPS unit is in “no GPS” status, the more effectively a parolee is being monitored through GPS.

Vendors A, B and C provided the study team with data on when the GPS units in the field study went into and out of “no GPS” status. That data is summarized in Table 6. The results are similar to those for message gap alerts, although instances of “no GPS” status were much more frequent for all caseloads than were message gap alerts. The two-piece caseloads had much more frequent instances of units going into “no GPS” status, but when the one-piece caseloads went into that status, they were in it for much longer on average. According to DAPO, Vendor C experienced technical difficulties (which

affected certain GPS units throughout California) during the field test period that resulted in two units included in the field test experiencing long periods of “no GPS” status, reflected in the maximum duration figures for the one-piece caseloads in Table 6.

The two-piece and one-piece caseloads had very nearly the same number of minutes per caseload day in “no GPS” status, but arrived at that number as a result of very different patterns. It is not clear whether brief but frequent periods of “no GPS” status are more or less problematic for GPS supervision than more infrequent but longer periods. Therefore, neither type of equipment had a clear advantage during the field test.

### WORKLOAD IMPACT

Interviews revealed mixed views among parole agents and DAPO staff regarding the workload impact of employing a two-piece GPS system. One agent felt that the workload using the two-piece system over the entirety of the field test averaged to be the same as for the one-piece, and that over the long term the two-piece system would require less work to use in supervision than the one-piece system. Other DAPO staff disagreed, believing that agent workload would always be higher for agents using two-piece equipment due to cuff leave alerts.

**TABLE 7: MINUTES PER CASELOAD DAY SPENT RESOLVING GPS ALERTS**

Two-Piece System		One-Piece System		Total	
Vendor A County 1	Vendor B County 2	Vendor C County 1	Vendor C County 2	Two-Piece	One-Piece
14.8	16.4	5.8	20.7	15.6	13.3

**Table 8: Agent Time Spent Resolving GPS Alerts, By Alert Type (in Minutes per Caseload Day)**

	Two-Piece System		One-Piece System		Total	
	Vendor A County 1	Vendor B County 2	Vendor C County 1	Vendor C County 2	Two-Piece	One-Piece
Low Battery	0.00	0.72	0.27	2.71	0.36	1.52
Cuff Leave	14.58	7.65	n/a	n/a	11.11	n/a
Strap Tamper	0.00	8.00	4.50	5.19	4.00	4.81
Inclusion Zone	0.23	0.00	0.00	10.71	0.12	5.45
No GPS*	0.00	0.00	0.00	1.86	0.00	0.96
Message Gap	0.00	0.00	1.07	0.20	0.00	0.63

\* “No GPS” information is not actively provided agents. They must access it via the vendor software.

One of the two-piece agents reported that all GPS alert information provided via text message required overtime during the field test, because there was no accompanying message when an alert cleared, requiring him to log into the tracking software to verify whether the alert had been resolved. Workload for that caseload was reduced due to less frequent unit replacement, but that reduction was off-set by the additional time necessary to utilize the slower tracking software. One DAPO staffer noted that the design of the field test placed a greater workload demand on the agents utilizing the two-piece units because additional agents were not trained, requiring the two-piece agents to be on-call at all times for any issues arising from their GPS-monitored parolees.

**Agent Time Spent Resolving GPS Alerts**

The parole agents utilizing the two-piece units as well as the agents supervising the comparison one-piece caseloads were asked to keep a log of all instances in which they had to initiate an investigative response to alerts generated by the GPS units on their caseload. The response had to be above and beyond what they would do in the regular course of their supervision. (Questioning the parolee during a home visit that would have occurred regardless of GPS alert would not count, for example.) For each investigative response, agents indicated how

much time they devoted to resolving the issue. The results are summarized in Table 7. The amount of time agents spent resolving GPS alerts per caseload day ranged from a low of 5.8 minutes to a high of 20.7 minutes per day. Both extremes were one-piece caseloads. The average across the caseloads was 15.6 minutes per caseload day for the two-piece and 13.3 minutes per caseload day for the one-piece caseloads.

Table 8 breaks down the time agents spent resolving GPS alerts by alert type. The two-piece agents spent the most time per caseload day resolving cuff leave violations, supporting the concern expressed by multiple interview subjects that dealing with this alert had a significant workload impact. The one-piece caseload in County 2 was an outlier in that the agent supervising it spent substantial time resolving inclusion zone alerts. Aside from cuff leave and inclusion zone alerts, agents spent the most time dealing with strap tamper alerts, due to the need to change worn bracelet straps.

In filling out their response log, parole agents indicated for each response whether they determined the alert to be the result of parolee behavior, a GPS unit issue, or whether it was uncertain.<sup>8</sup> Table 9 summarizes each agent’s response time devoted to resolving GPS alerts

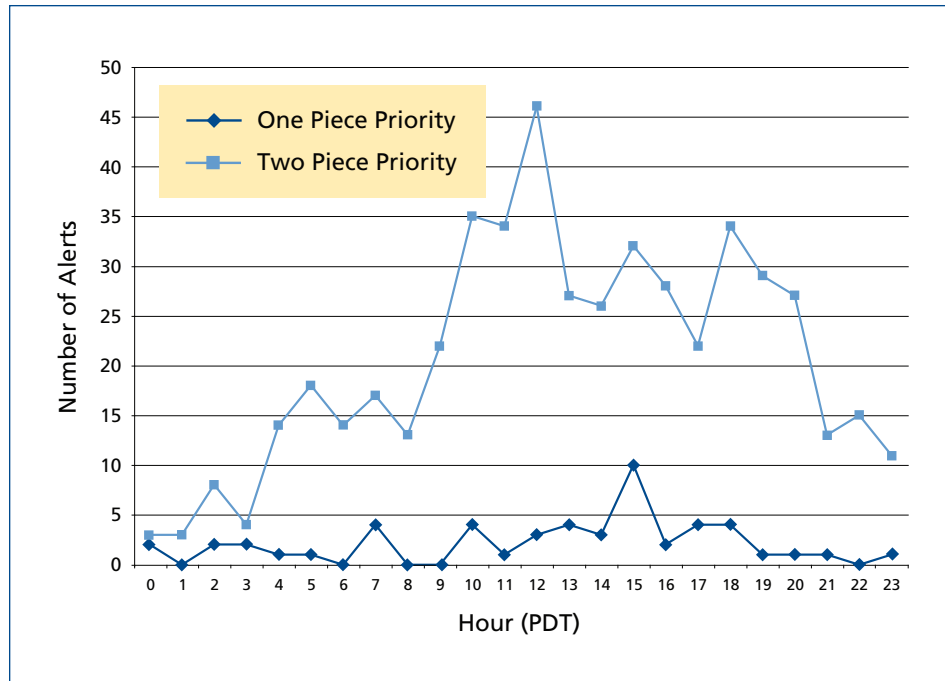
<sup>8</sup> These determinations were based on the agent’s best judgment and could not be independently verified.

**Table 9: Agent Time Spent Resolving GPS Alerts, By Cause (in Minutes per Caseload Day)**

	Two-Piece System		One-Piece System		Total	
	Vendor A County 1	Vendor B County 2*	Vendor C County 1	Vendor C County 2	Two-Piece	One-Piece
Parolee Behavior	11.0	7.8	2.6	3.0	9.4	2.8
GPS Unit Issue	2.0	6.2	0.0	16.8	4.1	8.6
Uncertain	1.8	1.6	3.3	0.9	1.7	2.1

\* This caseload’s figures do not add up to the total minutes per caseload day reported in Table 8 due to one alert categorized by the agent as caused by “Agent Error.”

**Figure 1: Total Priority Alerts by Time of Day\***



\* Alerts were sorted by the hour interval in which they occurred. For example, the total number of alerts occurring between midnight and 12:59AM are plotted at hour 0. Hours are reported in military time (17 is 5:00PM, etc.)

classified by those categories. The parole agents supervising the two-piece caseloads devoted roughly 60% (9.4 minutes of 15.6 total minutes per caseload day) of their time spent resolving alerts to alerts involving parolee behavior. This time was spent almost exclusively on cuff leave alerts. This is consistent with one parole agent’s stated opinion that the two-piece system generates alarms that are more likely to be the result of parolee behavior. By contrast, the agents supervising the comparison one-piece caseloads spent 65% (8.62 minutes of 13.3 total

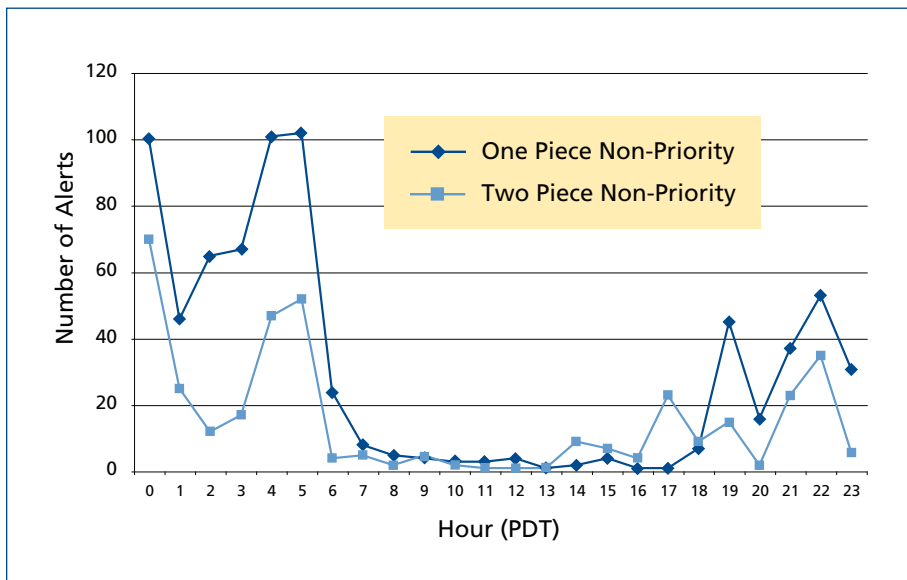
minutes per caseload day) of their time on resolving GPS unit issues. This figure might have been higher, as one of the one-piece agents classified all the alerts he investigated as arising from either parolee behavior or as having an uncertain cause. Presumably, some of the uncertain GPS alerts were caused by GPS unit issues.

The way in which GPS alerts affect agent workload is related to when the alerts occur. Alerts that occur while an agent is working may be addressed within the course of that agent’s working day, while those that occur outside of duty

hours may require overtime to address. Figures 1 and 2 plot the time of GPS alerts by hour of day. Priority alerts for both the two-piece and one-piece caseloads were most prevalent during the day, between 9:00AM and 6:00PM. These hours may or may not overlap with a parole agent’s working day; many agents begin work in the afternoon and work into the evening. For non-priority alerts, the pattern is the opposite: alerts are most common between 6:00PM and 6:00AM. This is due to most non-priority alerts being inclusion zone alerts, and inclusion zones are generally set for a parolee’s curfew hours.

Two-piece agents devoted slightly more time per caseload day to resolving GPS alerts during the field test than did the comparison

**Figure 2: Total Non-Priority Alerts by Time of Day**





**Table 10: Unit Replacement**

		Two-Piece System		One-Piece System		Total	
		Vendor A County 1	Vendor B County 2	Vendor C County 1	Vendor C County 2	Two-Piece	One-Piece
% Parolees with Units Replaced within 60 days		15%	55%	0%	0%	35%	0%
Replacements per Caseload Day	Tracking Unit	0.05	0.23	0.02	0.19	0.14	0.10
	Ankle Cuff	0.04	0.33	n/a	n/a	0.18	n/a
Days to Removal*	Tracking Unit	33.1	15.2	0.0 (61.9)	1.4 (22.5)	18.2	1.4 (25.6)
	Ankle Cuff	31.4	15.5	n/a	n/a	17.2	n/a

\* Days to unit removal were calculated in two ways for the one-piece caseloads. In the first calculation, units that were replaced after more than 60 days were excluded, because no two-piece unit was worn by a parolee for more than 60 days. In the second calculation, one-piece units that were replaced after 60 days were included. The results of the second calculation are reported in parentheses.

one-piece agents, although the comparison caseloads accounted for both the most and the least time devoted to resolving GPS alerts. Across the two-piece caseloads, the majority of response time was devoted to cuff leave alerts. As this alert does not exist for one-piece systems, it appears that employing a two-piece system does have a workload impact, either causing agents to do additional work relating to cuff leaves, or to substitute that work for other activities they would be engaged in. A difference of less than three minutes per caseload day in time spent resolving GPS alerts coupled with the lack of consensus on workload impact from the interviews leads to a conclusion that there was no clear advantage over the field test in terms of workload impact.

### UNIT REPLACEMENT

When GPS components need to be replaced, it generally means that the unit has stopped working, so turnover in units is significant in that it suggests periods of time when the GPS is not fully monitoring the offender. It also adds to agent workload because replacing units requires the parole agent to either bring the parolee to the parole office or to go to where the parolee is. High unit replacement rates can consume a substantial amount of agent time. Unit replacement is disruptive to the parolee's routine as well.

A comparison between the unit replacement rate of the two-piece units and the one-piece units is imperfect because there are two pieces that can be replaced with the former and only one with the latter. It is also worth noting that DAPO had been utilizing the one-piece units for two years when the field test began, and it may be the case that equipment failure is a greater problem in the initial stages of deploying equipment. This was the case when DAPO began using one-piece equipment.<sup>9</sup>

The unit replacement results in the field test are summarized in Table 10. The first row shows the percentage of parolees on each caseload on August 13 with a unit replacement over the course of the field test. It is calculated differently for the two-piece and one-piece caseloads because the parolees on the one-piece caseloads continued to wear GPS units that had been assigned to them before the field test period began. Parolees on the one-piece caseloads were only counted as having a unit replaced if unit replacement occurred within 60 days of the date on which the GPS unit they were wearing at the start of the field test was assigned to them. Parolees on the two-piece caseloads were counted if they experienced a unit replacement over the course of the field test. This slightly biases the results in favor of the two-piece units, because the two-piece agents had until August 24 to place two-piece units on their parolees, so some parolees wore the two-piece unit for less than 60 days. Parolees were not counted as having a unit replaced if they were discharged from parole supervision over the course of the field test, or if they had their parole revoked and were returned to custody.

Unit replacement was more common in the two-piece caseloads, mostly due to replacements in the two-piece caseload in County 2. Unit replacements were most prevalent early in the field test on that caseload, when the supervising agent reported issues with the transmitter and the bracelet "losing sync." These issues seemed to be resolved by the vendor after the early stages of the study, although a complete explanation of the cause was not provided to the agent. Overall, there were 0.14 tracking unit replacements per caseload day in the two-piece caseloads, or roughly one every seven days. There were 0.18 ankle cuff replacements per caseload day, or roughly one every six days. Two-piece tracking units and ankle cuffs were often changed at the same time. By comparison, there were 0.1 one-piece GPS unit replacements per caseload day, or one every ten days. Although there were

<sup>9</sup> See Turner, S. and Jannetta, J. (2007, forthcoming). *Implementation and Early Outcomes for the San Diego High Risk Sex Offender GPS Pilot Program*. Irvine, CA: Center for Evidence-Based Corrections.

unit replacements in the one-piece comparison caseloads, all the one-piece units worn by parolees on those caseloads at the start of the field test period lasted at least 60 days before being replaced.

Another mode of analysis for unit replacement is time to replacement, the number of days the average unit is in the field before it is replaced. Two-piece tracking units that were replaced lasted an average of 18.2 days, and the ankle cuffs an average of 17.2 days. When time to unit replacement was calculated only for those one-piece units that had been worn by parolees for less than 60 days, the average unit was replaced after just 1.4 days. If one-piece units that had been worn for more than 60 days are included, the average increases to 25.6 days. In essence, Vendor C’s one-piece units tended to either require replacement almost immediately after placement on a parolee, or to last a long time.

Despite the more frequent replacement of the two-piece units, parolees in the focus groups, parole agents and DAPO expressed the belief that the two-piece units were more durable. This may be due in part to bracelet straps wearing out more quickly in the one-piece units. Data on bracelet strap replacement was not available, although the rate of strap tamper alarms can be used as a proxy for bracelet straps wearing out. DAPO staff and parole agents noted that the bracelet straps for the

one-piece units generally last longer than 60 days, so the field test may not have been long enough for a valid comparison of the durability of bracelet straps.

It is difficult to directly compare the unit replacement performance of the one-piece units, which were already in use when the field test began, with that of the two-piece units deployed as part of the field test. However, it appears that the one-piece units had to be replaced less frequently, although they had a greater tendency to require replacement soon after being assigned to a parolee. On balance, the advantage in field test performance on unit-replacement is with the one-piece units.

### PAROLEE, PAROLE AGENT AND DAPO STAFF PREFERENCE

At the conclusion of each interview and parolee focus group, the interview subject or the parolee focus group was asked whether they would prefer to see the two-piece system continue to be employed at the end of the field test, or a return to the one-piece system.

Fresno parolees were unanimous in preferring the two-piece. Parolees in County 1 were split on whether they preferred the two or the one-piece unit. Some felt that the two-piece is more difficult for parolees with active lifestyles, and parolees favoring the one-piece unit appreciated that the tracking unit couldn’t be forgotten.

For the majority of parolees across both focus groups, however, the longer battery life and ease of charging made the two-piece system preferable.

The DAPO staff, unit supervisors and regional GPS coordinators interviewed all stated that they would prefer to utilize one-piece equipment because the tracking unit is attached to the parolee’s ankle. One of the parolee agents who used the two-piece system concurred, but the other preferred one of the two-piece packages due to its superior software. That agent did feel that the most dangerous sex offenders should be monitored with one-piece systems so they could not leave their tracking units behind and commit a crime. The agent would prefer a one-piece system if it provided software of equivalent quality to the two-piece system.

Some of the interview subjects thought that two-piece systems might be preferable for homeless and transient parolees because of their longer battery life. The homeless and transient population is a serious concern for DAPO due to more stringent residency requirements for sex offenders required by Proposition 83. Several interview subjects mentioned that having to charge units less frequently would be important for parolees without an established address. One interview subject said that the opposite

**Table 11: Summary of System Performance in the Field Test**

	One-Piece System	Two-Piece Systems
Ease of Installation	◇	△
Unit Size	‡	‡
Battery Life/Ease of Charging	◇	△
Text Messaging Capability	◇	△
Location-Fixing Accuracy	‡	‡
Tracking Unit Attached to Parolee	△	◇
Total Alert Volume	△	◇
Priority Alert Volume	△	◇
Strap Tamper Alerts	◇	△
Low Battery Alerts	‡	‡
Inclusion Zone Alerts	◇	△
Message Gap Alerts	‡	‡
No GPS Status	‡	‡
Workload Impact	‡	‡
Unit Replacement	△	◇
Parolee Preference	◇	△
Agent/DAPO Staff Preference	△	◇

△ System advantage  
 ◇ System disadvantage  
 ‡ No clear system advantage

might be the case: carrying the tracking unit and the charging base could be more cumbersome and difficult to carry around for a homeless parolee.

## **CONCLUSION**

Interpreting the results of the field test of the two-piece GPS systems is challenging, because the small number of caseloads and the short period of the field test involved means that differences in parole agent use of the GPS tool or random variation in circumstances could easily result in differences in result for the two-piece caseloads and the comparison caseloads that are not the result of differences between two-piece and one-piece systems. Although the results of the field test must be treated as appropriately provisional, some conclusions about the relative advantages of each type of system can be drawn. These conclusions are summarized in Table 11.

*It is not clear that each of these elements is of equal importance.* Depending on the goals and structure of the overall supervision approach of which GPS monitoring is a component, an advantage in one of these categories could outweigh advantages in many other categories. How to weigh the relative value of an equipment advantage in any of these categories is a policy decision.

Neither type of equipment clearly outperformed the other during the field test in terms of alert volume or workload impact. Based on the importance assigned to them in the interviews with parole agents and DAPO staff, the primary issue with regard to utilizing a two-piece systems as opposed to a one-piece system appears to be the trade-off between the longer battery life and

relative ease of charging with the two-piece unit and the greater confidence that agents and supervisors feel having all the GPS equipment physically attached to the parolee through the one-piece unit. Selecting one type or another may depend on the risk level and living situation of specific parolees or types of parolee.

Interviewing the agents, parolees and other DAPO staff also made it clear that the quality of a GPS technology package is a combination of three elements: the GPS unit hardware, the offender tracking software, and the service provided by the GPS monitoring center. This study was designed to examine the relative merits of two types of GPS unit hardware. It is not clear, however, that GPS unit hardware is the most important of the three elements, so the relative desirability of two-piece and one-piece units is only one consideration among several is weighing different GPS vendors and their technology packages.

A definitive recommendation of one GPS system over the other is not warranted by the results of the field test. Rather, each type of equipment had advantages and disadvantages. As one interview subject noted, there is no reason that DAPO needs to rely on a single vendor and a single GPS technology package for all of its GPS monitoring. It may be beneficial for DAPO to have the option to deploy more than one type of GPS technology package, so that it can supervise its total population of GPS-monitored parolees as effectively as possible. Policymakers need to consider the relative advantages of each type of system in evaluating whether it is appropriate to the risk level and living situation of specific parolees or types of parolee.

## GLOSSARY

Different GPS vendors and GPS-utilizing agencies use different terms to refer to the components of a GPS offender monitoring package. In this report, we use the following terms.

**911 Zones:** Inclusion and exclusion zones designated by a supervising parole agent to generate priority alerts.

**Alert:** Any activity recorded by the GPS unit that the monitoring center informs the GPS parole agent of, by call, text message or e-mail.

**Ankle Cuff:** A transmitter worn on the ankle of a parolee monitored by a two-piece GPS system that sends a signal to the GPS tracking unit verifying that they are in the same location. If the ankle cuff and tracking unit are too far apart, a cuff leave alert is generated.

**Base Charging Unit:** A docking station into which the two-piece tracking unit is placed to charge it. In some two-piece GPS systems, the tracking unit does not take GPS points while in the base charging unit unless it is moving. Instead, it monitors whether the ankle cuff is within a certain distance of the tracking unit.

**Bracelet Strap:** The strap used to attach a one-piece GPS unit or two-piece ankle cuff to the leg of a parolee.

**Caseload Day:** A caseload-based standard measure defined for this report consisting of a 24-hour period over which 20 parolees are continuously monitored by GPS.

**Clear:** When a GPS unit ceases to be in an alert status.

**Cuff Leave:** An alert occurring when the two-piece tracking unit and the ankle cuff are too far away from one another, meaning that the location of the tracking unit no longer indicates the location of the parolee. This alert does not exist for one-piece systems.

**Drift:** When a parolee's GPS point is fixed at a distance from the parolee's actual location due to the position of the GPS satellites relative to the GPS unit.

**Exclusion Zone:** A perimeter entered into GPS software around areas that parolees are not allowed to enter. If the parolee enters an exclusion zone, an exclusion zone alert is triggered.

**GPS Point:** A location fixed by a GPS unit and plotted on a map in the vendor-provided GPS software.

**Inclusion Zone:** A perimeter placed around an area at which a parolee is supposed to be at a certain time of day. If the parolee exits an inclusion zone at a time at which he is required to remain within it, an inclusion zone alert is triggered.

**Low Battery:** An alert generated when the parolee's one-piece GPS unit or two-piece tracking unit has very little charge remaining.

**Message Gap:** An alert generated when the GPS unit is not calling in to the monitoring center.

**Monitoring Center:** A GPS vendor's central data center to which each GPS unit sends its data and from which alerts are communicated to parole agents.

**No GPS:** A unit status occurring when the GPS unit is not able to fix its position due to not receiving signal from a sufficient number of GPS satellites

**Non-Priority Alerts:** Category defined for this report as consisting of alerts that are communicated to parole agents only via e-mail, not by either phone call or text message.

**Priority Alerts:** Category defined for this report as consisting of alerts that are communicated to parole agents by either phone call or text message from the monitoring center.

**Strap Tamper:** An alert triggered by a break in the fiber-optic connection running through the bracelet strap attaching the ankle unit to the parolee.

**Tracking Unit:** A GPS unit that fixes its position using signals from GPS satellites and transmits that location to a monitoring center via a cellular network. In a one-piece system, the tracking unit is attached to the parolee's leg. In a two-piece system, the parolee must carry the tracking unit, but it is not attached to him.



## APPENDIX A: GPS SYSTEM TECHNICAL SPECIFICATIONS

	Two-Piece Vendors		One-Piece Vendor
	Vendor A	Vendor B	Vendor C
Cellular Provider	T-Mobile (can be switched to Cingular)	Verizon	T-Mobile, Cingular
Charging Requirement	6-8 hours for a full charge (lasting 2-3 days)	6 hours for a full charge (lasting 16 hours on active monitoring)	Every 12 hours for one hour
Unit Size	Ankle cuff: 2"x1.9"x1" Tracking Unit: 4.2"x3.5"x1.6"	Ankle cuff: 2.6"x1.6"x.9" Tracking Unit: 4"x2.36"x1.3"	4.33"x2.08"x1.25"
Unit Weight	Ankle Cuff: 2.5 oz. Tracking Unit: 15 oz.	Ankle Cuff: 3.5 oz. Tracking Unit: 8 oz.	6 oz.
Tamper Alert Triggers	Breaking of fiber-optic connection in bracelet strap; tracking unit light sensor triggered by attempt to open it	Breaking of fiber-optic connection in bracelet strap; tracking unit alarm if unit is opened or smashed	Breaking of fiber-optic connection in the bracelet strap
Tracking Unit-Ankle Cuff Distance that Triggers Alarm	In Base: 150 ft. Not in Base: 75-100 ft.	In Base: 250 ft. Not in Base: 50-75 ft.	n/a

## APPENDIX B: BACKGROUND CHARACTERISTICS OF PAROLEES ON THE FIELD TEST AND COMPARISON CASELOADS

DAPO provided background data on the parolees on the study caseloads. This data is summarized in Table 12. All parolees on study caseloads were males.

**Table 12: Parolee Background Characteristics**

		Two-Piece System		One-Piece System		Total	
		Vendor A County 1	Vendor B County 2	Vendor C County 1	Vendor C County 2	Two-Piece	One-Piece
Number		21	20	26	27	41	53
Race	White	11	12	14	8	23	22
	Black	1	3	4	7	4	11
	Hispanic	8	5	6	10	13	16
	Nat. Am.	0	0	0	2	0	2
	Filipino	1	0	0	0	1	0
	Other	0	0	2	0	0	2
Current Offense a Sex Offense?	Yes	16	18	19	17	34	37
	No	5	2	7	10	7	17
Parole Revocation During Current Parole Period?	Yes	8	8	6	14	16	20
	No	13	12	20	13	25	33
STATIC-99 Score*		3.52	2.55	3.24	2.42	3.05	2.82
Age		50.85	41.69	42.08	42.13	46.38	42.11
Days Since First Parole		877	548	416	500	459	717
Days Since Most Recent Release**		642	302	312	239	275	476
Days in Study Period		54.2	56.4	43.0	43.7	55.2	43.3

\* The STATIC-99 is an instrument that assesses the risk of sex crime recidivism for sex offenders on a nine point scale. A score of 2 or 3 indicates moderate-low risk for sexual re-offense, while 4-5 indicates moderate-high risk. There were two parolees for whom a STATIC-99 score was unavailable, one from each one-piece caseload.

\*\* Most recent release includes releases after a return to custody for a parole violation.

## APPENDIX C: REGRESSION RESULTS

In order to determine whether placement on the two-piece or one-piece unit was associated with a statistically significant difference in the number of GPS alerts per parolee over the field test period, the study team conducted regression analyses using the total number of alerts per parolee and each individual type of alerts as the dependent variable. The results for the model with the total GPS alerts as the dependent variable are summarized in Table 13.

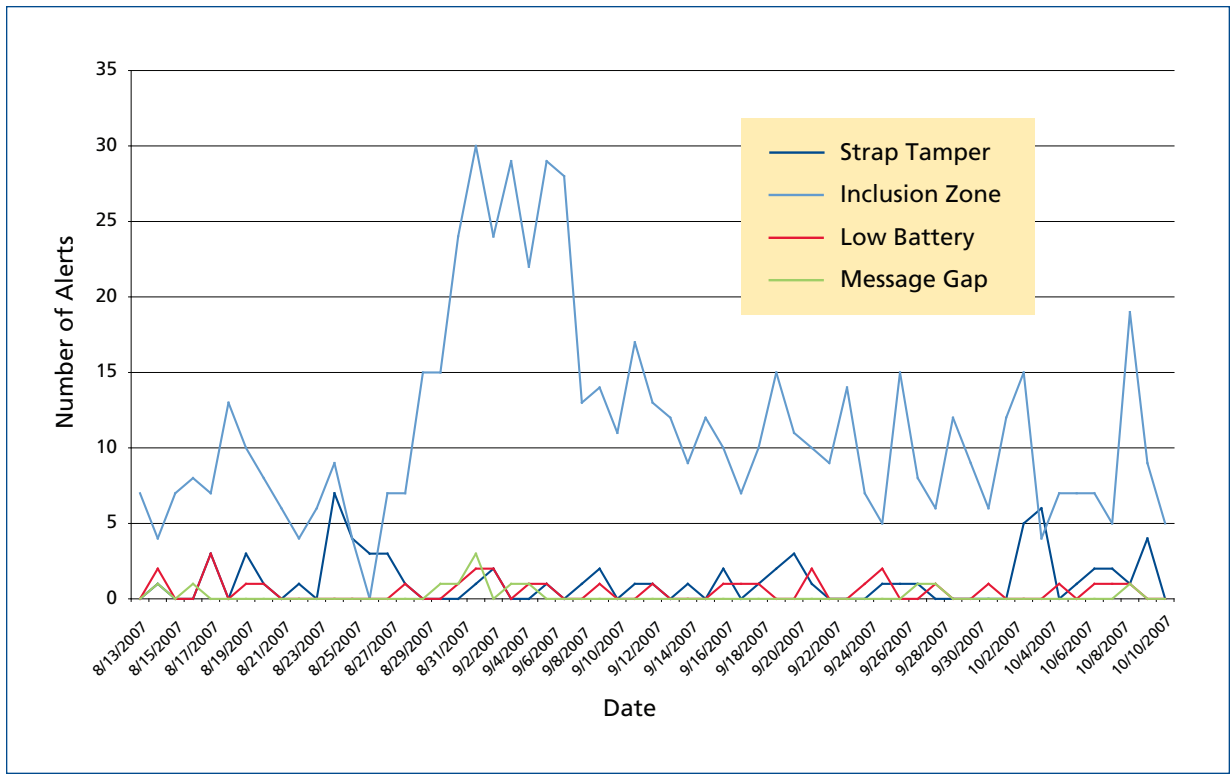
**Table 13: Regression Results, Total Alerts as the Dependent Variable**

R	R Square	Adjusted R Square	Std. Error of the Estimate
.487	.237	.084	22.720

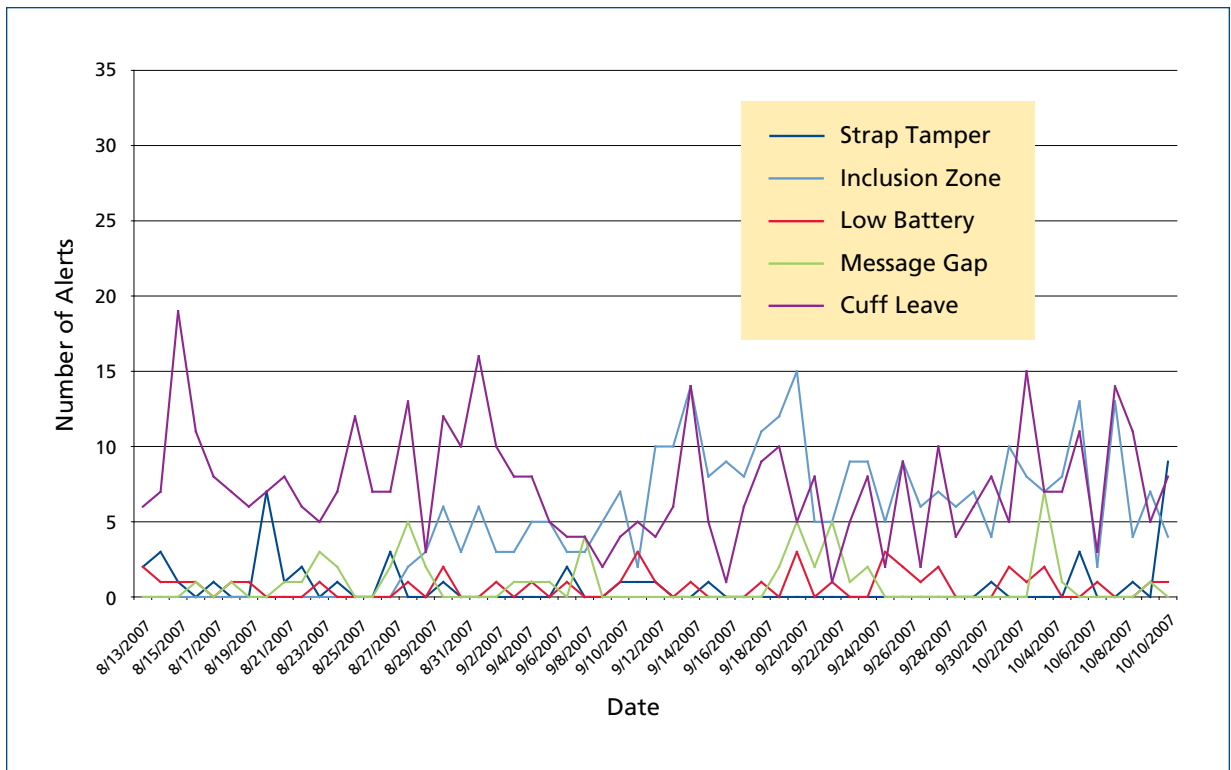
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	88.212	33.218		2.656	.010
County 1	-10.207	6.324	-.216	-1.614	.111
Two-Piece GPS	1.846	5.910	.039	.312	.756
Days in Study	-.896	.464	-.238	-1.930	.058
Days since Most Recent Release	.000	.012	-.007	-.052	.959
STATIC-99 Score	4.678	1.719	.399	2.721	.008
Age	-.357	.253	-.171	-1.411	.163
Instant Offense a Sex Offense	8.581	8.307	.165	1.033	.305
Returned to Custody for Parole Violation	-10.681	5.941	-.222	-1.798	.077
Hispanic	-5.873	6.612	-.108	-.888	.378
African-American	-13.514	8.373	-.198	-1.614	.111
Instant Offense Rape/Sexual Assault	-8.167	11.635	-.084	-.702	.485
Instant Offense Other Sex Offense	-16.772	10.731	-.214	-1.563	.123
Instant Offense Failure to Register	20.223	9.645	.285	2.097	.040

**APPENDIX D: GPS ALERTS BY DATE**

**Figure 3: GPS Alerts by Date, One-Piece Caseloads**



**Figure 4: GPS Alerts by Date, Two-Piece Caseloads**

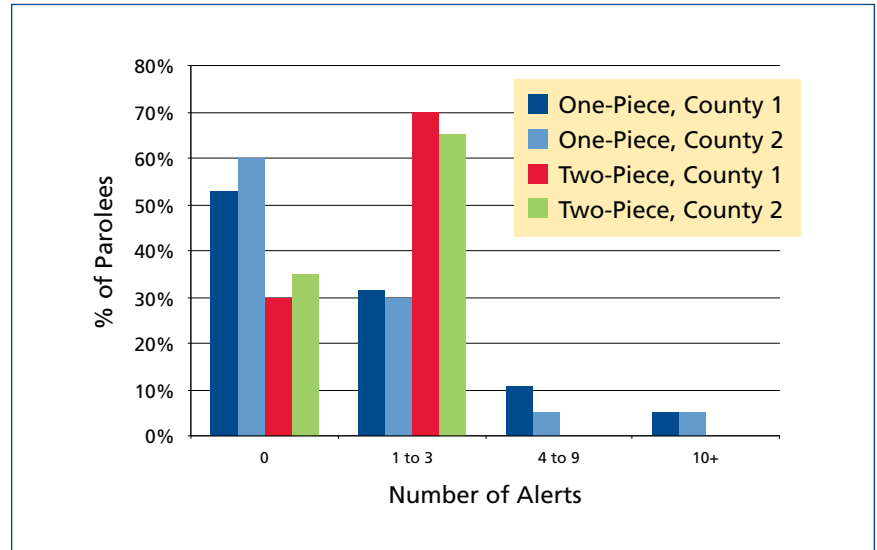




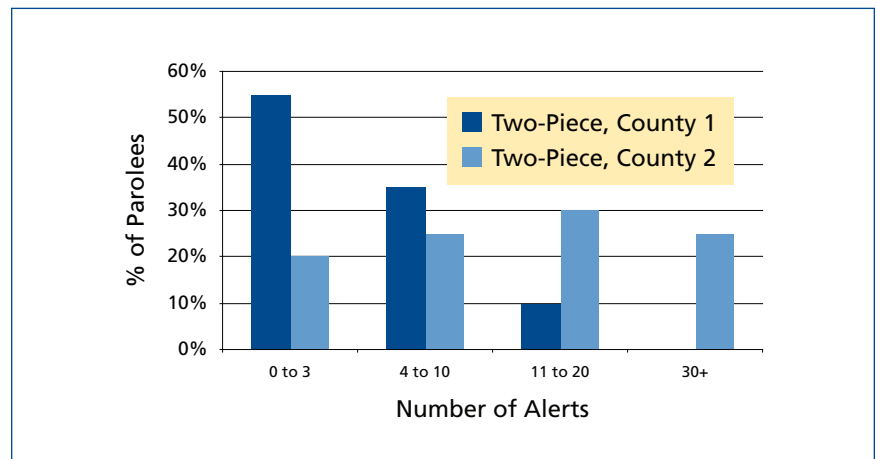
**APPENDIX D: DISTRIBUTION OF GPS ALERTS**

Figures 5 through 7 represent the distribution of alerts among parolees on the four caseloads discussed in this report. Only parolees who had been on one of the caseloads for at least 30 days during the study period were included. There were 20 parolees fitting that description on the two-piece caseloads and the one-piece caseload in County 2. The one-piece caseload in County 1 had 19 parolees who had been on the caseload for at least 30 days. We conducted this analysis for the three alert types that accounted for at least 100 total alerts during the field test period (101 strap tamper alerts, 435 cuff leave alerts, 935 inclusion zone alerts).

**Figure 5: Strap Tamper Alerts Per Parolee During the Field Test**



**Figure 6: Cuff Leave Alerts Per Parolee During the Field Test**



**Figure 7: Inclusion Zone Alerts Per Parolee During the Field Test**

