ASSESSING CELLULAR DATA COVERAGE AT FACILITIES LOCATED THROUGHOUT CALIFORNIA

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ABSTRACT

Mobile computer devices (laptops, tablets, etc.) have been used for data capture by various organizations for many years. An important factor in CalRecycle's assessment of the use of mobile devices for tire facility inspections is whether they could use CalRecycle's existing web-based applications, and this would depend on whether Internet access (e.g., cellular data service) was available at the tire facility location. To assess this, CalRecycle extracted data on 1,698 inspections performed from May through December 2012. GIS analysis of FCC cellular coverage data identified which of the facilities were located outside identified cellular coverage regions, and an additional GIS analysis identified which facilities were located >5 miles from a major highway, a proxy measure for "remote" locations less likely to have cellular data service. A total of 29 sites met these criteria, and assessment of cellular data service at these locations (based on tools from AT&T and Verizon) indicated that Internet access should be available at 85 percent of these remote sites. A similar assessment performed on a random sample of 25 locations selected from the original 1,698 sites indicated that 95 percent of these locations should have Internet access available. Based on these analyses, CalRecycle concludes that Internet access should be available at 85 percent or more of the tire facilities in the state, and that inspectors should therefore generally be able to use mobile devices (e.g., laptops, tablets, etc.) accessing existing web-based applications to perform inspections at these facilities. Where Internet access is not available, inspectors would need to revert to the use of paper forms as they do at present.

PROBLEM/OPPORTUNITY

Mobile computer devices (laptops, tablets, smartphones, etc.) have been used in the field for data capture for many years. Relevant factors in determining whether to use these devices depends on the specific business process and personnel involved, but probably the most important factor has always been cost. Applications that involve relatively frequent and consistent use of a mobile device throughout a workday (package pick-up or drop-off, restaurant inspections, field use by sales representatives, etc.) have often justified the expense of implementing and supporting mobile devices, even years ago when the equipment was relatively expensive. Use of mobile devices also sometimes justified the expense of developing and implementing data capture applications based on a store-and-forward or "synchronization" model. Basically, this means that an application is developed that can be installed on the mobile device so that the mobile device can be used even when an Internet connection is not available. Any data collected on the mobile device is later synched up or forwarded once an Internet connection is available or when the employee returns to the office. While development of these types of applications can be costly, it can be justified if the benefits of the onsite data collection outweigh the application development and maintenance costs. However, in assessments that CalRecycle had previously undertaken regarding the potential use of mobile devices for CalRecycle business functions such as performing landfill inspections, it had always been concluded that the relatively high cost to implement could not be justified.

Two changes have occurred that potentially can increase the use of mobile devices for data capture:

- Laptops, smartphones, and especially tablets have reduced in price to the point that they can be cost justified in many more applications. Plus, the price is low enough that the cost to replace equipment damaged during field use is normally not significant.
- Onsite Internet access is now much more broadly available via cellular wireless data connections (3G and 4G). This means that the same web-based application that is used in an "office setting" for data collection can also be used in the field. While it is acknowledged that there are sometimes advantages in tailoring applications to support mobile devices, it does increase support costs.

Consequently, CalRecycle decided to again assess the potential for use of mobile devices for data collection in the field. The specific business process for which mobile devices are being considered is for site inspections associated with the Waste Tire program. There are currently approximately 15,000–18,000 inspections performed annually, so there is enough volume to justify some expense for the use of mobile devices.

While CalRecycle can readily determine approximate costs for mobile devices, another relevant factor would be Internet access. CalRecycle already has a web-based application for online inspection reporting. So, as discussed above, implementation of mobile devices would be substantially simplified if they were able to use the existing web-based application for data entry, and this can only occur if there is relatively complete coverage of cellular data access at the locations where the inspections would occur. While there would always be the need to allow for "paper-based" capture of inspection data for circumstances when equipment failures occur, the overall success of the use of mobile devices for CalRecycle is dependent on Internet access via cellular data connections.

SOLUTION

The specific problem that CalRecycle sought to address was to determine the likelihood that CalRecycle inspectors in the field would be able receive cellular data service at specific tire facilities. If cellular data access was widespread (e.g., >90 percent), then use of mobile devices with the current online web-based inspection application would likely be effective. Conversely, if coverage was spotty (e.g., <66 percent), then the use of the web-based application may not be effective. While tools are available from cellular vendors to determine whether the provider has cellular service available at a specific address or longitude/latitude, this assessment must be done on a case-by-case basis and obviously would be extremely time-consuming to perform for thousands of sites. Instead, Information Technology Services staff took advantage of Geographic Information Systems to quickly filter site data and arrive at smaller subset for more detailed inspection.

In order to assess whether mobile devices such as tablets or laptops would be able to receive cellular data service at tire facilities, it was proposed that CalRecycle extract facility location information from the existing database and then use geographic information systems (GIS) to look at the point-based locations (tire facilities in this case) overlaid on top of a layer showing cellular coverage, assuming there was cellular data coverage layer(s) available. It turned out that there was a cellular data coverage layer available from the Federal Communications Commission (FCC) website. While this data layer did not distinguish between voice and data coverage, the first step of the analysis was to determine if there were facilities that fell within regions with no coverage. As explained below, among a sample of 1,698 inspection sites, it turned out that there was only one (1) tire facility that was not within an FCC-identified cellular coverage region.

The next step in the analysis was to consider if there was some "proxy" measure based on the data available to us that we could use to identify facilities that were less likely to have cellular data service available. The major carriers

provide cellular coverage along the major highways as this is important for their customers. Hence, a good proxy measure for cellular coverage is proximity of a facility to major highways. While the range of a cellular signal depends on various geographical elements, it would not be unusual for a cellular signal to have a range of 5-10 miles in a rural setting. So, an additional analysis was conducted to determine which of the tire facilities was located more than 5 miles away from a major highway. It turned out that 28 facilities met this criterion. The location of these 28 facilities plus the 1 facility identified above with no cellular coverage were then entered into vendor-supplied cellular coverage assessment tools one-by-one to determine the likely availability of cellular 3G/4G data service at these locations. It was presumed that the percentage of these sites without cellular data service would set a lower bound for the rest of the 1,600+ sites, since these facilities were in the most remote areas. However, to provide some assessment of this, an additional analysis was performed in which a random sample of 25 facilities was selected from the remaining 1,600+ sites and the same process was followed of using the vendor-supplied cellular coverage assessment tools one by one to determine the likely availability of cellular 3G/4G data service at these locations. This provided a reasonable assessment of worst-case and average likelihood of cellular data service available at tire facility locations throughout the state. A more detailed description and the results of the analysis are included below.

DATA COLLECTION

The first step in performing this research was to collect the data to be used in the analysis. The first set of necessary data was a list of all of the relevant tire facilities. For the point-based locations, it is generally necessary to either have previously created GIS point-data or a spreadsheet with locational information in order to display that as GIS data. The locational information can either be in the form of geographical coordinates or addresses, but ultimately the address data must be converted to GIS coordinates such as latitude and longitude in order to perform GIS analyses. For our tire facilities, Roger Evans performed a search query in the Waste Tire Management System Database to select all sites where CalRecycle inspectors (which are only about 20 percent of the total) had performed inspections during the past eight months (i.e., May–December, 2012). The list consisted of 1,698 locations, all located within the state of California. All addresses in the Waste Tire Management System are processed through the Melissa Data Address verification service to ensure address accuracy, format standardization, and accurate GIS coordinates. The selected data was exported into an Excel spreadsheet (see Figure 1) which included Facility/Organization, County, City, Street address, and GIS Coordinates (latitude and longitude).

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	CountyName	City	Address1	ZipCode	FirstName	LastName	Inspection Date	InspectionFormNumber	OrganizationTPID	OrganizationName	Latitude	Longitude	
2	San Bernardino	Baker	56500 Baker Boulevard	92309	Elizabeth	Randolph	5/15/2012	IW-1002262	1651283	Robertson's Ready Mix	35.256659	-116.087208	
3	San Francisco	San Francisco	4298 Mission (at Silver)	94112	Rob	Baumann	9/26/2012	IW-1003096	1325659	Silver & Mission Auto Repair S	37.728946	-122.431269	
4	Sonoma	Santa Rosa	211 #A Crewco Ct	95407	Barbara	Strough	8/9/2012	IW-1002758	1409331	Graton Tractor Inc	38.381448	-122.718723	

Figure 1: A sample of the spreadsheet that Roger Evans produced for use in geographical analysis.

Another important piece of data that was needed for the analysis process was GIS data representing cellular coverage for the state of California. Evan Levy determined that this cellular coverage data layer is available via the Federal Communications Commission (FCC) web site: (http://wireless.fcc.gov/geographic/index.htm?job=licensing_database_extracts). While this data represented cellular coverage in the entire United States, our interest for this analysis is limited to cellular coverage within California (Figure 2).

Figure 2: GIS data showing FCC-provided cellular coverage regions and county borders within California.

ANALYSIS

The first step in analyzing the collected data was to take the spreadsheet that Roger Evans created with the tire facility locations and display them as points in ESRI's ArcGIS program. Steve Barnett accomplished this and then included the FCC cellular coverage data to find points that did not fall in covered regions. Only 1 of the 1,698 inspection sites did not fall within a cellular coverage region (Figure 3). Since we assumed that urban areas were more likely to have cellular coverage, additional GIS analysis yielded that 1,088 of the 1,698 (64%) inspection sites fell outside the 2010 census Urban Areas boundaries. This is not unexpected given that tire facilities are a kind of "light industry" that often requires a reasonable amount of floor space and is probably much more economical to operate in locations outside of urban areas. As discussed above, an additional GIS analysis was conducted to identify facilities that were located more than five miles away from a major highway as this was deemed to be a reasonable proxy measure for locations less likely to have cellular data coverage. Of the 1,698 facilities, it was determined that 28 (1.6%) were not within 5 miles of a major highway (Figure 4). So, overall, we concluded that there were 29 sites located in remote areas less likely to have cellular data coverage–the 28 sites further than 5 miles from a major highway and the one site that fell outside of the FCC-provided cellular coverage areas.

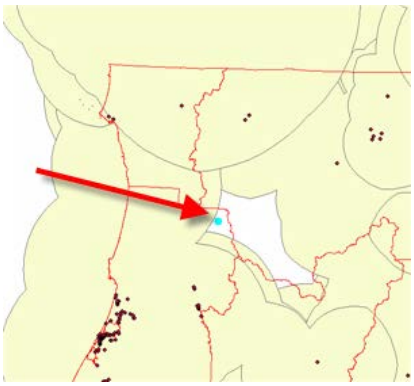

Figure 3: The one site that fell outside FCC-supplied cellular coverage regions.

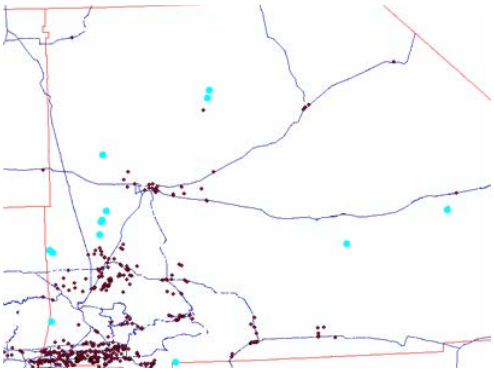

Figure 4: Large blue dots are examples of sites further than 5 miles from a major highway.

Following this initial analysis, Steve Barnett created a web mapping application to show the data he had used for his analysis, providing an interactive method of viewing the data and demonstrating the results of the analysis for program group customers.

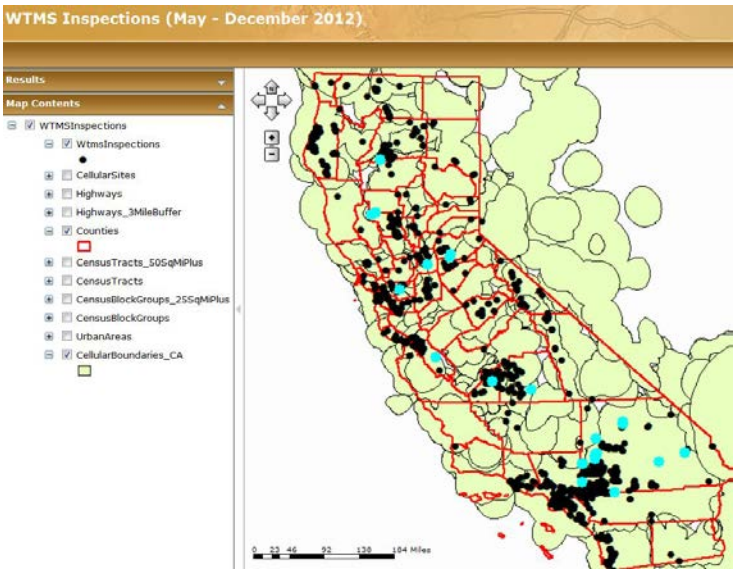

Figure 5: View of the web mapping application Steve Barnett produced showing locations of facilities where inspections had taken place--black dots are sites within 5 miles of a major highway; blue dots are sites further than 5 miles from a major highway.

Since our objective was to assess the expected availability of cellular data services at tire inspection sites located throughout California, we continued our analysis of the available information to determine whether cellular data services were available at the 29 identified "remote" locations. Evan Levy used the address or locational data for the 29 sites that were deemed to be in remote areas and used the coverage locators available through both AT&T's (http://www.wireless.att.com/coverageviewer/#?type=voice) and Verizon's (http://www.verizonwireless.com/wireless-coverage-area-map.shtml) websites to identify the sites that did or did not receive cellular data service. As shown in Figure 6, this assessment indicated that AT&T 3G or 4G cellular data services should be available at 25 of the 29 remote sites (86%), and that Verizon 3G or 4G cellular data services should be available at 24 of the 29 remote sites (83%). So, even for those inspections sites that we anticipate would be the most remote among the 1,698 identified sites, we should expect that cellular data service will be

available at about 85 percent of them. Alternatively stated, if a staff member were assigned to perform inspections at twenty such sites, we should expect that they would have to revert to paper form processing for only three of the twenty sites, which seems pretty reasonable.

	C	D	E	F	G	H	I	J	K	L	M	N	O
1	City	Address1	ZipCode	FirstName	LastName	Inspection	Inspection	Organizatio	OrganizationName	Latitude	Longitude	AT&T	VERIZON
2	Yucaipa	41100 Pine Bench Rd	92399	Elizabeth	Randolph	6/14/2012	IW-100243	1487409	California Department of Forestry	34.034057	-116.907676	Yes	Yes
3	Mt Baldy	3112 Lytle Creek Road	91759	Elizabeth	Randolph	6/13/2012	IW-100243	1536909	Storkson Ranch	34.253934	-117.639423	Yes	Yes
4	Amboy	15750 Sultis Road	92304	Elizabeth	Randolph	6/26/2012	IW-100248	1565913	Tetra Technologies, Inc.	34.586055	-115.861855	Yes	No - Very spotty
5	Adelanto	2121 Erlon St	92301	Frank	Simpson	7/17/2012	IW-100254	1700682	J & R Enviromental	34.59061	-117.621971	Yes	Yes
6	Adelanto	1280 Smith Rd	92301	Frank	Simpson	7/17/2012	IW-100254	1668152	Mary Hsu	34.604507	-117.640762	Yes	Yes
7	Oro Grande	23382 National Trails Hwy	92368	Vance	Tracy	6/26/2012	I1-1157792	1609169	Hi-Grade Materials	34.676255	-117.339464	Yes	Yes
8	Essex	NATIONAL TRAILS HWY 66	92332	Elizabeth	Randolph	6/7/2012	IW-100236	1221812	JUNIOR'S TIRES	34.730567	-115.251429	Yes	Yes - Spotty in areas nearby
9	Helendale	26731 Vista Rd	92342	Elizabeth	Randolph	5/1/2012	IW-100206	1428367	Silver Lakes Golf Cars	34.737278	-117.329269	Yes	Yes
10	Helendale	VACANT LOT BONANZA RD	92342	Elizabeth	Randolph	12/6/2012	IW-100373	1461494	CHOI,TOM SOK-WON	34.744636	-117.322163	Yes	Yes
11	Helendale	27073 National Trails Highway	92342	Elizabeth	Randolph	5/1/2012	IW-100206	1566523	W.A. Murphy	34.745056	-117.321896	Yes	Yes
12	Helendale	16966 Wild Rd	92342	Elizabeth	Randolph	5/1/2012	IW-100206	1476852	Tommy McDaniel Youth Ranch	34.790872	-117.294891	Yes	Yes
13	Hinkley	9200 Harpper Lake Road	92347	Elizabeth	Randolph	6/27/2012	IW-100248	1561193	B.N.S.F RailRoad	35.06881	-117.308549	Yes	Yes - But very spotty nearby
14	Fort Irwin	Building 825	92310	Vance	Tracy	6/5/2012	I1-1169198	1612685	Raytheon Technical Services Company	35.332146	-116.662331	Yes	Yes
15	Fort Irwin	Bldg 896	92310	Vance	Tracy	6/5/2012	IW-100233	1307625	Department Of Army	35.37074	-116.652458	Yes	Yes
16	Fort Irwin	Bldg. 934	92310	Vance	Tracy	6/5/2012	IW-100233	1370829	U.S. Army Central Receiving Ft. Irwin	35.37074	-116.652458	Yes	Yes
17	Fort Irwin	Bldg. 934	92310	Vance	Tracy	6/5/2012	IW-100233	1370829	U.S. Army Central Receiving Ft. Irwin	35.37074	-116.652458	Yes	Yes
18	Fort Irwin	PO Box 10585	92310	Vance	Tracy	6/5/2012	IW-100233	1370829	U.S. Army Central Receiving Ft. Irwin	35.37074	-116.652458	Yes	Yes
19	Fort Irwin	PO Box 10585	92310	Vance	Tracy	6/5/2012	IW-100233	1370829	U.S. Army Central Receiving Ft. Irwin	35.37074	-116.652458	Yes	Yes
20	Porterville	340 N Reservation Rd	93257	Barbara	Strough	5/24/2012	IW-100225	1329658	Tule River Tribal Council	36.029913	-118.788328	No	No
21	Hanford	19258 14th Ave	93230	Peder	Kryski	8/9/2012	I1-1218396	1363139	Tri-C Inc. Waste Tire Site	36.197517	-119.70869	Yes	Yes
22	Paicines	20111 Panoche Rd	95043	Nancy	Fallan	6/13/2012	IW-100242	1610259	Bill Hunter	36.646804	-121.030475	No	No
23	Clayton	Lat:37.86368 Long: -121.94180	94517	Don	Van Dyke	6/6/2012	IW-100234	1624844	Turtle Rock Ranch Dump Clean Up (2136 Proje	37.93186	-121.922409	Yes	No
24	Wilton	Salvage Yard	95693	Barbara	Strough	8/16/2012	IW-100282	1371911	Lake Providence Salvage	38.41077	-121.270899	Yes	Yes
25	Mount Aukum	8080 Mount Aukum Road	95656	Mary	LeClaire	5/15/2012	I1-1223489	1287203	Mt. Aukum Tire	38.558652	-120.72594	Yes	Yes
26	Somerset	6860 Mount Aukum Rd	95684	Mary	LeClaire	5/15/2012	I1-1223490	1445348	Pioneer Union School District	38.606052	-120.713799	Yes	Yes
27	Stonyford	Lodoga/Stonyford Rd; 1 Mi S Stonyfor	95979	Alex	Souza	6/6/2012	I1-1210756	1101553	Stonyford Disposal Site	39.346803	-122.662777	No	No - Very spotty
28	Stonyford	401 2nd Street	95979	Alex	Souza	6/6/2012	I1-1210757	1632865	Michael Roeduck	39.375522	-122.547668	Yes	Yes
29	Cottonwood	15631 Gas Point Rd	96022	Don	Van Dyke	6/26/2012	I1-1169918	1700845	Mike Hartgrave	40.385792	-122.478256	Yes	Yes
30	Orleans	1241 Evergreen Rd	95556	Alex	Souza	10/25/2012	I1-1191327	1397575	Evergreen Tire	41.323687	-123.532338	No	No

Figure 6: The 29 remote sites, indicating whether AT&T and Verizon cellular data service is available.

Since 85 percent is a fairly high percentage of cellular data service availability for remote sites, we needed to verify that the availability of cellular data service was at least as good in less remote locations, which we expect should be the case. To assess this, Evan Levy took the list of all 1,698 sites and selected a random sample of 25 sites. In order to get a *random* sample of the sites, Evan performed the following steps: (1) create a new column "X" in the Excel sheet containing all 1,698 sites; (2) in the first cell underneath the heading row of "X", enter the formula "=RANDBETWEEN(1,10000)" and press Enter; (3) select the first cell in that column and then position to the last cell in the column (e.g., row 1,699) and then holding down the shift key press the left mouse button to select all the cells; (4) enter Ctrl-D to copy the formula "down" from the first cell to all the other selected cells; (5) then, because the random value will unnecessarily be recalculated every time it is processed by Excel, create another new column "Y" and copy and "Paste … Values" the contents of the "X" column into the "Y" column; (6) delete column "X"; (7) then sort the contents of the Excel worksheet based on column "Y". The first 25 locations listed represent a random sample of 25 sites. These sites were then entered into the coverage location tools from AT&T and Verizon, as was done in the previous analysis. The results of this analysis are shown in Figure 7.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	CountyName	City	Address1	ZipCode	FirstName	LastName	Inspection Date	InspectionFormNumber	OrganizationTPID	OrganizationName	Latitude	Longitude	AT&T	Verizon
2	San Bernardino	Big Bear Lake	41390 Big Bear Boulevard	92315	Frank	Simpson	5/15/2012	IW-1002188	1006867	Stock's Automotive (Hauler)	34.243655	-116.899250	Yes - 2G areas nearby though	Yes
3	Shasta	Bella Vista	26258 State Highway 299	96008	Don	Van Dyke	6/27/2012	I1-1169915	1451784	Ingot Auto Dismantlers	40.726784	-122.079292	No - 3G nearby but not at location	Yes
4	San Francisco	San Francisco	730 Ellis St	94109	Rob	Baumann	6/20/2012	I1-1148025	1444459	KSH Automotive	37.784428	-122.418419	Yes	Yes
5	San Bernardino	Bloomington	11411 Cedar Ave	92316	Frank	Simpson	6/18/2012	IW-1002444	1441667	Quality Tire Shop	34.046329	-117.396004	Yes	Yes
6	San Bernardino	San Bernardino	1954 W Highland Ave	92407	Harley	Thompson	5/4/2012	I1-1168921	1703028	Highland Tires, Inc.	34.136608	-117.333580	Yes	Yes
7	San Bernardino	Colton	445 S La Cadena Dr	92324	Vance	Tracy	10/16/2012	IW-1003165	1339801	ADAMS AUTO SERVICE	34.060655	-117.325961	Yes	Yes
8	San Diego	National City	2700 National City Blvd	91950	Steve	Dolan	5/9/2012	I1-1157595	1023025	MOSSY DATSUN INC	32.659042	-117.101128	Yes	Yes
9	Kings	Hanford	430 E 4th St	93230	Peder	Kryski	8/9/2012	I1-1218420	1058005	Hanford Alignment Service Inc.	36.324584	-119.639635	Yes	Yes
10	Alameda	Hayward	21980 Meekland Ave	94541	Mary	LeClaire	7/31/2012	IW-1002647	1577298	ER Tires Road Assistance	37.671123	-122.103507	Yes	Yes
11	San Bernardino	Yucaipa	34996 Yucaipa Blvd	92399	Vance	Tracy	6/19/2012	I1-1157799	1646559	Koritas Tires	34.034203	-117.041237	Yes	Yes
12	Ventura	Ventura	1084 E Thompson Blvd Unit	93001	Steve	Dolan	8/29/2012	I1-1157533	1306092	Neighborhood Car Care, Inc.	34.277376	-119.284375	Yes - 2G areas nearby though	Yes
13	San Bernardino	Hesperia	15888 Walnut St	92345	Harley	Thompson	9/6/2012	I1-1169053	1466328	Avit Khoury	34.422777	-117.316243	Yes	Yes
14	Riverside	North Palm Spring	6545 North Indian Cry	92258	Vance	Tracy	5/9/2012	IW-1002157	1335422	Bud's Tire	33.901437	-116.545564	Yes - 2G areas nearby though	Yes
15	Sonoma	Santa Rosa	211 #A Crevco Ct.	95407	Barbara	Strough	8/9/2012	IW-1002758	1409331	Graton Tractor Inc.	38.381448	-122.718723	Yes	Yes
16	Kern	Buttonwillow	7408 Brandt Rd	93206	Vance	Tracy	11/5/2012	IW-1003378	1528927	Brandt Road Waste Tire Site	35.428547	-119.373901	Yes	Yes
17	San Bernardino	Fontana	14212 Santa Ana Ave	92337	Vance	Tracy	10/15/2012	I1-1157150	1001094	B J Used Tire & Rubber Recycling, In	34.056549	-117.495209	Yes	Yes
18	San Bernardino	Phelan	9235 Middleton Rd	92371	Elizabeth	Randolph	5/28/2012	IW-1002305	1586828	McNamara Group	34.417927	-117.494057	Yes	Yes
19	Alameda	Oakland	4500 International Blvd	94601	Mary	LeClaire	7/17/2012	IW-1002537	1287189	Honda Kawasaki of Oakland	37.771564	-122.212502	Yes	Yes
20	San Bernardino	Barstow	660 W Main St	92311	Vance	Tracy	12/11/2012	IW-1003875	1374475	Cummins Enterprises Inc.	34.897156	-117.034294	Yes	Yes
21	Tulare	Terra Bella	26147 Avenue 96	93270	John	Duke	6/26/2012	I1-1163272	1312358	Shannon Brothers Cattle	35.963284	-118.985870	Yes	Yes
22	San Diego	Santee	10541 Prospect Ave	92071	Harley	Thompson	6/19/2012	I1-1212299	1520068	One Stop Tire	32.830807	-116.968002	Yes	Yes
23	Los Angeles	Gardena	1726 W 139th St	90249	Steve	Dolan	5/8/2012	I1-1157596	1706913	Grand Enterprise	33.905505	-118.308013	Yes	Yes
24	Humboldt	Arcata	2400 Baldwin St	95521	Mary	LeClaire	7/26/2012	I1-1148356	1686884	Arcata School District	40.883055	-124.086035	Yes	Yes
25	San Bernardino	Fontana	14080 Valley Blvd	92335	Vance	Tracy	6/12/2012	I1-1169156	1692099	Thermal King	34.070220	-117.497830	Yes	Yes
26	Alameda	Oakland	3093 Broadway	94611	Mary	LeClaire	7/19/2012	IW-1002591	1527809	Bay Bridge Auto Center	37.820410	-122.261336	Yes	Yes

Figure 7: The 25 random sites including if AT&T and Verizon provide cellular data service.

Based on this analysis of 25 randomly selected inspection sites from throughout California, this assessment indicated that AT&T 3G or 4G cellular data services should be available at 24 of the 25 sites (96%) sites, and that Verizon 3G or 4G cellular data services should be available at all 25 of the sites (100%).

RESULTS

This method of analysis has illustrated that it is highly likely that cellular data coverage would be available at 95 percent or more of the tire inspection sites in the state. And, even for the most remote sites, cellular data services are expected to be available at about 85 percent. As a result of our analysis, we have concluded that cellular data service should be available at most sites and that therefore there would likely **not** be a requirement to develop a separate "mobile" application to facilitate use of mobile computer devices (e.g., laptops, tablets, etc.) by CalRecycle staff or local agency staff performing inspections or similar activities on behalf of CalRecycle.

This assessment also demonstrated a very effective use of GIS analysis to quickly filter data and provide a meaningful analysis very rapidly and for very low cost. When trying to assess whether the use of mobile devices in specific locations is a viable option, this methodology allowed a reliable preliminary conclusion to be reached. The next step in determining whether cellular data service is actually available at these sites will be to initiate a mobile device testing program in the field to find out if the preliminary analysis matches reality. This testing will be initiated shortly and should be completed within the next six months.