Analytical Report for the

Illinois Automotive ERP

12/7/09 Draft

Prepared for Illinois EPA by:

Brent Ranalli and Richard Krop, The Cadmus Group, Inc.

With assistance from:
Michael Crow, environmental consultant
A. Richard Bolstein, statistician

The Environmental Results Program (ERP) is an innovative set of tools that States can use to regulate large communities of small business, such as dry cleaners, printers, and automotive facilities, without sending inspectors to every facility. ERP generally involves compliance assistance, facility self-assessment, verification activities at a subset of facilities, and statistical analysis.[1] This report presents an analysis of findings from the automotive ERP implemented by Illinois Environmental Protection Agency (Illinois EPA) between 2005 and 2009 with funding from the United States Environmental Protection Agency's (USEPA) State Innovation Grant (SIG) program. The analysis was performed and the report was prepared by The Cadmus Group, Inc. and allied experts (the Cadmus team) under contract with Illinois EPA. The focus of this automotive ERP was to identify motor vehicles waste disposal wells (MVWDW) for closure or permitting.

The report is divided into four parts.

- Part I provides background on the design and implementation of the project, including the compilation of a prospective universe of automotive facilities in the target area, voluntary self-certification, and follow-up verification activities such as phone calls and site visits.

- Part II presents the core project analysis: the estimation of the actual number of automotive facilities in the project's target area, and the estimation of the number of those facilities that have illegal injection wells.

- Part III presents several measures of the efficacy of the project, including: the self-certification response rate among automotive facilities, the rate of self-disclosure of illegal wells, the results of targeted follow-up activities, and the accuracy of self-reporting.

- Part IV evaluates the public health and environmental outcome of the project and attempts to quantify project benefits

Part I: Design and Implementation of the Automotive ERP

A. Project design

The State of Illinois designed the automotive ERP to identify MVWDWs for closure or permitting. Though closure or permitting of MVWDWs is mandatory (per the Class V injection well regulation promulgated in 64 FR 68546, December 7, 1999), self-certification was voluntary. The ERP was designed with one round of site visits by inspectors, following self-certification, rather than the "before-and-after" approach that many ERPs employ. In this case, the two primary measurement goals of site visits were to identify illegal MVWDWs and to verify the accuracy of self-certification. Baseline

[1] For background on ERP, see: USEPA. 2007. *ERP States Produce Results: States' Experience Implementing the Environmental Results Program.* National Center for Environmental Innovation. December. EPA 100-R-07-009.

measurement was not necessary for either of these core measurement goals, so site-visit resources were focused on post-certification site visits, to improve precision.

Commercial facilities that perform automotive work were targeted in two counties, Madison and Grundy. Automotive work was defined broadly to involve any activity that could result in the release of automotive fluids, including auto repair, oil changing, and maintenance of a fleet of vehicles. Although this pilot project was limited in scope to commercial facilities, it should be understood that MVWDWs may be present anywhere automotive fluids are used around septic systems, dry wells, or other Class V injection wells, including at non-commercial locations such as municipal facilities and private residences.

B. Defining the prospective universe

With assistance from the Cadmus team (under a prior contract), Illinois used three databases to develop a prospective universe of automotive facilities. The three databases were consulted on or around June 14, 2007. InfoUSA yielded 443 business entities in the target counties, Illinois' Bureau of Land (BOL) Inventory System yielded 379 entities, and the Bureau of Air (BOA) Motor Vehicle Registration database yielded 91 entities. Duplicates were consolidated and entities that clearly were not related to automotive work were removed, as described in the project's Universe Identification Protocol documentation. The result was an initial prospective universe of 675 entities that were known or suspected to engage in automotive work in the two counties. (The size of the prospective universe was later reduced to 674 for analytical purposes, as one facility was found, during a site visit, to be located outside the two targeted counties. The facility was near the county line and the State believes this is the only facility that falls outside the study area.)

Each entity in the prospective universe was assigned a unique Facility ID.

C. Facility self-certification

On approximately June 23, 2008, Illinois EPA mailed self-certification packets to the 675 facilities in the prospective universe. The packets included a cover letter, a self-certification form, and a Q&A document. The self-certification form included a component to allow entities to declare themselves as non-automotive facilities, and thereby exempt from MVWDW requirements. Facilities that engage in automotive work were asked to determine the destination of each floor and sink drain in work areas, and to declare any MVWDWs present. The Q&A document included instructions on closure and permitting requirements for MVWDWs, and indicated that Illinois EPA would work cooperatively with facility owners/operators who act in good faith to bring their facilities into compliance.

A total of 149 self-certification forms were completed and returned to Illinois EPA over the following months. An additional 70 were returned by the Post Office as undeliverable. Because the forms were addressed to specific named businesses, it was

not clear whether forms were returned because there was no automotive facility at that address, or because the facility was under different ownership (i.e. had a different business name). Therefore, these 70 facilities were not discarded from the universe of prospective automotive facilities.

Based on self-certification responses, the 675 entities in the initial prospective universe were divided into five categories:

- Category 1: No response (including packets returned by the Post Office as undeliverable)
- Category 2: Self-certified as non-automotive and not subject to MVWDW requirements
- Category 3: Self-certified as automotive, with one or more MVWDW
- Category 4: Self-certified as automotive, with no MVWDW
- Category 5: Self-certified as automotive, with ambiguous response about MVWDW status

The number of facilities in each category is presented in Table 1, below.

D. Verification: phone calls and site visits

A limited number of follow-up phone calls and site visits were made to verify responses, as summarized below and described in greater detail in the project's Sampling Plan. Phone calls were considered sufficient in most cases to determine a facility's automotive status, while a determination of MVWDW status required a site visit. Verification activity was conducted by Illinois EPA primarily in March and April, 2009. Data entry was completed in September, 2009.

Verification activity was conducted for a random sample of nonrespondents (category 1). Illinois EPA called facilities on the phone in a pre-determined random order in order to determine their automotive status. If the phone call indicated that a facility was an automotive facility, or if a phone call was insufficient to determine automotive status, a site visit was performed. The process continued until a fixed number of site visits had been performed. (In practice, there were many instances in which a phone number was no longer in service. Rather than scheduling a site visit to a possibly nonexistent business, Illinois EPA made a policy of skipping to the next entity on the list in such cases.)

Among respondents that self-declared as non-automotive (category 2), verification activity was conducted at every entity. Phone calls were made to confirm non-automotive status. Follow-up site visits were performed in two cases where phone calls revealed that facilities performed automotive work, and in two other cases where phone contact could not be made.

The four facilities that self-declared as having one or more MVWDW (category 3) were referred to the BOL for appropriate administrative action. Positive confirmation that the facilities self-certified correctly had not yet been received from BOL at the time of

analysis. Illinois EPA assumed, for analytical purposes, that these facilities had certified correctly.

Site visits were made at a random sample of facilities that self-declared as automotive but having no MVWDW (category 4).

All seven facilities that certified ambiguously about MVWDW status (category 5) received site visits.

Verification activity for the five categories is summarized in Table 1.

Table 1: A summary of the five categories and verification activity undertaken

Category	Description	Number of facilities	Proportion of total facilities in prospective universe	Follow-up verification activity
1. Non-respondents	No completed self-certification form received by Illinois EPA	526 (525 for analytical purposes*)	77.9%	Phone call to a random sample of 98 facilities (97 for analytical purposes*), follow-up site visit to a subset of 28 (27 for analytical purposes*)
2. Self-certified as "not applicable"	Facility certified that it is not automotive	47	7.0%	Phone call to all 47 facilities; follow-up site visit to a subset of 4 (census)
3. Self-certified as having a well	Facility certified that it is automotive, and acknowledged having at least one MVWDW	4	0.6%	All 4 facilities referred to appropriate office for administrative action; assumed in meantime to have self-certified correctly
4. Self-certified as not having a well	Facility certified that it is automotive, and denied having a MVWDW	91	13.5%	Site visit to a random sample of 22 facilities
5. Self-certified, with ambiguity	Self-certification response ambiguous; not clear whether facility has a MVWDW	7	1.0%	Site visit to all 7 facilities (census)
Total	--	675 (674 for analytical purposes*)	100%	--

* One facility was removed from the sampling frame when a site visit revealed that it was located outside the target counties.

Part II: Core Project Analysis

Based on the results of the verification activity performed by Illinois EPA, the Cadmus team estimated the number of automotive facilities in the prospective universe, and the number of automotive facilities with one or more MVWDW.

A. Estimating the number of automotive facilities

The first question to be answered was: **How many entities in the prospective universe are actually facilities that perform automotive work?** The analysis for automotive status is presented in Table 2. The percentage of facilities that are automotive repair facilities is shown, along with 90-percent binomial exact confidence intervals in instances where they can be calculated.[2] The final column of Table 2 shows the estimated count of facilities in each category that are automotive repair facilities, and 90-percent confidence intervals of estimates assuming normal distribution.

Note that the *confidence intervals* for the percentage of facilities that are automotive facilities (in the "percentage automotive" column) and the count of automotive facilities (in the "number of automotive facilities in population" column) are similar but not identical. For example, the lower bound of the percentage of non-respondents that are automotive facilities is 46.1%, while the lower bound of the count of systems is 249, which is 47.4%. The confidence intervals for the proportion and the counts were estimated separately, using methodologies that make different assumptions about the underlying distribution and therefore produce different results. Where *point estimates* diverge, rounding is responsible: for example, the percentage of non-respondents that are automotive is actually 57.627%, yielding an estimate of 302.54 automotive facilities. These values were rounded to 57.6% and 303, respectively.

[2] Clopper, C.J., and S. E. Pearson. 1934, "The Use of Confidence or Fiducial Limits in the Case of the Binomial," *Biometrika* 26: 404-413.

Table 2: Estimation of the number of automotive facilities in the study area

Category	Size of population (prospective universe)	Size of sample	Automotive?			Percentage automotive	Number of automotive facilities in population
			Yes	No	Unknown		
1. Non-respondents	525	97	34	25	38	57.6% (46.1 - 68.6%)	303 (249 - 356)
2. Self-certified as "not applicable"	47	47	3	44	0	6.4%	3
3. Self-certified as having a well	4	4	4	0	0	100%	4
4. Self-certified as not having a well	91	22	20	2	0	90.9% (74.1 - 98.4%)	83 (75 - 91)
5. Self-certified, with ambiguity	7	7	7	0	0	100%	7
Total / All Categories	674	177	68	72	38	59.3%	400 (345 - 453)

Thus, an estimated 400 of the 674 entities in the prospective universe (59.3%) are automotive facilities. We can be 90% certain that the actual number of automotive facilities falls between 345 and 453.

Note that Illinois EPA was unable during the verification stage to determine the automotive status of 38 of the non-respondents selected for the random sample in category 1. It appears that most or all of these 38 cases were instances where Illinois EPA chose to skip over an entity with a disconnected phone number rather than possibly waste one of the few allotted site visits on a non-existent facility. The calculations above excluded these 38 facilities from the analysis, implicitly assuming that they were no more or less likely to be automotive facilities than the other facilities in the category 1 sample. If all 38 facilities were assumed to be non-automotive, the estimated total number of automotive facilities would drop from 400 to 281. On the other hand, if all 38 facilities were assumed to be automotive, the estimated total number of automotive facilities would rise from 400 to 486.

As noted above, 70 of the 675 self-certification forms mailed by Illinois EPA were returned by the Post Office as undeliverable and retained in category 1. Twelve of the 70 were included in the random sample. Of those, Illinois EPA was able to determine that one was a business of a non-automotive nature. The other 11 were among the 38 facilities discussed above whose automotive status was not determined.

In future ERPs of this nature, steps could perhaps be taken (e.g., addressing self-certification forms to "[business name] *or current occupant*") that would enable the Agency to eliminate facilities from the universe when self-certification forms are

returned by the Post Office. Eliminating non-automotive facilities from the universe at that stage could increase the likelihood that site visits are not wasted on non-existent facilities and would also make subsequent calculations more precise.

B. Estimating the number of automotive facilities with MVWDWs

The next question to be answered was: **How many automotive facilities have one or more MVWDW?** Four facilities self-certified that they have one or more MVWDWs (category 3). Four other facilities were identified as having one or more MVWDWs during site visits. The following table shows the MVWDW analysis by facility category.

Table 3: Estimation of the number of automotive facilities in the study area that have one or more MVWDWs.

Category	Size of population (automotive facilities)	Size of sample	One or more MVWDW?			Percentage of automotive facilities with one or more MVWDWs	Number of automotive facilities with one or more MVWDWs in population
			Yes	No	Unknown		
1. Non-respondents	303 (est.)	34	2	21	11	8.7% (1.6 – 24.9%)	26 (2 – 56)
2. Self-certified as "not applicable"	3	3	0	1	2	0.0%	0
3. Self-certified as having a well	4	4	4	0	0	100.0%	4
4. Self-certified as not having a well	83 (est.)	20	2	17	1	10.5% (1.9 – 29.6%)	9 (2 – 18)
5. Self-certified, with ambiguity	7	7	0	6	1	0.0%	0
Total / All Categories	400 (est.)	68	8	45	15	9.8%	39 (8 – 70)

Thus, an estimated 39 facilities have MVWDWs. That is 9.8% of the estimated number of automotive facilities (400), and 5.8% of the population of the prospective universe (674).

Illinois EPA was unable to confirm the MVWDW status of some automotive facilities. In some cases, it was not possible to confirm or rule out the presence of a MVWDW based on a visual inspection and available documentation. In other cases, buildings were unoccupied (in transition to new ownership, or simply vacant) at the time of the site visit. In still other cases, facilities that Illinois EPA originally categorized as non-automotive

and did not investigate for MVWDWs at the time of the site visit (e.g., oil change and towing businesses) were later re-categorized as automotive in consultation with the Cadmus team. For the purposes of the calculations above, it was assumed that the 15 facilities with unknown MVWDW status were substantially similar to other facilities in their respective samples and they were therefore excluded from the analysis. If we assume that all 15 facilities do not have any wells, then the estimated number of automotive repair facilities with wells would fall from 39 to 30. On the other hand, if we assume that all 15 of these facilities have wells, the estimated number of facilities with wells would increase to 135.

Part III: Project Efficacy Analysis

In consultation with the Cadmus team, Illinois EPA selected several measures of project efficacy to investigate. The results of those analyses are presented below.

A. FACILITY RESPONSE RATE: Percentage of the estimated total number of automotive facilities that returned the self-certification form.

The facility response rate gives an idea of the willingness of facilities in the target industry to participate in an ERP-type project. It can also reflect on the ease-of-use of the certification packet and instructions, and the adequacy of the incentives (positive and negative) that the agency provides for participation.

In the project's Quality Assurance Project Plan (QAPP), Illinois EPA set a goal of a 50% facility response rate.

According to the statistical extrapolations performed in Table 2, the number of automotive facilities that responded to the request for self-certification (categories 2-5) was approximately 97, out of an estimated total automotive population of 400. **This yields an estimated facility response rate of approximately 24% among automotive facilities.** (For comparison, the estimated response rate among non-automotive facilities was 19%, or 52 out of 274.)

A USEPA evaluation of three earlier voluntary-certification ERPs, all involving automotive facilities, reported certification rates of 42%, 47%, and 68%.[3] Those higher participation rates may reflect the fact that the ERPs were more elaborate, with more opportunities for facilities to learn about and become invested in the program (e.g., baseline site visits before certification and compliance assistance workshops).

[3] United States Environmental Protection Agency (USEPA). 2009. *Evaluation of Three Environmental Results Programs (ERPs): Final Report*. August. Chapter 2, Part III.

B. NON-COMPLIANCE SELF-DISCLOSURE RATE: Percentage of all facilities estimated to have one or more MVWDWs that self-disclosed a well.

The rate of self-disclosure provides an indication of how candid facilities in the target population are about admitting violations, and thus the extent to which self-certification data may need to be verified. It may also reflect on the clarity of the self-certification materials and the effectiveness of incentives offered and threats made by the agency to encourage self-reporting.

In the project's QAPP, Illinois EPA set a goal of identification of 50% of illegal wells through self-certification.

Four facilities voluntarily disclosed having one or more MVWDWs. The project analysis concluded that a total of approximately 39 facilities in the two target counties have MVWDWs. **Dividing 4 into 39 gives an estimated self-disclosure rate of 10%.**

C. TARGETED FOLLOW-UP YIELD: Percentage of facilities receiving targeted follow-up that had serious compliance issues.

Following ERP self-certification, an agency must strike a balance between "targeted" and "random" follow-up: that is, spending follow-up resources at facilities that stand out for one reason or another and seem to require special attention means taking away resources that could be used to implement a more robust random sample of facilities. Reviewing the results of targeted follow-up can give an idea of the return on investment for targeted follow-up, and the appropriateness of the balance struck.

In this project, two groups of site visits could be considered "targeted." (1) Seven facilities self-certified in a manner that was ambiguous about MVWDW status. These facilities were placed in category 5, and Illinois EPA judged that all seven should receive site visits. (2) Illinois EPA was able to confirm by phone that nearly all the facilities that certified as non-automotive (category 2) were indeed non-automotive. However, two facilities appeared to be automotive after all, and another two could not be reached by phone. Illinois EPA judged that those four facilities should receive site visits.

None of the 11 facilities targeted for site visits were found to have MVWDWs or any other serious compliance issue. In the case of the category 5 facilities at least, this limited experience suggests that filling out the form incorrectly or ambiguously is not necessarily an indication that a facility is hiding wrongdoing. Although the targeting of the 11 facilities did not reveal any serious compliance issues and used resources that might otherwise have gone to expand the random samples in other categories, the fact that the 11 site visits were all part of censuses means that they were not "wasted" from the point of view of statistical analysis. (If a targeted site visit is not part of a census, it may need to be disregarded in the final project analysis so as not to introduce bias into a random sample.)

D. CRITICAL INACCURACY RATE: Percentage of MVWDW declarations that were inaccurate in the "wrong" direction.

Programs like ERP that utilize self-reporting must be vigilant about the possibility of self-certification inaccuracy, whether due to oversight, misunderstanding, or dishonesty. It is instructive to look at the percentage of self-certifiers who falsely or incorrectly certified as having no MVWDW.

Of the 20 facilities that positively self-certified as not having a MVWDW (category 4), site visits confirmed that declaration in 17 cases and contradicted it in 2 cases. In the final case, Illinois EPA staff conducted a site visit but were not able to make a determination of MVWDW status. **Dividing 2 into (2+17) yields a critical inaccuracy rate of 10.5%.** If the inconclusive case is assumed to have certified accurately/honestly, the critical inaccuracy rate falls to 2/20 or 10.0%; if it is assumed to have certified inaccurately or dishonestly, the critical inaccuracy rate rises to 3/19 or 15.7%.

Failure to return a self-certification form (category 1) or certification of non-applicability (category 2) could be considered a tacit or implicit assertion that a facility has no MVWDW. Among visited category 1 and category 2 facilities, that assertion was false in 8.7% and 0% of cases, respectively. Combining the results from categories 1, 2, and 4 (extrapolated to the population level to make them comparable) yields an alternate critical inaccuracy rate of (26+0+9)/(303+3+83), or 9.0%.

A 2007 report by USEPA states that the rate of agreement between self-certification results and inspection findings was 86% in one mandatory-certification ERP and 74% in another.[4] That translates to inaccuracy rates of 14% and 26%. The accuracy of MVWDW self-reporting in the Illinois automotive ERP compares favorably to those examples, though one should be cautious about drawing conclusions from the comparison (e.g., on account of potentially significant differences in the types of questions asked and general differences between mandatory-certification and voluntary-certification ERPs).

Part IV: Environmental Outcome / Benefits Analysis

The Cadmus team was asked to evaluate the benefits of the project in terms of environmental and/or public health outcome in accordance with the Draft Outcome Methodology prepared by the Cadmus team in 2005.

Eight MVWDWs were identified for closure and/or permitting as a result of the project: four during self-certification, and four during site visits. The fact that there will be no future discharges of harmful chemicals into the subsurface from these eight injection wells is the starting point of the benefits analysis.

[4] USEPA. 2007. *ERP States Produce Results: States' Experience Implementing the Environmental Results Program.* National Center for Environmental Innovation. December. EPA 100-R-07-009. Page 8.

It is possible to discuss project benefits in relative or comparative terms: The eight wells identified during the project represent 21% of the 39 wells estimated to be present in the two counties. Assuming that the eight wells discovered are representative of the larger population of wells in terms of the types and volumes of fluids discharged, we can conclude that the annual quantity of fluids discharged to the subsurface by illegal MVWDWs at automotive facilities in the two counties will decrease by approximately 21% as a result of the project.

In addition to the comparative measure, it would be desirable to have an absolute measure of environmental or public health benefit. One strategy to obtain an absolute measure might be to base the analysis on the properties of particular automotive fluids (e.g., environmental fate and transport, and toxicity). However, as discussed in the Draft Outcome Methodology, this approach is deemed not feasible. There is too much uncertainty and variability on a site-to-site basis regarding the types of chemicals present, the likelihood of discharge, and the quantities discharged.

An alternative approach, described in the Draft Outcome Methodology, is to quantify the population whose public drinking water quality will likely be improved by eliminating one or more MVWDWs as a pollution source. In the project QAPP, Illinois EPA established a goal that at least 50% of the population served by drinking water from the two counties would have possible improvements in water quality as a result of the project. The Cadmus team has carried out that analysis, as described below. **The analysis suggests that the closure/permitting of the eight MVWDWs discovered in this project may not result in any definitive net benefit to drinking water quality, because none of the wells are located in designated source water protection areas.** In the two counties under study, source water protection areas cover a relatively small fraction of total area.

If Illinois EPA wishes to pursue alternative outcome methodologies, there may be several ways in which this type of geographic analysis could be expanded or varied using superior data or modeling. Part IV ends with a discussion of possible variations to the methodology.

A. Methods

The Cadmus team mapped the location of the eight facilities with MVWDWs identified during the project, and also mapped source water protection areas in the two target counties.

The eight facilities with MVWDWs were mapped in ArcView using latitude and longitude data (see Table 4). For facilities that received site visits, latitude and longitude were obtained by Illinois EPA staff using a Global Positioning System (GPS) device. In other cases, latitude and longitude were determined using Google Earth Imagery. (The Google Earth method was used to confirm the GPS measurements as well, and the two methods were found to give consistent results.) The resulting coordinates were used to create points in ArcView. The points were re-projected to match the Lambert Conformal

Conic projection used by Illinois Source Water Assessment Program (SWAP) in their mapping applications.

It should be noted that the latitude and longitude used in the analysis describe the location of the main entrance of the facility, not necessarily the actual location of the MVWDW. Given the relatively small size of automotive facilities compared to the distance between facilities and protected areas (discussed below), the precise location of the spatial coordinates on the facility property appears to have had no impact on the outcome of the analysis.

Table 4: The eight facilities identified as having MVWDWs, with spatial coordinates

Facility ID	County	Latitude	Longitude	Source of Data
IL000006	Madison	38.730700	-89.957100	Google Earth
IL000144	Madison	38.793990	-89.950890	Global Positioning System
IL000173	Madison	38.692700	-89.969800	Google Earth
IL000195	Grundy	41.177700	-88.322200	Google Earth
IL000234	Madison	38.889800	-90.059800	Google Earth
IL000343	Madison	38.768290	-89.801270	Global Positioning System
IL000405	Madison	38.72702	-90.070560	Global Positioning System
IL000640	Madison	38.85699	-89.852630	Global Positioning System

Source water protection areas were mapped using ArcView data obtained from Illinois EPA Bureau of Water via the Agency's SWAP website.[5] Mapped source water protection areas included:

- Community Water System (CWS) Phase 1 Wellhead Protection Areas
- CWS Phase 2 Wellhead Protection Areas
- Non-CWS Phase I Wellhead Protection Area
- Public Water System (PWS) Lakes
- PWS Watersheds
- Zone 1 Source Water Protection Areas for CWS River Intakes

The "protected area" polygon data and the "facilities" point data were overlaid using ArcView to determine the proximity of the facilities to the protected areas and to identify any facilities located within protected areas.

B. Results

Figure 1 presents the protected areas and seven facilities located in Madison County, and Figure 2 presents the protected areas and one facility located in Grundy County. As the maps demonstrate, none of the eight facilities falls within a protected area. Thus, no population of drinking water customers is shown by this analysis to have a direct improvement in drinking water quality as a result of the project.

[5] http://www.epa.state.il.us/water/groundwater/source-water-assessment/

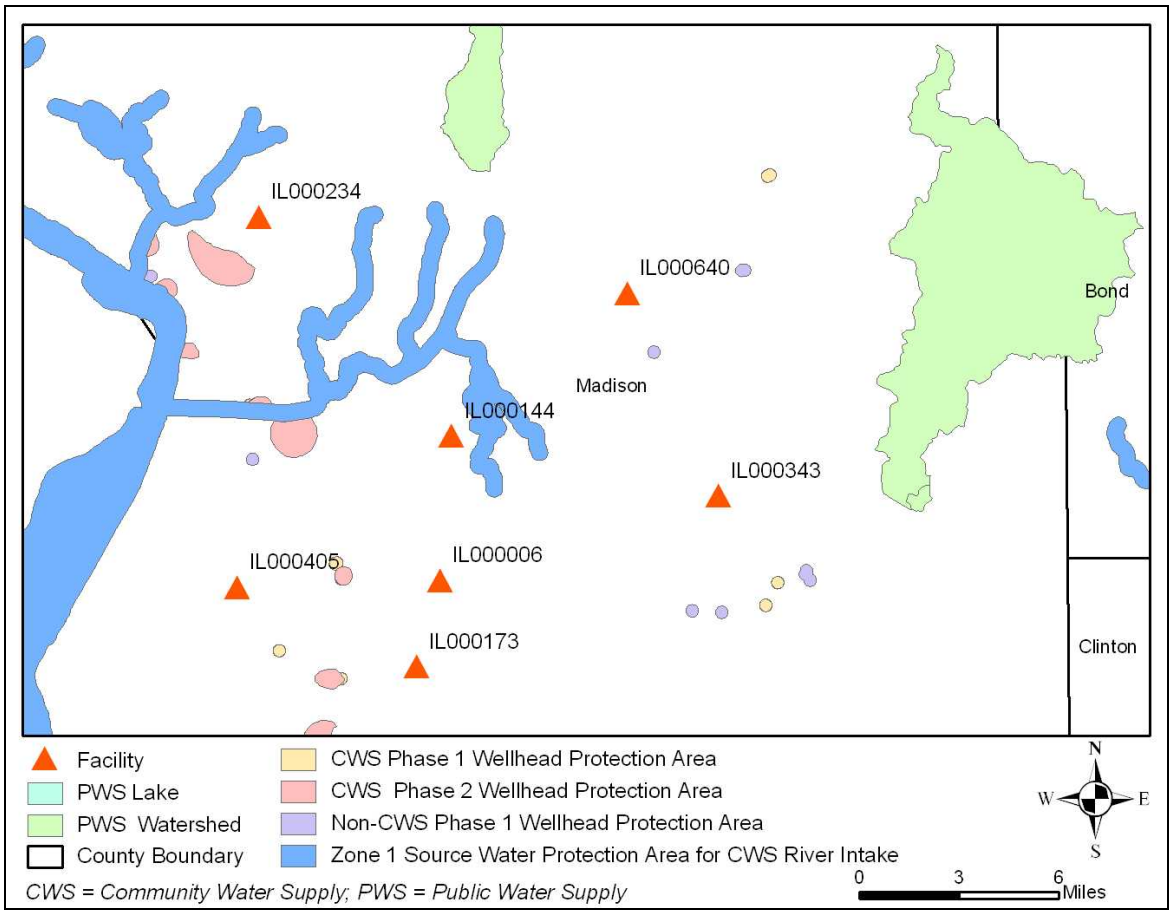

Figure 1: Madison County facilities with MVWDWs and protected areas

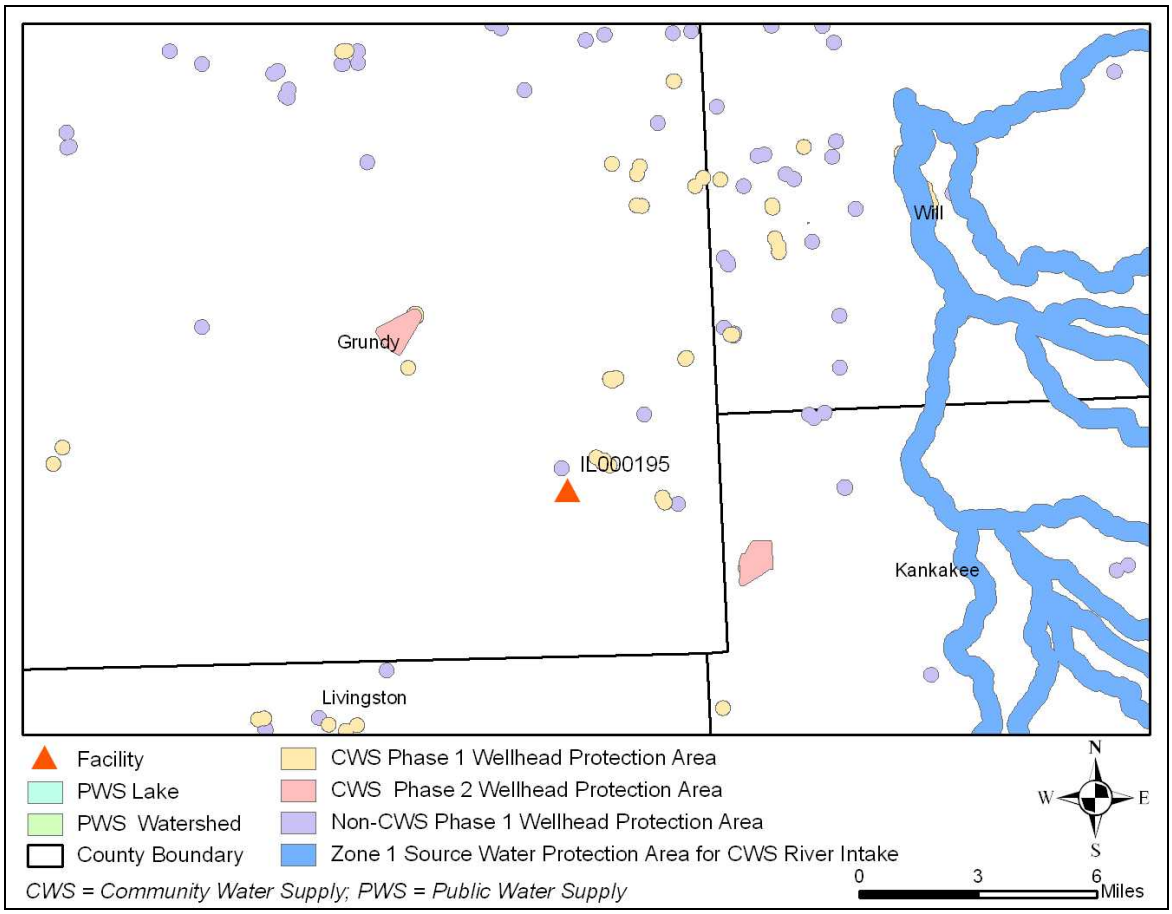

Figure 2: Grundy County facilities with MVWDWs and protected areas

To give an idea of the proximity of the eight facilities to source water protection areas, Table 5 indicates the distance from each facility to the nearest protected area in miles. Where available, the well/intake ID numbers and Public Water System ID (PWSID) numbers for the various protected areas are presented. All eight facilities were located within three miles of a protected area, and two of the facilities (IL000195 and IL000144) were located within one mile of a protected area.

Table 5: Distance from each facility identified as having an MVWDW to the nearest protected area

Facility ID	County	Distance to Protected Area (Miles)	Protected Area Type	Well / Intake ID(s)	PWS ID
IL000006	Madison	2.68	CWS Phase 2 Wellhead Protection Area	60131, 60132, 60133, 01604	1190750
IL000144	Madison	0.59	Zone 1 SWAP Areas for CWS River Intakes	60236, 60237	1195030
IL000173	Madison	2.34	CWS Phase 2 Wellhead Protection Area	60217, 60218, 60219	1191000
IL000195	Grundy	0.39	Non-CWS Phase 1 Wellhead Protection Area	06300248	0030726
IL000234	Madison	1.11	CWS Phase 2 Wellhead Protection Area	60016, 60017, 60018, 60019, 60020, 60021, 60022	1190150
IL000343	Madison	2.99	CWS Phase 1 Wellhead Protection Area	60200	1190950
IL000405	Madison	2.11	CWS Phase 1 Wellhead Protection Area	60125	1195154
IL000640	Madison	1.70	Non-CWS Phase 1 Wellhead Protection Area	11900040	0002428

C. Discussion

Consumers of public drinking water in the two counties may be reassured by the finding of this analysis that their water appears not to have been directly threatened by contamination from any of the eight MVWDWs identified during the project. However, it should be borne in mind that (a) protected zones are only approximations of the area in which pollution may pose a hazard, (b) over time, ground water can migrate significant distances, and (c) some automotive chemicals (for instance, the oxygenate MTBE, which was until recently very common in gasoline) migrate through the subsurface much faster than ground water.

Another consideration is the approximately 31 additional facilities with MVWDWs estimated to exist in the two counties but not identified during the project. Precise knowledge of the number and locations of these facilities would enable Illinois EPA to calculate a "ceiling" for benefits the project could have achieved. In the absence of that information, a rough quantification of missed potential benefits could be performed via a geographic analysis of the entire population of non-responders and facilities that certified as having no wells (i.e., category 1 and category 4, the two groups believed to have

additional unidentified facilities with MVWDWs). That analysis is, however, beyond the scope of the current project.

Statewide, the extent of source water protection areas varies greatly from county to county. In Madison, 15% of total area is protected area, and in Grundy, the protected area coverage is 2%. Some other Illinois counties have even lower coverage, according to SWAP data, while Piatt, Fayette, Douglas, and Moultrie Counties have protected area coverage of 92-100%. The extent of protected area coverage may be an important determining factor on the outcome of a benefits analysis like the one used here. In future ERPs of this type, it may be beneficial to perform a preliminary geographic analysis in the project design phase, either to select a target project area with high protected-area coverage or to specifically target facilities known to be located in source water protection areas. Some source water protection plans include lists of "potential sources of contamination" that include automotive facilities; using these plans, it may be possible to more easily identify target facilities in protected areas.

D. Possible alternative methodologies

Since the specific analytical methodology used here did not to quantify positive benefits, we close with a discussion of possible expanded/alternative benefit-measurement methodologies.

(1) Protected zones are usually based on conventional or legally defined distances from wells or intakes rather than on hydrogeologic analysis. For instance, Phase 1 wellhead protection areas are generally circular with a radius of 1000 ft. If data on ground water flow direction and speed are available, it would be possible to say with more precision whether contaminated ground water from an MVWDW would reach a drinking water well or intake and on what time scale.

In some cases, Illinois EPA calculated a 5-year recharge area for drinking water wells, and in at least one case (PWSID 1190200) Illinois EPA calculated a 50-year recharge area.[6] If a 50-year recharge area were calculated for all drinking water sources in Grundy, Madison, and neighboring counties and mapped in ArcView, it is quite possible that one or more of the eight facilities could be shown to have an impact on drinking water quality.

(2) Available ground water models might be used to predict the migration of typical automotive chemicals in the subsurface of the two counties. While it is beyond the scope of this report to screen ground water flow models or contaminant fate and transport models, the following are several well-established models that might be evaluated for their applicability:

- MODFLOW (http://water.usgs.gov/nrp/gwsoftware/modflow2000/modflow2000.html)

[6] http://maps.epa.state.il.us/water/swap/FactSheets/il_swap/cws/madison/1190200.pdf

- WhAEM2000 (http://www.epa.gov/athens/software/whaem/index.html)
- MT3DMS (http://hydro.geo.ua.edu/mt3d/)

(3) The analysis could be extended from public water supplies to private water supplies as well. The SWAP system includes a map of private and semi-private drinking water wells based on data compiled by Illinois State Geographic Survey (ISGS). The Illinois EPA Bureau of Water notes that although the data set is incomplete and in some cases the well locations might not be accurate, it is the most complete electronic database of private wells currently available.[7] In order to perform the analysis Illinois EPA would need to decide how close a well would need to be to a MVWDW to be considered threatened. (Or, to add more precision, hydrogeologic analysis or modeling could be applied as described above.) The results of the analysis could be reported in terms of number of wells no longer threatened by MVWDWs, or (if adequate supporting data are available) the number of households or individuals served by those wells.

The SWAP system also tracks "water well density," an indicator of the number of drinking water wells (public, semi-private, and private) within each township. The following strata are used:

Number of Wells	Designated Well Density
0-150	Low
151-500	Low to Medium
501-1000	Medium
1001-2000	Medium to High
2001-3803	High

This data set could be used to draw some rough conclusions about project outcome. For instance, one could determine the number of MVWDWs closed/permitted in townships with over 1000 drinking water wells, or the number of drinking water wells in townships where an MVWDW has been closed or permitted. However, several caveats would apply.

First, as noted above, there are quality issues associated with private and semi-private well data. Second, a township-level analysis is far from precise: a MVWDW might pose no danger to the vast majority of drinking water wells in its own township, and yet might threaten some drinking water wells across the township border. Third, this analysis gives public wells and private wells equal weight, although one might serve thousands of drinking water customers and the other might serve only a household. Fourth, this analysis includes wells only, and would give no indication of the impact of MVWDW closure/permitting on surface water supplies. Finally, townships vary in size. Normalizing by township area would give more useful categories for the purpose of this analysis: that is, rather than categorizing townships by number of drinking water wells, they could be categorized by average number of drinking water wells per square mile.

[7] http://maps.epa.state.il.us/website/swap/intro.htm