UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, ILLINOIS 60604

Reply to the Attention Of: SR-6J

RECEIVED

DEC 1 1 2009

PLYMOUTH DNR

December 9, 2009

Jeff Plass, Manager
EHS Program Management
Kohler, Co.
444 Highland Drive
Kohler, WI 53044

RE: Sheboygan River and Harbor Site Floodplain Additional Sampling and Remediation, Sheboygan, Wisconsin

Dear Mr. Plass:

The purpose of this letter is to provide you with a copy of the memo summarizing EPA's evaluation of the 10 criteria for selecting floodplain areas for soil remediation at the Sheboygan River and Harbor Superfund Site. The memo is dated September 4, 2008, and it includes the list of 10 criteria for selecting areas for soil remediation that "balance remediation of PCB-contaminated soil with maintaining existing high quality ecological habitat" as it pertains to the Sheboygan River and Harbor Superfund Site and that are included in the Statement of Work for the Remedial Design and Remedial Action for the Upper River Sediment, Floodplain Soil, and the former Tecumseh Products Company Plant Site.

The September 2008 memo discusses 9 of the 10 criteria. The only criterion not discussed in the memo is criterion 8, "implementability considerations." In evaluating this criterion, EPA will take into account the surface area of soil that needs remediation, the concentration of PCB contamination, and the method to be used to accomplish the remediation of the area. Depending on the size and location of an area that needs remediation, there are low impact methods that could be implemented, in combination with other soil management techniques and institutional controls, to achieve a sufficient remediation.

In addition, I have enclosed the February 2009 report entitled *Sheboygan River and Harbor Superfund Site: Revision of Floodplain Analysis*. The February 2009 report updates the March 2007 report entitled *FIELDS Statistical Evaluation Report: Sheboygan River and Harbor Superfund Site* which summarized the floodplain PCB soil sample data collected to date for the Sheboygan River and Harbor Superfund Site. In the March 2007 report, the available data points were evaluated to determine which areas within the floodplains would need remediation in order to achieve the 10 ppm cleanup goal for the floodplains as stated in the May 2000 Record of Decision. The February 2009 report uses differently-processed data to reconcile discrepancies in the previous analysis and achieves the following:

- Re-evaluation of data and new analysis for:
  - Depth intervals: 0-6 inch and 6-18 inch
  - Regions of the floodplains: sub-areas and 100-ft wide foraging units that further divide sub-areas.
- Provides a more conservative estimate of the remediation areas.

In order to minimize the areas to be impacted by soil remediation, EPA proposes that additional soil samples be collected within the areas identified in the February 2009 *Revision of Floodplain Analysis* report as needing remediation. The collection of additional soil samples will help further refine the extent of soil contamination above the cleanup goal of 10 ppm and further minimize the extent of floodplain areas impacted as part of the remediation. I am including with this letter an *Aligned Grid ("hotspot") Sample Design*. The proposed sample designs are based on a "hotspot" search because EPA believes that the floodplain contamination likely occurs in discrete locations. EPA proposes that this approach be used to determine how many samples will need to be collected to refine the floodplain remediation areas and determine the appropriate remedial approach.

EPA would like to set up a meeting with Kohler, Co. in January 2010 to discuss these findings. Additionally, we would like to discuss access for the additional sampling and remediation of the areas, so we can proceed with implementation of a cleanup plan.

Sincerely,

Pablo N. Valentín

Pablo N. Valentín
Remedial Project Manager

Enclosures

cc w/ enclosures:
Richard Nagle, ORC
Thomas Wentland, WDNR
Ken Aukerman, PRC
James Chapman, USEPA
Mark Mittag, CH2MHill

ATTACHMENT 1 – ***Evaluation of Ten Criteria for Selecting Floodplain Areas for Soil Remediation, Sheboygan River and Harbor Superfund Site, Sheboygan Falls, Wisconsin***

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

DATE: September 4, 2008

SUBJECT: Evaluation of Ten Criteria for Selecting Floodplain Areas for Soil Remediation, Sheboygan River and Harbor Superfund Site, Sheboygan Falls, Wisconsin

FROM: James Chapman, Ph.D., Ecologist

TO: Pablo Valentin, RPM

The Statement of Work for the Remedial Design and Remedial Action for the Upper River Sediment, Floodplain Soil, and Tecumseh Products Company Plant Site (URSOW) includes a list of 10 criteria for selecting areas for soil remediation that "balance remediation of PCB-contaminated soil with maintaining existing high quality ecological habitat":

1. the magnitude of the PCB concentrations observed
2. the size of the area containing greater than 10 ppm PCBs
3. the degree to which the area-averaged PCB concentration exceeds 10 ppm PCBs
4. the quality and value of existing habitat
5. the extent and duration of habitat disruption that would be associated with remediation, including potential aesthetic impacts
6. potential impacts on river bank stability
7. the accessibility of the area, including consideration of the potential ecological impacts associated with creating access
8. implementability considerations
9. the incremental risk reduction from remediation of an area relative to the incremental effort needed to address that area
10. any other relevant factors

Criteria 1 – 3 are explicitly addressed in the FIELDS analyses which calculate spatially-averaged soil PCB concentrations and the associated reach-specific minimum PCB concentrations requiring action to attain the objectives set forth in the ROD, and show the size and location of the areas requiring action (USEPA 2007).

1. Magnitude of the PCB concentrations observed

Reach-specific maximum PCB concentrations in surface soils (0 to 0.5 ft) range from 37 to 56 ppm in floodplain areas (FP) 3, 4, 5 and 6; 18 ppm in FP 7; and 5 ppm in FP 8 (USEPA 2007). Maximum PCB concentrations in near-subsurface soils (0.5 to 1.5 ft) range from 42 to 194 ppm in FP 3, 4, and 6; 13 ppm in FP 7; and less than 4 ppm in FP 5 and 8. Maximum PCB concentrations in deep soils (1.5 to 2.5 ft and 2.5 to 5.5 ft) are less than 10 ppm with a single exception of 11 ppm at 1.5 to 2.5 ft in FP 3.

Under criterion 1, FP 8 is eliminated from further consideration, and deep soils (1.5 ft below surface or greater) are eliminated for all area with the possible exception of FP 3.

3. Degree to which the area-averaged PCB concentration exceeds 10 ppm PCBs

Evaluating 100-ft by 300-ft averaging areas adjacent and parallel to the Sheboygan River (consistent with the spatial basis used for calculating the 10 ppm goal in the ROD), the area-averaged PCB concentrations in surface soil range from 13 to 25 ppm in FP 3, 4, 5 and 6 (USEPA 2007). The spatial average in FP 7 is less than 10 ppm in surface soil, as is the arithmetic mean (not spatially averaged) for near subsurface soil, so it is eliminated from further consideration under criterion 3.

The surface soil spatial averages in some of the floodplain subareas greatly exceed the 10 ppm goal in the ROD – FP 3B, FP 4C, and FP 6B and C (17 to 25 ppm). Three additional subareas, FP 4B and D and FP 5B, exceed the ROD goal by smaller, but non-trivial amounts (13 - 14 ppm) (USEPA 2007). The surface soils of the remaining floodplain subareas have area-averaged PCB concentrations less than 10 ppm.

Area-averaged PCB concentrations in near subsurface soils (0.5 to 1.5 ft) greatly exceed the ROD goal in FP 6A and B (43 to 55 ppm) and FP 4B (15 to 21 ppm). Subsurface area-averaged PCB concentrations were not calculated for FP 3 because of the low sample number, but the arithmetic mean subsurface PCB concentration of 70 ppm greatly exceeds the ROD goal.

The area-averaged PCB concentration in near subsurface soil in FP 4A of 10.8 ppm only marginally exceeds the ROD goal and therefore is eliminated under criterion 3 (note, the value shown for percent remediated for FP 4A is incorrectly shown in USEPA 2007 Figure 20). This decision is reinforced by the low surface soil area-averaged PCB concentration in FP 4A which is well under 10 ppm (USEPA 2007 Table 5).

FP 6A requires special consideration. The area-averaged PCB concentration meets the ROD objective in the surface soil, but greatly exceeds it in the near subsurface.

2. Size of the area containing greater than 10 ppm PCBs

The FIELDS analysis can be used to delineate the size and location of soils with PCB concentrations greater than 10 ppm, but, consistent with criterion 3 (above), a more useful approach is to delineate the size and location of areas that require remediation so that the final spatially-averaged soil concentrations are no greater than 10 ppm. These results are shown in Table 1 for surface soils. The removal concentration for achieving the ROD goal of 10 ppm PCBs within 100-ft x 300-ft averaging areas adjacent to the river ranges from 14 to 32 ppm, with a median removal concentration of 23 ppm. On this basis, the size of the areas requiring remediation ranges from approximately 1000 to 22,000 ft^2 per floodplain area, for a total of 41,340 ft^2.

FIELDS repeated the same type of analysis using the original 300-ft x 300-ft averaging area initially assessed in the Terrestrial Ecological Risk Assessment (TERA) (USEPA 1999). The

PCB 10 ppm goal in the ROD is based on a 100-ft x 300-ft portion of the total 300-ft x 300-ft averaging area assuming the average pattern of diminishing soil PCB concentrations in the remaining 200-ft x 300-ft portion as indicated by the soil data available at that time. Over an entire 300-ft x 300-ft averaging area bordering the river, the spatially-averaged soil PCB goal is 4 ppm (USEPA 1999). On this basis, the surface soil removal concentration ranges from 10 to 21 ppm, with a median removal concentration of 18 ppm, and the associated remedial areas range from 11,300 to 81,400 ft^2 per floodplain area, for a total of 203,713 ft^2 (Table 1).

The approach based on the 10 ppm goal in the ROD applied to100-ft x 300-ft averaging areas adjacent to the river results in an 80 % decrease in total area remediated compared to the approach based on the 4 ppm goal in the TERA applied to 300-ft x 300-ft averaging areas bordering the river (Table 1).

Of the areas with sufficient subsurface soil data for calculating 100-ft x 300-ft area averages, the total area potentially requiring remediation is 47,299 ft^2 for FP 4B and 6A and B (calculated from Figure 20 excluding FP 4A – see comment under criterion 3). For subsurface soil in FP 6, the approach based on the 10 ppm goal in the ROD applied to100-ft x 300-ft averaging areas adjacent to the river results in a 45 % decrease in total area remediated compared to the approach based on the 4 ppm goal in the TERA applied to a 300-ft x 300-ft averaging area bordering the river (75,000 ft^2 calculated from Figure 13). (Note, the Figure 13 calculation for a 300-ft x 300-ft averaging area in FP 4 overestimates the subsurface area requiring remediation because it results in a post-remedial average much lower than the 4 ppm goal; and, therefore, is excluded from this memo.)

4. Quality and value of existing habitat

The habitat quality of the floodplain areas was evaluated by USEPA (2006) according to the Wisconsin Floristic Quality Assessment Methodology (WDNR 2003) using floral inventory data reported by URS (2004). None of the floristic approaches for evaluating the conservation value of the Sheboygan floodplain vegetation indicate high quality. Most (4 of 5) of the approaches indicate low conservation value, and one approach indicates marginal potential. The Sheboygan floodplain vegetation is categorized as degraded and of low floristic conservation value by the high percentage of non-native species, low mean coefficient of conservatism (mean CoC) when calculated including non-native species, and low floristic quality index (FQI) calculated either with or without non-native species. Mean CoC indicates marginal natural area quality in FP 5 and 6 if non-native plants are excluded from consideration, but all the other measures indicate low conservation value. The floodplain plant communities are predominantly comprised of species that tolerate disturbance, and that are found in a broad range of habitats (not restricted to specialized habitats) (USEPA 2006).

One use of floristic quality assessment is to identify areas of high conservation value that are candidates for protection because, if disturbed, regeneration of the replacement habitat is unlikely to successfully recreate a community of similar conservation value. In other words, habitats that score high in floristic quality assessments may be effectively irreplaceable. In contrast, the low floristic quality assessment scores of the Sheboygan River floodplain areas indicate that regeneration of similar quality habitat is feasible following disturbance by remedial actions. The low conservation value of these floodplain areas indicates that the quality of the floodplain plant communities along the Sheboygan River is not a constraint on remedial actions (USEPA 2006).

Floristic quality assessment has been shown to correlate well with measures of disturbance in wetlands and forests including streambank habitat in Ontario (Bowers and Boutin 2008), forested riverine wetlands in Ohio (Fennessy, et al. 1998), hardwood wetlands in Virginia (Nichols, et al. 2006), depressional wetlands in Ohio (Lopez and Fennessy 2002) and Florida (Cohen, et al. 2004), headwater wetlands in Pennsylvania (Miller and Wardrop 2006), forest in Michigan U.P. (Rooney and Rogers 2002), and woodlands in Ontario (Francis and Austen 2000). The measure most closely correlated with disturbance varies among studies – FQI (Fennessy, et al. 1998; Lopez and Fennessy 2002; Miller and Wardrop), mean CoC (Francis and Austen 2000; Rooney and Rogers 2002; Cohen, et al. 2004), or percentage of non-native species (Bowers and Boutin 2008). All of these measures were evaluated in the Sheboygan floodplain assessment, and all consistently show the floodplains do not have high conservation value. The approach resulting in the highest score indicates only marginal conservation value, which was calculated by omitting alien species. In comparison, FQI (native species only) correlated with disturbance of headwater wetlands, but the correlation was even closer when FQI included alien species (Miller and Wardrop 2006). All of the approaches that include data on non-native species indicate the Sheboygan floodplains have low conservation value.

The results of the floristic quality assessment of the Sheboygan River floodplains are largely driven by the understory species composition. This is consistent with the results of other studies of riparian forests:

> "Our results show that understorey herbaceous species, both individually and grouped according to functional types or guilds, are effective indicators of environmental change and disturbance associated with land use. … The majority of indicators of disturbance (85%) … were exotic. In contrast, nearly all vulnerable species (95%) were native, as were all species identified as effective indicators of high-integrity forests. … Woody species tend to be more resistant to disturbance… Disturbed secondary forests in eastern USA have more woody brush than relatively undisturbed primary forest…" (Moffatt and McLachlan 2004).

Consistent with these results, when the vegetative strata of hardwood wetlands were separately assessed, FQIs of the herbaceous layer and the sapling layer were negatively correlated with disturbance, but the FQIs of the canopy layer and the shrub layer "were not reliable indicators of current land use disturbance" (Nichols, et al. 2006). Although to an untrained eye, the understory herbaceous plants may appear to be insignificant in comparison to trees, the understory plants accurately record the history of the site – rich with native species in relatively pristine forests, but impoverished with a high proportion of alien species in disturbed forests.

Indicators of disturbance are important because they provide information on the ability of the habitat to recover to existing levels of habitat quality following remedial actions. The floristic quality assessment shows that the Sheboygan River floodplains have the characteristically low habitat quality associated with a history of disturbance. None of the floodplain areas under consideration are high quality habitats characteristic of undisturbed forest wetlands that would be difficult to regenerate following remedial actions.

5. Extent and duration of habitat disruption that would be associated with remediation, including potential aesthetic impacts

Most of the projected areas for remedial action in FP 3 and 4 are presently covered by grasses or shrubs. All of the remedial area in FP 4D is grassy. These areas will recover quickly following remediation, within 1 or 2 growing seasons, with appropriate reseeding practices. Aesthetic impacts will be correspondingly limited, and will be minimal within a couple of growing seasons.

Limited areas in FP3 and 4 bordering the river support trees. Tree growth will naturally reestablish following remediation if the areas are not mowed; however, the timeframe for natural establishment and regrowth will be highly variable depending on a variety of factors including soil condition, type and proximity of natural seed sources, weather, herbivory (e.g., deer, rabbits, rodents), and competition with other plants. Planting saplings will reduce both the uncertainty and timeframe for tree establishment and growth. Aesthetic impacts will be greatest the first couple of growing seasons as the groundcover is reestablished. Depending on the species of trees planted, attractive appearance is achievable within a few growing seasons, and significant stature within a decade. Of the trees recorded in the floodplain floral inventory (URS 2004), willow, poplar, aspen, and boxelder are particularly fast growing. Ecological impacts will be minimal to terrestrial animals because the riparian corridor along these areas is a mixture of wooded and herbaceous banks. The generally narrow and interrupted strips of trees along the banks in these areas indicate that the habitat they provide is predominantly utilized by opportunistic wildlife with broad habitat tolerances.

The same considerations apply to the small remedial area in FP 5.

Most of FP 6 is wooded, however, a significant portion of FP 6B is dominated by a large standing dead tree and a large downed log, so it is likely that most of the projected remediation in FP 6B can be achieved with minimal disturbance to living mature trees. Therefore, the ecological and aesthetic impacts of remedial actions in FP 6B are expected to be minimal and of short duration.

The projected remedial area in FP 6C is a relatively narrow band of surficial (0 to 6-inch) soil. Removal of trees in this limited area will have limited ecological impacts. Aesthetic impacts should be largely ameliorated within about a decade by planting saplings of fast growing trees, as discussed previously. However, because of the narrow shape of the remediated area and its orientation, the remediated area will not be readily visible from outside of the wooded area except from a relatively circumscribed vantage point across the river to the southeast.

In contrast to FP 6C, the subsurface (6 to 18-inch) soil is targeted in FP 6A, but not the surface layer, and the projected area is comparatively extensive (64 % of the subarea, Figure 20). Again, the ecological impacts will be minor because the potentially affected area is a small proportion of the floodplain forest, but the aesthetic impacts may be greater than at other floodplain subareas because of larger numbers of potentially affected trees and the greater visibility from the vantage point across the river to the north. Two possible approaches to minimize the aesthetic effects, without compromising risk reduction objectives, would be to either protect key individual dominant trees to breakup the visual impact of the remedial action (see Criterion 10), or to establish a procedure for monitoring windthrow (toppling of trees) and removing the exposed contaminated subsoil from the pit and the exposed root ball of downed trees.

Protection of selected trees could be considered on an individual basis in any of the wooded areas proposed for remediation (see Criterion 10).

6. Potential impacts on river bank stability

Subarea FP 4D will have no river bank remedial action. Subareas FP 4B, 4C, 5B, and 6C will have limited river bank remedial activity that should be straightforward to address.

The bank frontages for remediation of FP 3B and 6B are extensive, but only the surficial 0 – 6-inch soil layer is targeted. The impact on riverbank stability should be minimal.

The bank frontage for remediation of FP 6A is extensive and involves the subsurface 6 – 18-inch soil layer. Actions to maintain the stability of the bank will be necessary.

7. The accessibility of the area, including consideration of the potential ecological impacts associated with creating access

Access is relatively straightforward for FP 3 and 4, and should not, of itself, create significant ecological impacts.

Overland access to FP 5 may be problematic, so FP 5 may require access from the river.

Access to FP 6 might be feasible for small equipment from the trail from the south, but, if not, it will probably be most readily accessed from the river with the least ancillary impact.

8. Implementability considerations

[PABLO]

9. The incremental risk reduction from remediation of an area relative to the incremental effort needed to address that area

FP 3 and 4 are readily accessed and reasonably straightforward to remediate.

The projected area of remediation in FP 5B is small (2600 ft^2 based on Figure 19), but overland access may be problematic (see Criterion 7). The incremental risk reduction for FP 5B may not justify the incremental effort required to access and remediate the isolated hot spot.

Access and remedy implementation will require greater effort in FP 6 compared to FP 3 and 4, but FP 6 also has the highest and most extensive soil contamination along the Sheboygan River. The extra effort and care required for remediation of FP 6 is justified by the large potential risk reduction.

10. Any other relevant factors

In any of the projected remedial areas with existing trees, a combination of approaches may be appropriate. Protection of selected trees can be considered on an individual basis. Protective measures include restricting mechanical excavation in the vicinity of protected trees, possibly combined with hand excavation of selected areas within the dripline (canopy circumference). This approach has been successfully implemented in some USEPA Region 5 actions. Although tree roots may extend well beyond a tree's dripline, trenching outside the tree branch spread often causes no more than slight symptoms of damage (Hartman, et al. 2000). Conversely, trenching close to the trunk is likely to result in severe decline and death (Hartman, et al. 2000). Assuming 75 % of a tree's feeder roots are located outside the dripline, an excavation line located halfway between the trunk and dripline on one side of a tree would only remove approximately 30 % of the surface roots (Harris 1992). Most healthy trees can tolerate loss of up to 50 % of their absorbing roots without serious effect (Harris 1992), so excavation partly under the canopy on one side of a tree will likely not harm the tree. The recommended approach for surface soil removal from proportionately larger areas under the canopy of a protected tree is to "carefully fork soil away from the roots, working toward the trunk" (Harris 1992). Sinker roots (vertically descending roots) should not be severed, and horizontal roots not damaged.

Care should be taken when backfilling with clean soil to not raise the soil surface elevation around retained trees above the pre-remedial level.

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http://dnr.wi.gov/wetlands/documents/FQAMethodWithAcknowledgements.pdf

Table 1. Area of Floodplain Remediation based on FIELDS Analysis of Surface Soil, Sheboygan River and Harbor, Sheboygan Falls, Wisconsin (USEPA 2007)

Averaging Area Size (ft x ft)	Soil PCB Goal (mg/kg)	Floodplain ID	Total Surface Area (ft^2)	PCB Removal Conc. (mg/kg)	Remed. Area (%)	Remediated Area Size (ft^2)	Difference in Remediated Area Size (%)
100 x 300	10	FP 3B	2,984	23.1	34.84	1,040	-93
300 x 300	4	FP 3	65,600	20.8	24.24	15,901	
100 x 300	10	FP 4B	31,121	28.4	12.53	3,899	
100 x 300	10	FP 4C	29,000	23.0	24.83	7,201	
100 x 300	10	FP 4D	29,469	14.0	14.93	4,400	
100 x 300	10	FP 4 total	89,590			15,500	-73
300 x 300	4	FP 4	192,300	11.7	30.32	58,305	
100 x 300	10	FP 5B	30,303	31.9	8.58	2,600	-77
300 x 300	4	FP 5	47,200	20.1	23.94	11,300	
100 x 300	10	FP 6B	31,433	23.8	43.27	13,601	
100 x 300	10	FP 6C	30,090	20.9	28.58	8,600	
100 x 300	10	FP 6 total	61,523			22,201	-73
300 x 300	4	FP 6	198,600	18.1	40.99	81,406	
100 x 300	10	FP 7	0	0.0	0	0	-100
300 x 300	4	FP 7	134,700	10.2	27.32	36,800	
100 x 300	10	Total				41,340	-80
300 x 300	4	Total				203,713	

Data from Figures 12 and 19 in USEPA. 2007. FIELDS Statistical Evaluation Report: Sheboygan River and Harbor Superfund Site, Sheboygan Falls, Wisconsin. Prepared by L. Walston. U.S. EPA Region 5. 3/12/07.

ATTACHMENT 2 – ***Sheboygan River and Harbor Superfund Site: Revision of Floodplain Analysis***

Sheboygan River and Harbor Superfund Site: Revision of Floodplain Analysis

Update to: FIELDS Statistical Evaluation Report: Sheboygan River and Harbor Superfund Site

Prepared By
Heather Rosenfeld, FIELDS Group, US EPA, Region V
John Bing-Canar, FIELDS Group, US EPA, Region V

February 2009

INTRODUCTION

The Sheboygan River and Harbor in Wisconsin is a Superfund site going through Phase II evaluation. In autumn 2004, the URS Corporation and Pollution Risk Services (PRS) collected soil samples to measure PCB concentrations in the floodplains of the Sheboygan River. These data were analyzed—spatially and statistically—in March 2007, and a report was generated, the "FIELDS Statistical Evaluation Report: Sheboygan River and Harbor Superfund Site".

This report serves as a revision of the March 2007 report, using differently processed data to reconcile discrepancies in the previous analysis. It achieves the following:

- Re-evaluation of data and new analysis for:
  - Depth intervals: 0 – 6 inch (0 – 0.5 ft) and 6 – 18 inch (0.5 – 1.5 ft)
  - Regions of the floodplain: subareas and 100 ft wide foraging units (of the American Robin) that further divide subareas
- Provides a more conservative estimate of remediation areas.

PRELIMINARY ANALYSIS

The data used in this analysis were PCB levels in soil samples gathered by URS and PRS in 2004. All samples used for this analysis are included in Appendices A and B, showing data for the 0 – 6 inch (0 – 0.5 ft) and 6 – 18 inch (0.5 – 1.5 ft) intervals, respectively. The data are displayed as maps in Figures 1 and 2, respectively. Samples at 106 locations were collected for the top (0 – 6 inch) interval, and samples at 27 locations were collected for the 6 – 18 inch interval. For cases in which duplicate samples were taken at the same location, the sample with the higher value was selected.

For each of the two depth intervals, a preliminary analysis was conducted by generating three different interpolations of PCB concentrations in mg/kg (ppm) using the FIELDS Tools for ArcGIS. These interpolations were generated in order to choose a conservative interpolation from a range of results given the low number of data points relative to the area. Two of these used an inverse distance weighted algorithm, with different parameters, and the third used a natural neighbor algorithm. The inverse distance weighted interpolations used, first, a power of two and eight neighbors, and then a power of four and six neighbors. The interpolations were done with all of the data from the depth interval chosen as opposed to dividing them into subareas or foraging units before interpolating.

Of the interpolations, the inverse distance weighted with a power of two and eight neighbors was found to be the most conservative of the three and was chosen. Results of the other interpolations are not shown in this report.

After interpolating, the grids (interpolated values) were clipped by subareas of the floodplain. Then, for potential use in ecological risk assessments (ERAs) regarding the foraging areas of the American robin (*Turdus migratorius*), they were clipped separately by approximately 100 ft wide (going outwards from the river) foraging units. Statistical analyses to estimate remediation areas was done for subareas and foraging units separately.

METHODS AND RESULTS: SUBAREA ANALYSIS

The interpolations, clipped by subareas, are mapped in Figures 3 and 4. Statistics were generated for interpolated data for each subarea using the FIELDS Tools for ArcGIS. The average, standard deviation, minimum, maximum, and median of each clipped grid were calculated, and those results are shown in Tables 1 (0 – 6 inch interval) and 2 (6 – 18 inch interval).

The preliminary remediation goal (PRG) was a 10 ppm site-wide average. For subareas in which the average PCB concentration was greater than or equal to this PRG, the FIELDS Tools' remediation scenario was employed. The remediation scenario identified areas within subareas requiring remediation in order to meet a site-wide average of less than 10 ppm. (The remediation scenario method sorts the (interpolated) PCB values within each subarea from highest to lowest. It then removes the highest value, re-calculates the average, and compares it to the 10 ppm PRG. If this re-calculated average is less than or equal to 10 ppm, then only the one area represented by the highest PCB value requires removal (remediation). If the average is greater than or equal to 10 ppm, then the next highest PCB value is removed and the average of remaining areas is recalculated. The process continues until the PRG is met.)

For the 0 – 6 inch interval, subareas 3 and 6 required removal, and for the 6 – 18 inch interval, subareas 3, 4, 6, and 7 required removal. In the 6 – 18 inch depth interval, removal of the entirety of subarea 7 was required; this occurred because the minimum value of the interpolation for subarea 7 was greater than or equal to 10 (it was 10.421 ppm, as seen in Table 2)—since there were no values below the PRG, the average couldn't be brought below it by eliminating less than all of it.

Maps and tables with data on the removal process for subareas were created and appear as Figures 5 and 6 and Tables 3 and 4. The maps show the removal areas for each of the two intervals, when spatially divided into subareas, and the tables show the initial and post-remediation average concentrations, the total volume, the volume removed (in cubic yards and percent), and the maximum concentration kept in areas in which removal took place. In the tables, only subareas requiring remediation were included—those in which the average concentration was already below 10 ppm were not.

METHODS AND RESULTS: FORAGING UNIT ANALYSIS

Subareas were divided into three to five foraging units, each, based on the foraging areas of the American robin. The same statistics that were generated for each subarea (average, standard deviation, minimum, maximum, median), after interpolating the data, were generated for each foraging unit, again using the FIELDS Tools for ArcGIS. This was done for both depth intervals, and the results appear in Figures 7 and 8 and Tables 5 (0 – 6 inch interval) and 6 (6 – 18 inch interval).

As was done for subareas, when the average interpolated value for a foraging unit was greater than or equal to the 10 ppm PRG, the FIELDS Tools' remediation scenario was employed, and removal areas were identified. Figure 9 contains a map of removal areas in foraging units for the 0 – 6 inch interval, and Figure 10 contains a map of removal areas in foraging units for the 6 – 18 inch interval. Tables 7 and 8 contain statistics associated with the removal areas for foraging units that required removal.

For the 0 – 6 inch interval, foraging units 3B, 4C, 5B, 6B, and 6C required removal. For the 6 – 18 inch interval, foraging 3A, 3B, 3C, 4A, 4B, 4C, 6A, 6B, 7A, 7B, 7C, and 8D required removal.

TABLES AND FIGURES

Subarea	Average	Standard deviation	Minimum	Maximum	Median
3	10.309	9.477	0.45	55.997	6.034
4	7.634	6.786	0.25	36.999	5.497
5	7.287	9.734	0.01	41.996	2.148
6	16.339	10.173	0.821	46	17.069
7	4.899	3.618	0.14	16.498	3.785
8	0.848	0.999	0.01	4.9	0.393

Table 1: Statistics for interpolation of PCB data, clipped by subareas, for the 0 – 6 inch depth interval. Highlights denote subareas with average concentrations greater than or equal to the 10 ppm PRG. Visualized in Figure 3.

Subarea	Average	Standard deviation	Minimum	Maximum	Median
3	59.634	23.643	8.312	193.994	57.819
4	15.384	13.699	1.4	58.166	8.161
5	4.373	1.408	2.27	8.652	3.885
6	33.743	21.111	1.1	85.998	39.52
7	13.138	3.113	10.421	23.449	11.536
8	5.871	2.877	1.702	12.451	5.607

Table 2: Statistics for interpolation of PCB data, clipped by subareas, for the 6 – 18 inch depth interval. Highlights denote subareas with average concentrations greater than or equal to the 10 ppm PRG. Visualized in Figure 4.

Subarea requiring removal	Initial average concentration (ppm)	Maximum concentration kept (ppm)	Total volume (cu. yds)	Volume removed (cu. yds)	Percent remediated (%)	Remediated concentration (ppm)
3	**10.309**	**48.3294**	1141.1	8.4	**0.7 %**	**9.99964**
6	**16.339**	**19.6686**	1283.7	487.8	**38.0 %**	**9.99982**

Table 3: Statistics for removal areas in subareas, for the 0 – 6 inch depth interval. Visualized in Figure 5.

Subarea requiring removal	Initial average concentration (ppm)	Maximum concentration kept (ppm)	Total volume (cu. yds)	Volume removed (cu. yds)	Percent remediated (%)	Remediated concentration (ppm)
3	**59.634**	**11.5044**	2282.1	61281	**99.5 %**	**9.99972**
4	**15.384**	**28.9812**	6155.1	28693	**17.3 %**	**9.99991**
6	**33.743**	**32.2964**	2567.5	43139	**62.2 %**	**9.99997**
7	**13.138**	**n/a***	3017.4	81469	**100 %**	**n/a***

Table 4: Statistics for removal areas in subareas, for the 6 – 18 inch depth interval. *n/a means that the entire subarea or foraging unit required remediation, so there is no "maximum concentration kept" or "remediated concentration". Visualized in Figure 6.

Subarea	Foraging Unit	Average	Standard deviation	Minimum	Maximum	Median
3	A	4.861	0.935	2.653	6.401	4.964
3	B	13.623	10.865	0.56	55.997	12.63
3	C	5.758	3.346	0.45	19.962	5.394
4	A	0.738	0.492	0.45	3.02	0.598
4	B	3.251	1.612	0.25	7.208	3.44
4	C	18.113	7.348	3.9	36.999	18.109
4	D	8.603	2.57	4.326	17.739	8.655
4	E	3.184	0.879	1.18	4.5	3.593
5	A	0.941	0.672	0.07	3.098	0.795
5	B	12.573	11.171	0.38	41.996	10.048
5	C	2.135	2.459	0.01	14.048	1.335
6	A	4.842	2.097	0.821	15.08	4.674
6	B	23.333	9	2.655	46	22.251
6	C	14.416	5.904	2.881	25.637	15.894
7	A	1.43	0.495	0.57	2.653	1.368
7	B	7.808	3.634	1.038	16.498	7.578
7	C	3.902	2.225	0.14	8.999	3.104
8	A	0.454	0.359	0.199	1.557	0.25
8	B	0.885	0.659	0.24	3.31	0.64
8	C	1.73	1.447	0.691	4.9	1.172
8	D	0.118	0.063	0.01	0.29	0.114

Table 5: Statistics for interpolation of PCB data, clipped by foraging units, for the 0 - 6 inch depth interval. Highlights denote subareas with average concentrations greater than or equal to the 10 ppm PRG. Visualized in Figure 7.

Subarea	Foraging Unit	Average	Standard deviation	Minimum	Maximum	Median
3	A	57.743	0.316	56.914	58.177	57.844
3	B	57.935	30.308	8.312	193.994	53.252
3	C	64.677	1.577	60.697	67.238	65.144
4	A	48.319	4.894	38.471	58.166	48.4
4	B	25.783	6.937	15.872	41.344	24.555
4	C	17.236	9.678	1.4	42	14.872
4	D	5.198	1.656	1.817	9.358	5.218
4	E	7.804	0.637	6.56	9.481	7.76
5	A	5.525	0.44	4.649	5.575	5.513
5	B	3.51	0.608	2.27	5.022	3.592
5	C	5.169	1.65	3.021	8.628	4.839
6	A	40.033	6.951	27.812	63.226	38.998
6	B	48.734	13.536	12.307	85.998	47.421
6	C	6.116	3.372	1.1	19.831	5.472
7	A	18.817	2.055	14.275	23.449	18.818
7	B	12.701	1.271	10.625	16.941	12.69
7	C	10.995	0.267	10.421	11.744	10.973
8	A	6.974	0.826	4.77	9.309	7.035
8	B	3.765	1.326	1.707	7.19	3.491
8	C	4.664	1.836	1.775	8.071	4.508
8	D	10.233	1.301	7.67	12.465	10.309

Table 6: Statistics for interpolation of PCB data, clipped by foraging units, for the 6 – 18 inch depth interval. Highlights denote subareas with average concentrations greater than or equal to the 10 ppm PRG. Visualized in Figure 8.

Subarea requiring removal	Foraging Unit	Initial average concentration (ppm)	Maximum concentration kept (ppm)	Total volume (cu. yds)	Volume removed (cu. yds)	Percent remediated (%)	Remediated concentration (ppm)
3	B	13.622	21.8477	685.4	105.8	15.4 %	9.99966
4	C	18.113	15.3072	584.4	392.7	67.2 %	9.99976
5	B	12.573	27.718	734.0	80.7	11.0 %	9.99994
6	B	23.333	14.128	596.0	509.2	85.4 %	9.99997
6	C	14.416	17.619	391.2	171.1	43.7 %	9.99984

Table 7: Statistics for removal areas in foraging units, for the 0 – 6 inch depth interval. Visualized in Figure 9.

Subarea requiring removal	Foraging Unit	Initial average concentration (ppm)	Maximum concentration kept (ppm)	Total volume (cu. yds)	Volume removed (cu. yds)	Percent remediated (%)	Remediated concentration (ppm)
3	A	57.743	n/a*	316.1	316.1	100 %	n/a*
3	B	57.935	11.5044	1370.8	1358.3	99.1 %	9.99972
3	C	64.677	n/a*	595.5	595.5	100 %	n/a*
4	A	48.319	n/a*	516.7	516.7	100%	n/a*
4	B	25.783	n/a*	1106.9	1106.9	100 %	n/a*
4	C	17.236	14.9093	1168.9	579.8	49.6 %	9.99975
6	A	40.033	n/a*	592.7	592.7	100 %	n/a*
6	B	48.734	n/a*	1190.4	1190.4	100 %	n/a*
7	A	18.817	n/a*	578.6	578.6	100 %	n/a*
7	B	12.701	n/a*	1132.4	1132.4	100 %	n/a*
7	C	10.995	n/a*	1306.3	1306.3	100 %	n/a*
8	D	10.233	11.928	741.7	80.7	10.9 %	9.99994

Table 8: Statistics for removal areas in foraging units, for the 6 – 18 inch depth interval. *n/a means that the entire subarea or foraging unit required remediation, so there is no "maximum concentration kept" or "remediated concentration". Visualized in Figure 10.

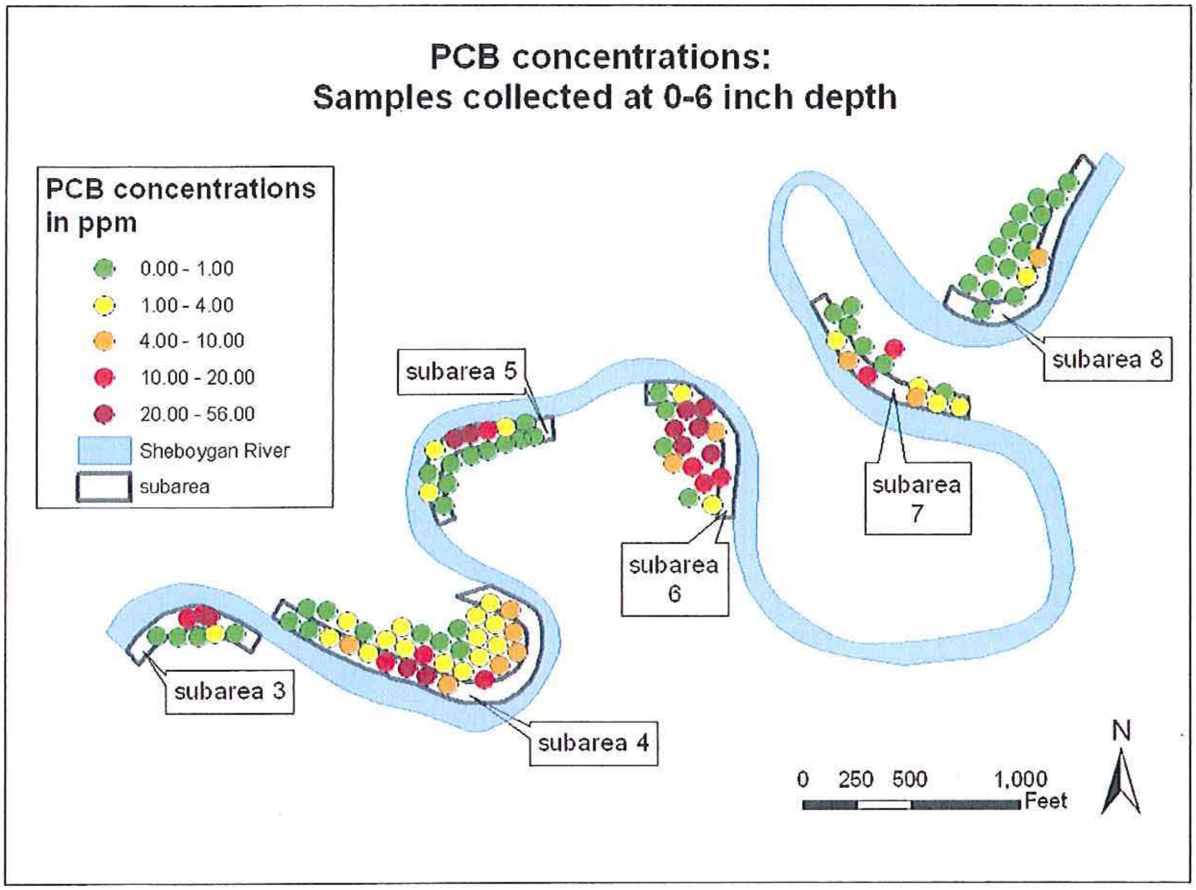


Figure 1: PCB Concentrations: Samples collected at 0 – 6 inch (0.0 – 0.5 ft) depth (from Phase II 2005 Floodplain Sample Results in Appendix A).

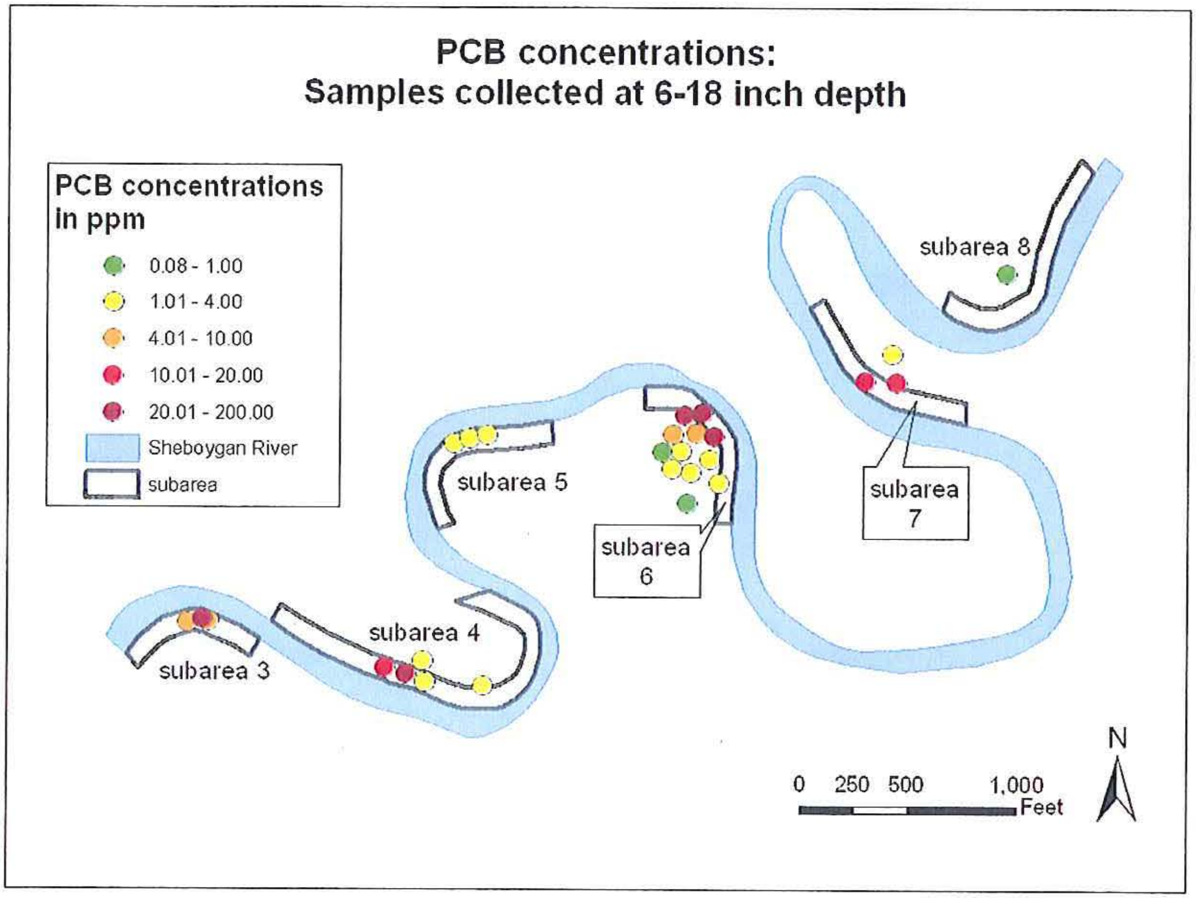


Figure 2: PCB Concentrations: Samples collected at 6 – 18 inch (0.0 – 0.5 ft) depth (from Phase II 2005 Floodplain Sample Results in Appendix B).

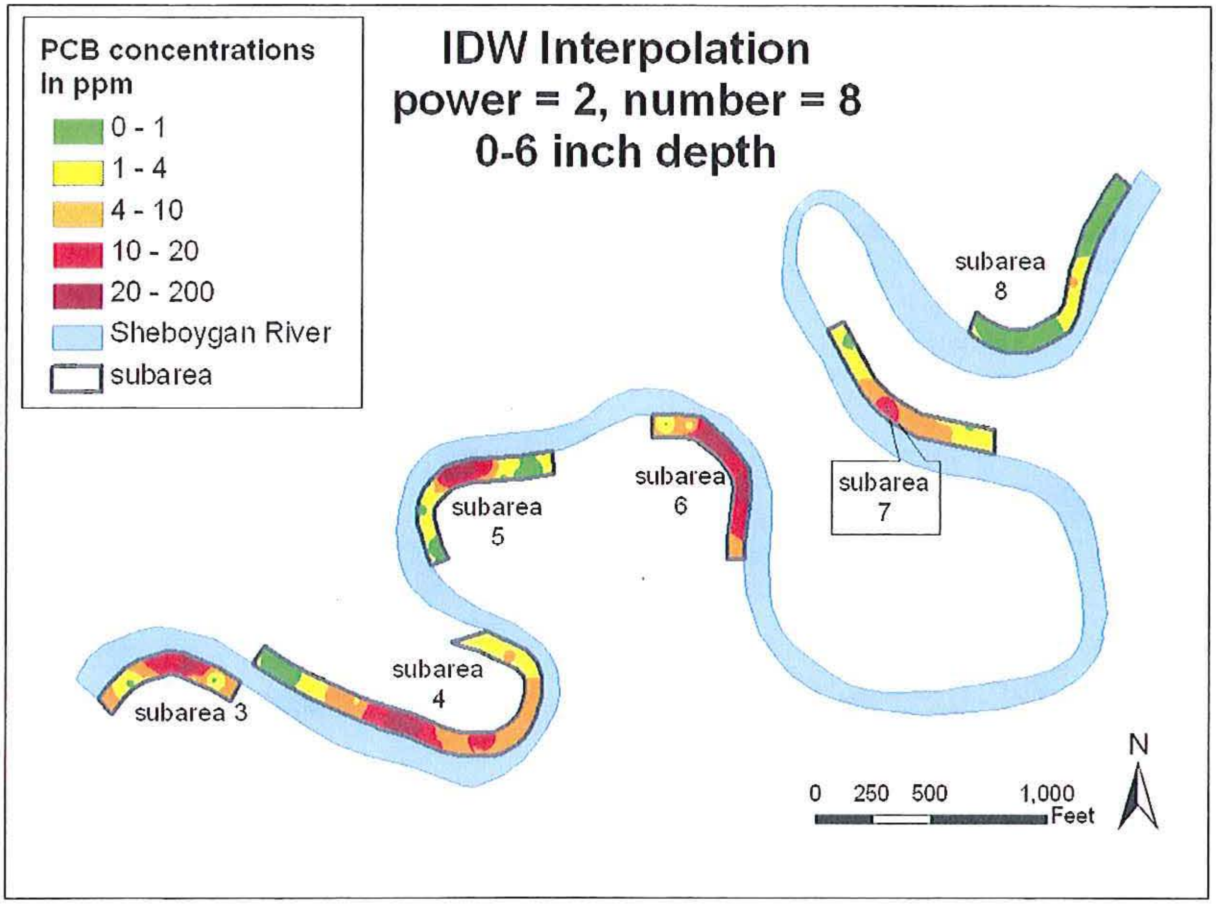


Figure 3: Inverse distance weighted (power = 2, number = 8) interpolation of PCBs, clipped by subareas, for 0 – 6 inch depth. Associated with statistics in Table 1.

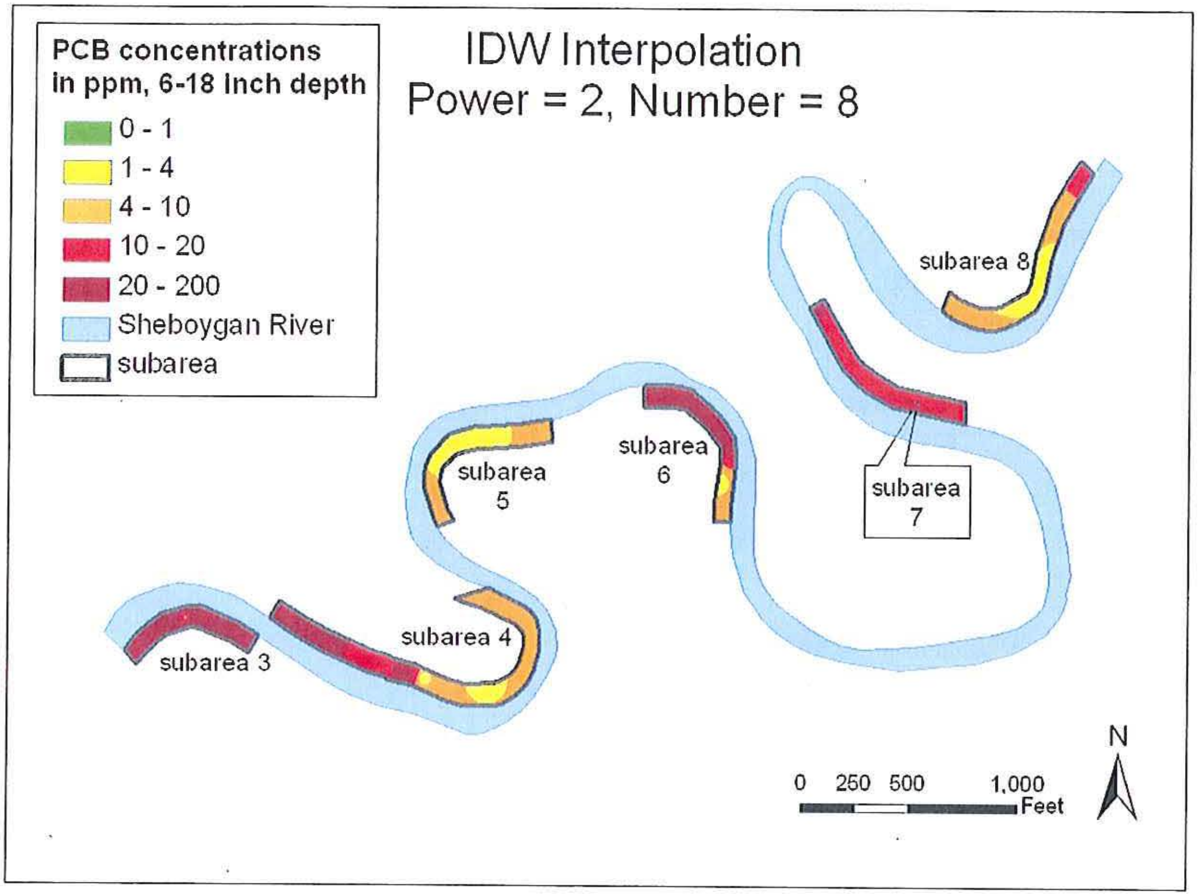


Figure 4: Inverse distance weighted (power = 2, number = 8) interpolation of PCBs, clipped by subareas, for 6 – 18 inch depth. Associated with statistics in Table 2.

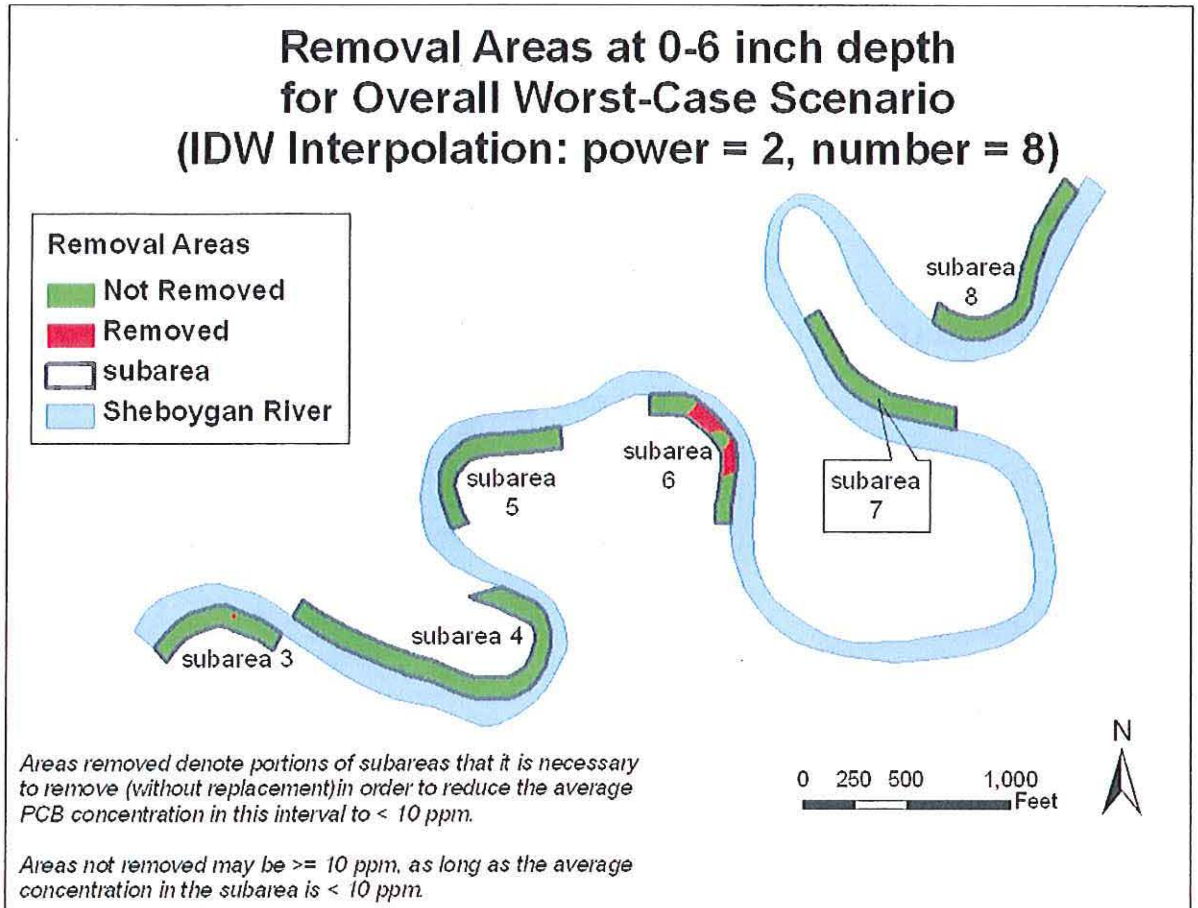


Figure 5: Removal areas in subareas for 0 – 6 inch depth—portions of subareas that it is necessary to remove (without replacement) in order to reduce the average (interpolated) PCB concentration to < 10 ppm. Associated with statistics in Table 3.

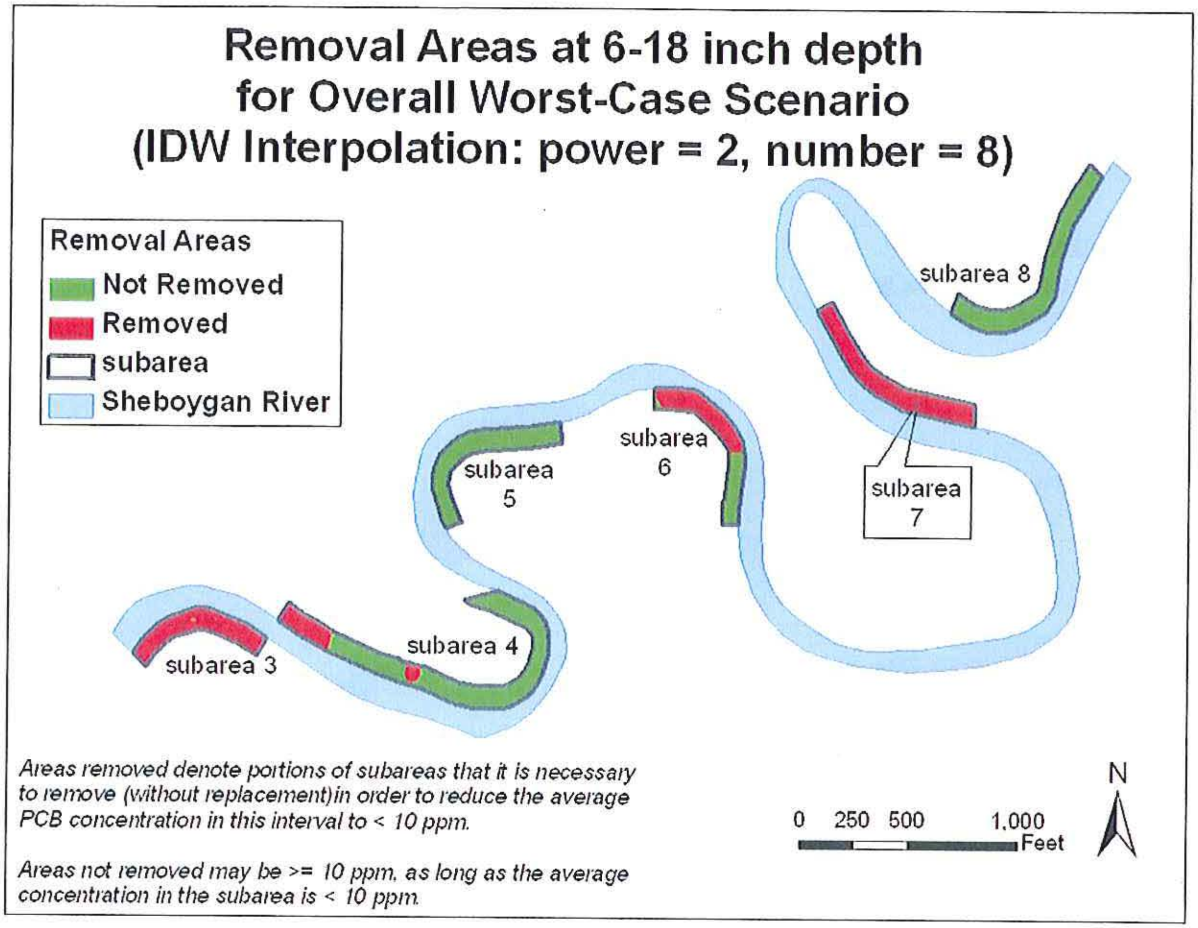


Figure 6: Removal areas in subareas for 6 – 18 inch depth—portions of subareas that it is necessary to remove (without replacement) in order to reduce the average (interpolated) PCB concentration to < 10 ppm. Associated with statistics in Table 4.

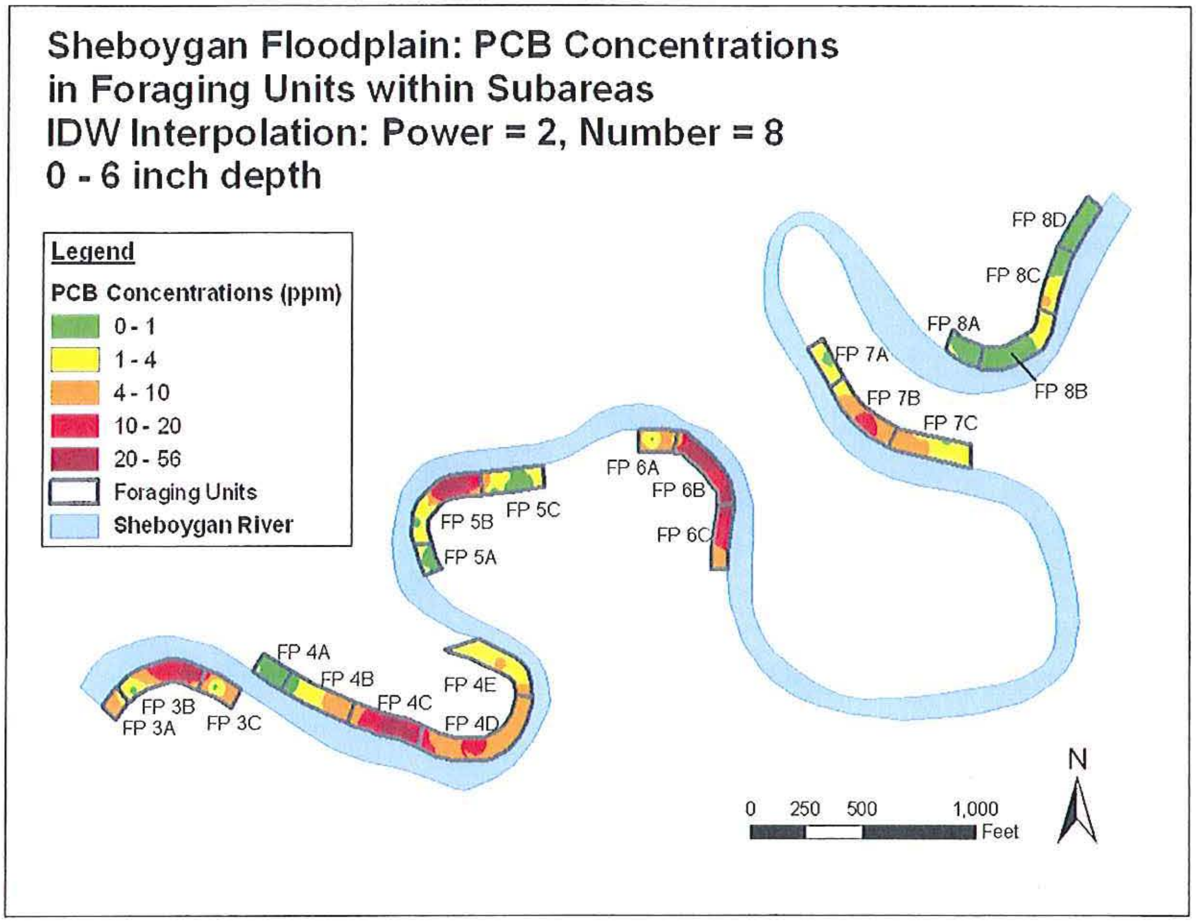


Figure 7: Inverse distance weighted (power = 2, number = 8) interpolation of PCBs, clipped by foraging units, for 0 – 6 inch depth. Associated with statistics in Table 5.

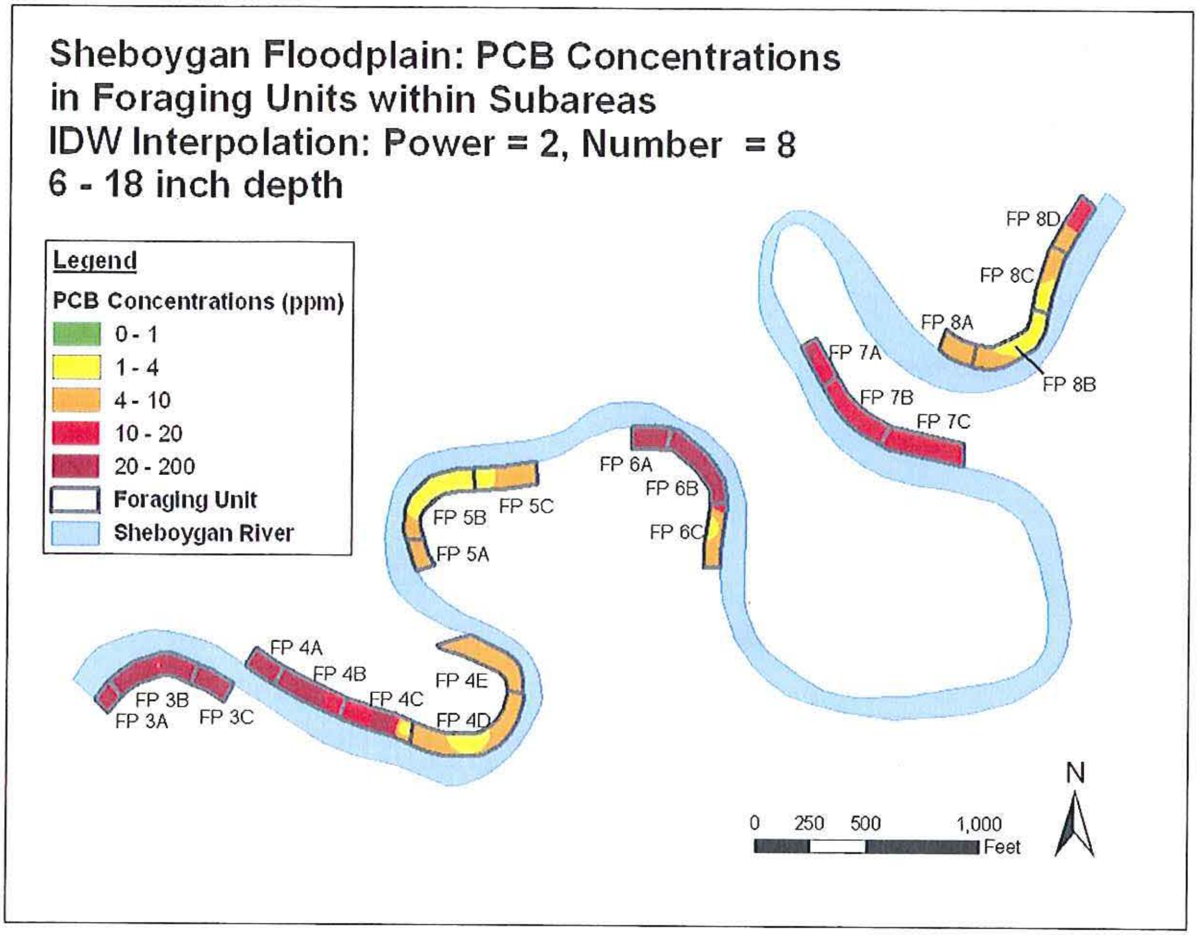


Figure 8: Inverse distance weighted (power = 2, number = 8) interpolation of PCBs, clipped by foraging units, for 6 – 18 inch depth. Associated with statistics in Table 6.

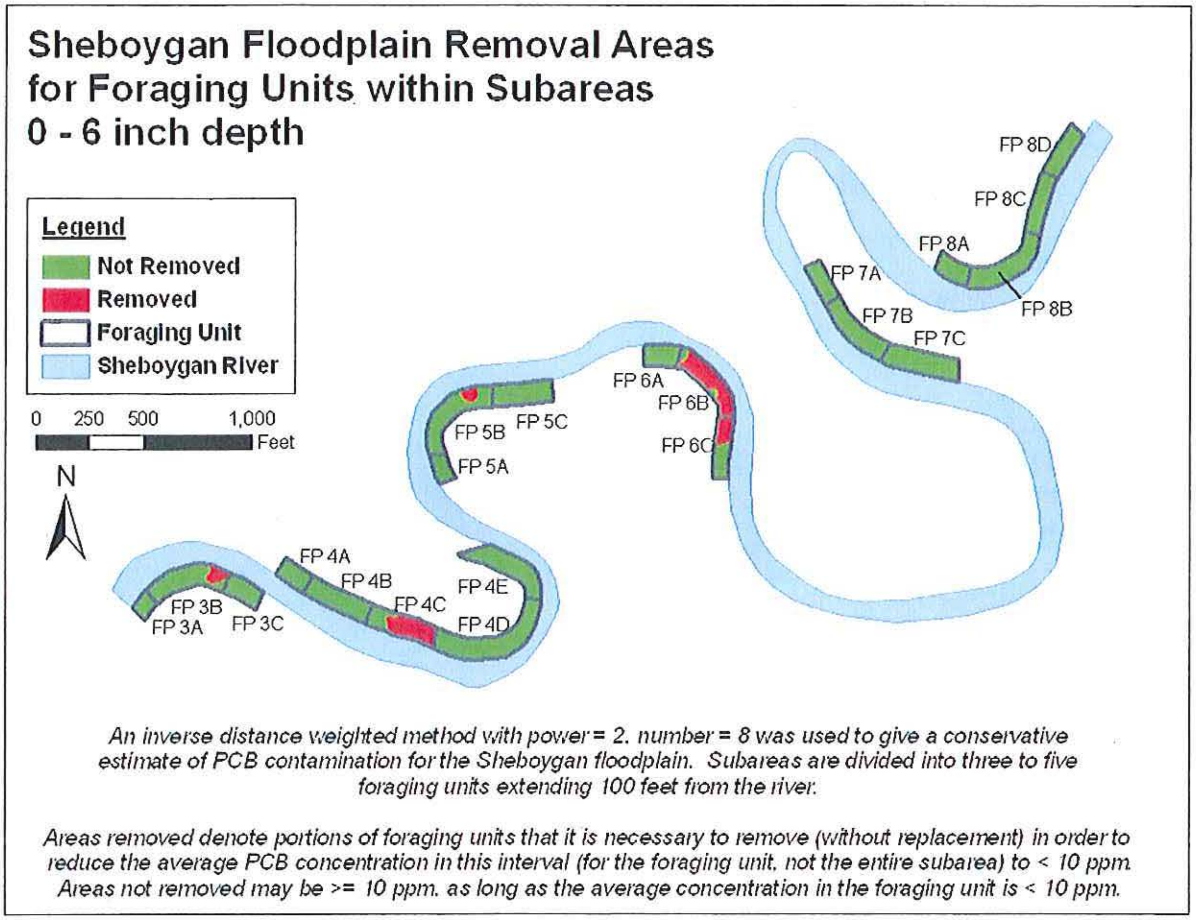


Figure 9: Removal areas in foraging units for 0 – 6 inch depth—portions of foraging units that it is necessary to remove (without replacement) in order to reduce the average (interpolated) PCB concentration to < 10 ppm. Associated with statistics in Table 7.

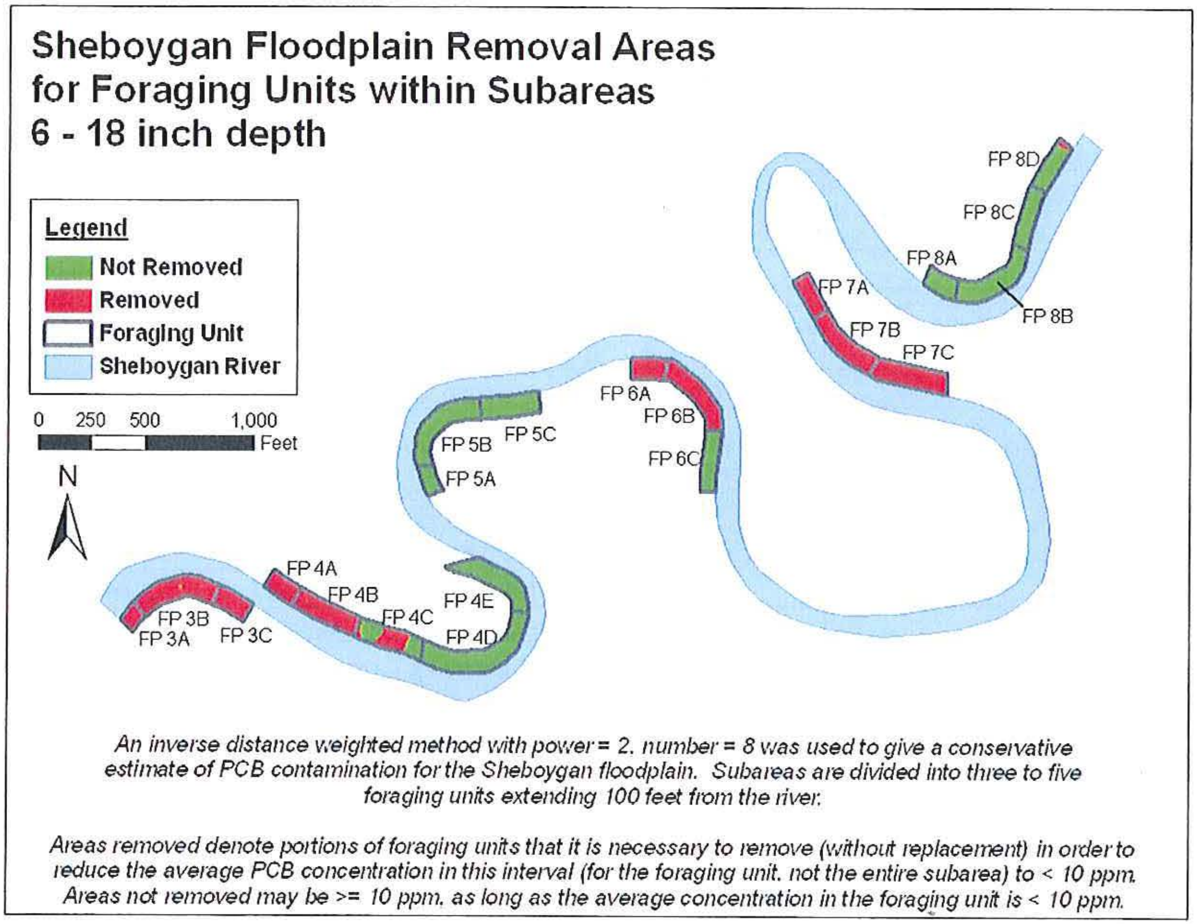


Figure 10: Removal areas in foraging units for 6– 18 inch depth—portions of foraging units that it is necessary to remove (without replacement) in order to reduce the average (interpolated) PCB concentration to < 10 ppm. Associated with statistics in Table 8.

APPENDIX A: PHASE II 2005 FLOODPLAIN SAMPLE RESULTS FOR 0.0 TO 0.5 FT DEPTH INTERVAL

Samples taken in autumn 2004; maximum taken when duplicate samples exist

SAMPLE_ID	FLOODPLAIN	START_FT	END_FT	NORTHING	EASTING	PCB_CONC	UNITS
FP3_S1_0_0.5	3	0.0	0.5	2549939.81	636737.82	14.00	MG/KG
FP3_S2_0_0.5	3	0.0	0.5	2549869.65	636723.40	17.00	MG/KG
FP3_S3_0_0.5	3	0.0	0.5	2549968.77	636725.00	56.00	MG/KG
FP3_S4_0_0.5	3	0.0	0.5	2549728.65	636638.65	0.56	MG/KG
FP3_S5_0_0.5	3	0.0	0.5	2549824.18	636637.12	0.07	MG/KG
FP3_S6_0_0.5	3	0.0	0.5	2549920.41	636636.62	0.12	MG/KG
FP3_S7_0_0.5	3	0.0	0.5	2549993.12	636653.74	2.90	MG/KG
FP3_S8_0_0.5	3	0.0	0.5	2550087.13	636654.19	0.45	MG/KG
FP4_S1_0_0.5	4	0.0	0.5	2550331.88	636704.20	0.45	MG/KG
FP4_S2_0_0.5	4	0.0	0.5	2550423.94	636667.13	0.25	MG/KG
FP4_S3_0_0.5	4	0.0	0.5	2550515.24	636631.06	3.50	MG/KG
FP4_S4_0_0.5	4	0.0	0.5	2550606.49	636597.01	5.70	MG/KG
FP4_S5_0_0.5	4	0.0	0.5	2550694.85	636560.95	3.90	MG/KG
FP4_S6_0_0.5	4	0.0	0.5	2550778.48	636517.69	16.00	MG/KG
FP4_S7_0_0.5	4	0.0	0.5	2550875.14	636489.95	37.00	MG/KG
FP4_S8_0_0.5	4	0.0	0.5	2550960.07	636450.67	23.00	MG/KG
FP4_S9_0_0.5	4	0.0	0.5	2551054.94	636415.40	9.50	MG/KG
FP4_S10_0_0.5	4	0.0	0.5	2550412.51	636766.09	0.40	MG/KG
FP4_S11_0_0.5	4	0.0	0.5	2550504.97	636753.19	0.05	MG/KG
FP4_S12_0_0.5	4	0.0	0.5	2550595.83	636707.76	3.00	MG/KG
FP4_S13_0_0.5	4	0.0	0.5	2550679.89	636654.65	0.43	MG/KG
FP4_S14_0_0.5	4	0.0	0.5	2550774.10	636619.97	3.50	MG/KG
FP4_S15_0_0.5	4	0.0	0.5	2550862.49	636582.50	2.00	MG/KG
FP4_S16_0_0.5	4	0.0	0.5	2550948.43	636549.02	10.70	MG/KG
FP4_S17_0_0.5	4	0.0	0.5	2551038.43	636512.20	2.20	MG/KG
FP4_S18_0_0.5	4	0.0	0.5	2551126.80	636476.04	2.50	MG/KG
FP4_S19_0_0.5	4	0.0	0.5	2551224.64	636436.80	18.00	MG/KG
FP4_S20_0_0.5	4	0.0	0.5	2550845.95	636680.31	1.20	MG/KG
FP4_S21_0_0.5	4	0.0	0.5	2550938.72	636644.27	0.79	MG/KG
FP4_S22_0_0.5	4	0.0	0.5	2551025.59	636609.09	0.83	MG/KG
FP4_S23_0_0.5	4	0.0	0.5	2551114.00	636570.92	0.73	MG/KG
FP4_S24_0_0.5	4	0.0	0.5	2551201.58	636536.77	2.10	MG/KG
FP4_S25_0_0.5	4	0.0	0.5	2551295.79	636501.78	5.50	MG/KG
FP4_S26_0_0.5	4	0.0	0.5	2551102.65	636666.84	0.54	MG/KG
FP4_S27_0_0.5	4	0.0	0.5	2551191.02	636630.69	1.10	MG/KG
FP4_S28_0_0.5	4	0.0	0.5	2551280.85	636594.57	1.30	MG/KG
FP4_S29_0_0.5	4	0.0	0.5	2551372.13	636559.51	7.00	MG/KG
FP4_S30_0_0.5	4	0.0	0.5	2551187.69	636728.85	1.30	MG/KG

SAMPLE_ID	FLOODPLAIN	START_FT	END_FT	NORTHING	EASTING	PCB_CONC	UNITS
FP4_S31_0_0.5	4	0.0	0.5	2551270.21	636691.53	1.10	MG/KG
FP4_S32_0_0.5	4	0.0	0.5	2551358.60	636654.36	4.10	MG/KG
FP4_S33_0_0.5	4	0.0	0.5	2551252.20	636789.30	2.30	MG/KG
FP4_S34_0_0.5	4	0.0	0.5	2551342.79	636752.19	4.50	MG/KG
FP5_S1_0_0.5	5	0.0	0.5	2551039.88	637235.42	0.07	MG/KG
FP5_S2_0_0.5	5	0.0	0.5	2551057.91	637331.11	0.18	MG/KG
FP5_S3_0_0.5	5	0.0	0.5	2551071.57	637425.66	0.19	MG/KG
FP5_S4_0_0.5	5	0.0	0.5	2551164.69	637459.53	0.06	MG/KG
FP5_S5_0_0.5	5	0.0	0.5	2551237.53	637483.10	0.06	MG/KG
FP5_S6_0_0.5	5	0.0	0.5	2551320.71	637516.10	0.02	MG/KG
FP5_S7_0_0.5	5	0.0	0.5	2551392.78	637536.98	0.01	MG/KG
FP5_S8_0_0.5	5	0.0	0.5	2551449.80	637549.84	0.04	MG/KG
FP5_S9_0_0.5	5	0.0	0.5	2550970.99	637295.76	3.20	MG/KG
FP5_S10_0_0.5	5	0.0	0.5	2550968.82	637382.35	0.38	MG/KG
FP5_S11_0_0.5	5	0.0	0.5	2550998.66	637488.56	1.70	MG/KG
FP5_S12_0_0.5	5	0.0	0.5	2551091.56	637539.13	28.00	MG/KG
FP5_S13_0_0.5	5	0.0	0.5	2551160.51	637560.83	42.00	MG/KG
FP5_S14_0_0.5	5	0.0	0.5	2551237.64	637576.32	16.00	MG/KG
FP5_S15_0_0.5	5	0.0	0.5	2551319.76	637591.63	2.70	MG/KG
FP5_S16_0_0.5	5	0.0	0.5	2551413.89	637604.35	0.20	MG/KG
FP6_S1_0_0.5	6	0.0	0.5	2552023.66	637749.51	0.82	MG/KG
FP6_S2_0_0.5	6	0.0	0.5	2552052.05	637665.85	0.28	MG/KG
FP6_S3_0_0.5	6	0.0	0.5	2552092.54	637578.53	25.00	MG/KG
FP6_S4_0_0.5	6	0.0	0.5	2552130.40	637506.75	23.00	MG/KG
FP6_S5_0_0.5	6	0.0	0.5	2552174.12	637407.14	20.00	MG/KG
FP6_S6_0_0.5	6	0.0	0.5	2552229.55	637330.87	12.00	MG/KG
FP6_S7_0_0.5	6	0.0	0.5	2552266.54	637234.46	1.80	MG/KG
FP6_S8_0_0.5	6	0.0	0.5	2552122.69	637742.18	2.60	MG/KG
FP6_S9_0_0.5	6	0.0	0.5	2552148.66	637666.67	26.00	MG/KG
FP6_S10_0_0.5	6	0.0	0.5	2552199.70	637584.40	22.00	MG/KG
FP6_S11_0_0.5	6	0.0	0.5	2552258.69	637465.81	35.00	MG/KG
FP6_S12_0_0.5	6	0.0	0.5	2552304.94	637357.79	20.00	MG/KG
FP6_S13_0_0.5	6	0.0	0.5	2552227.00	637676.04	46.00	MG/KG
FP6_S14_0_0.5	6	0.0	0.5	2552280.83	637568.67	10.00	MG/KG
FP6_S15_0_0.5	6	0.0	0.5	2552041.66	637499.65	0.94	MG/KG
FP6_S16_0_0.5	6	0.0	0.5	2552085.68	637421.31	5.00	MG/KG
FP6_S18_0_0.5	6	0.0	0.5	2552154.86	637268.98	0.17	MG/KG
FP7_S1_0_0.5	7	0.0	0.5	2552831.12	637986.52	2.60	MG/KG
FP7_S2_0_0.5	7	0.0	0.5	2552886.28	637892.85	8.00	MG/KG
FP7_S3_0_0.5	7	0.0	0.5	2552969.51	637823.44	16.50	MG/KG
FP7_S4_0_0.5	7	0.0	0.5	2553095.59	637946.37	17.90	MG/KG
FP7_S5_0_0.5	7	0.0	0.5	2553196.58	637727.02	9.00	MG/KG

SAMPLE_ID	FLOODPLAIN	START_FT	END_FT	NORTHING	EASTING	PCB_CONC	UNITS
FP7_S6_0_0.5	7	0.0	0.5	2553296.96	637699.98	2.90	MG/KG
FP7_S7_0_0.5	7	0.0	0.5	2553398.88	637681.49	1.49	MG/KG
FP7_S8_0_0.5	7	0.0	0.5	2552817.96	638107.68	0.57	MG/KG
FP7_S9_0_0.5	7	0.0	0.5	2552890.43	638051.00	0.12	MG/KG
FP7_S10_0_0.5	7	0.0	0.5	2552957.56	637956.98	0.06	MG/KG
FP7_S11_0_0.5	7	0.0	0.5	2553048.30	637875.04	0.18	MG/KG
FP7_S13_0_0.5	7	0.0	0.5	2553211.64	637773.73	1.40	MG/KG
FP7_S14_0_0.5	7	0.0	0.5	2553326.80	637745.35	0.14	MG/KG
FP7_S15_0_0.5	7	0.0	0.5	2552899.30	638139.22	0.08	MG/KG
FP8_S1_0_0.5	8	0.0	0.5	2553438.83	638240.99	0.15	MG/KG
FP8_S2_0_0.5	8	0.0	0.5	2553514.47	638329.53	0.00	MG/KG
FP8_S3_0_0.5	8	0.0	0.5	2553576.72	638412.90	0.12	MG/KG
FP8_S4_0_0.5	8	0.0	0.5	2553629.36	638484.92	0.21	MG/KG
FP8_S5_0_0.5	8	0.0	0.5	2553675.22	638566.28	0.19	MG/KG
FP8_S6_0_0.5	8	0.0	0.5	2553752.40	638634.85	0.19	MG/KG
FP8_S7_0_0.5	8	0.0	0.5	2553498.29	638121.19	0.24	MG/KG
FP8_S8_0_0.5	8	0.0	0.5	2553543.79	638213.96	0.23	MG/KG
FP8_S9_0_0.5	8	0.0	0.5	2553620.43	638313.86	0.13	MG/KG
FP8_S10_0_0.5	8	0.0	0.5	2553683.02	638396.26	0.97	MG/KG
FP8_S11_0_0.5	8	0.0	0.5	2553713.61	638476.14	0.52	MG/KG
FP8_S12_0_0.5	8	0.0	0.5	2553772.68	638554.68	0.05	MG/KG
FP8_S13_0_0.5	8	0.0	0.5	2553841.40	638631.56	0.01	MG/KG
FP8_S14_0_0.5	8	0.0	0.5	2553891.78	638708.77	0.01	MG/KG
FP8_S15_0_0.5	8	0.0	0.5	2553761.50	638360.81	4.90	MG/KG
FP8_S16_0_0.5	8	0.0	0.5	2553702.86	638275.55	1.60	MG/KG
FP8_S17_0_0.5	8	0.0	0.5	2553650.97	638183.55	0.56	MG/KG

Appendix B: Phase II 2005 Floodplain Sample Results for 0.5 – 1.5 ft Depth Interval

Samples taken in autumn 2004, maximum taken when duplicate samples exist

SAMPLE_ID	FLOODPLAIN	START_FT	END_FT	NORTHING	EASTING	PCB_CONC	UNITS
FP3_S1_0.5_1.5	3	0.5	1.5	636737.82	2549939.81	194.00	MG/KG
FP3_S2_0.5_1.5	3	0.5	1.5	636723.40	2549869.65	8.30	MG/KG
FP3_S3_0.5_1.5	3	0.5	1.5	636725.00	2549968.77	9.30	MG/KG
FP4_S6_0.5_1.5	4	0.5	1.5	636517.69	2550778.48	11.00	MG/KG
FP4_S7_0.5_1.5	4	0.5	1.5	636489.95	2550875.14	42.00	MG/KG
FP4_S8_0.5_1.5	4	0.5	1.5	636450.67	2550960.07	1.40	MG/KG
FP4_S16_0.5_1.5	4	0.5	1.5	636549.02	2550948.43	1.90	MG/KG
FP4_S19_0.5_1.5	4	0.5	1.5	636436.80	2551224.64	1.80	MG/KG
FP5_S12_0.5_1.5	5	0.5	1.5	637539.13	2551091.56	3.80	MG/KG
FP5_S13_0.5_1.5	5	0.5	1.5	637560.83	2551160.51	2.27	MG/KG
FP5_S14_0.5_1.5	5	0.5	1.5	637576.32	2551237.64	3.00	MG/KG
FP6_S3_0.5_1.5	6	0.5	1.5	637578.53	2552092.54	5.40	MG/KG
FP6_S4_0.5_1.5	6	0.5	1.5	637506.75	2552130.40	2.60	MG/KG
FP6_S5_0.5_1.5	6	0.5	1.5	637407.14	2552174.12	1.60	MG/KG
FP6_S9_0.5_1.5	6	0.5	1.5	637666.67	2552148.66	87.00	MG/KG
FP6_S10_0.5_1.5	6	0.5	1.5	637584.40	2552199.70	5.60	MG/KG
FP6_S11_0.5_1.5	6	0.5	1.5	637465.81	2552258.69	1.90	MG/KG
FP6_S12_0.5_1.5	6	0.5	1.5	637357.79	2552304.94	1.10	MG/KG
FP6_S13_0.5_1.5	6	0.5	1.5	637676.04	2552227.00	41.00	MG/KG
FP6_S14_0.5_1.5	6	0.5	1.5	637568.67	2552280.83	86.00	MG/KG
FP6_S15_0.5_1.5	6	0.5	1.5	637499.65	2552041.66	0.27	MG/KG
FP6_S16_0.5_1.5	6	0.5	1.5	637421.31	2552085.68	2.30	MG/KG
FP6_S18_0.5_1.5	6	0.5	1.5	637268.98	2552154.86	0.08	MG/KG
FP7_S3_0.5_1.5	7	0.5	1.5	637823.44	2552969.51	13.00	MG/KG
FP7_S4_0.5_1.5	7	0.5	1.5	637946.37	2553095.59	3.40	MG/KG
FP7_S12_0.5_1.5	7	0.5	1.5	637818.15	2553116.69	11.00	MG/KG
FP8_S9_0.5_1.5	8	0.5	1.5	638313.86	2553620.43	0.67	MG/KG

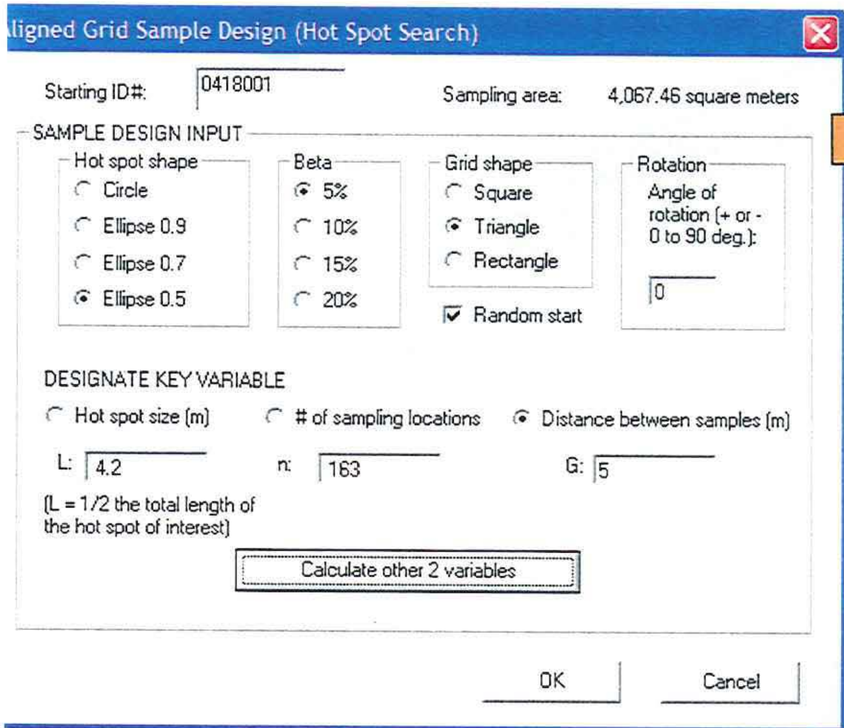
ATTACHMENT 3 – ***Aligned Grid ('hot spot") Sample Design***

Aligned Grid ("hotspot") Sample Designs

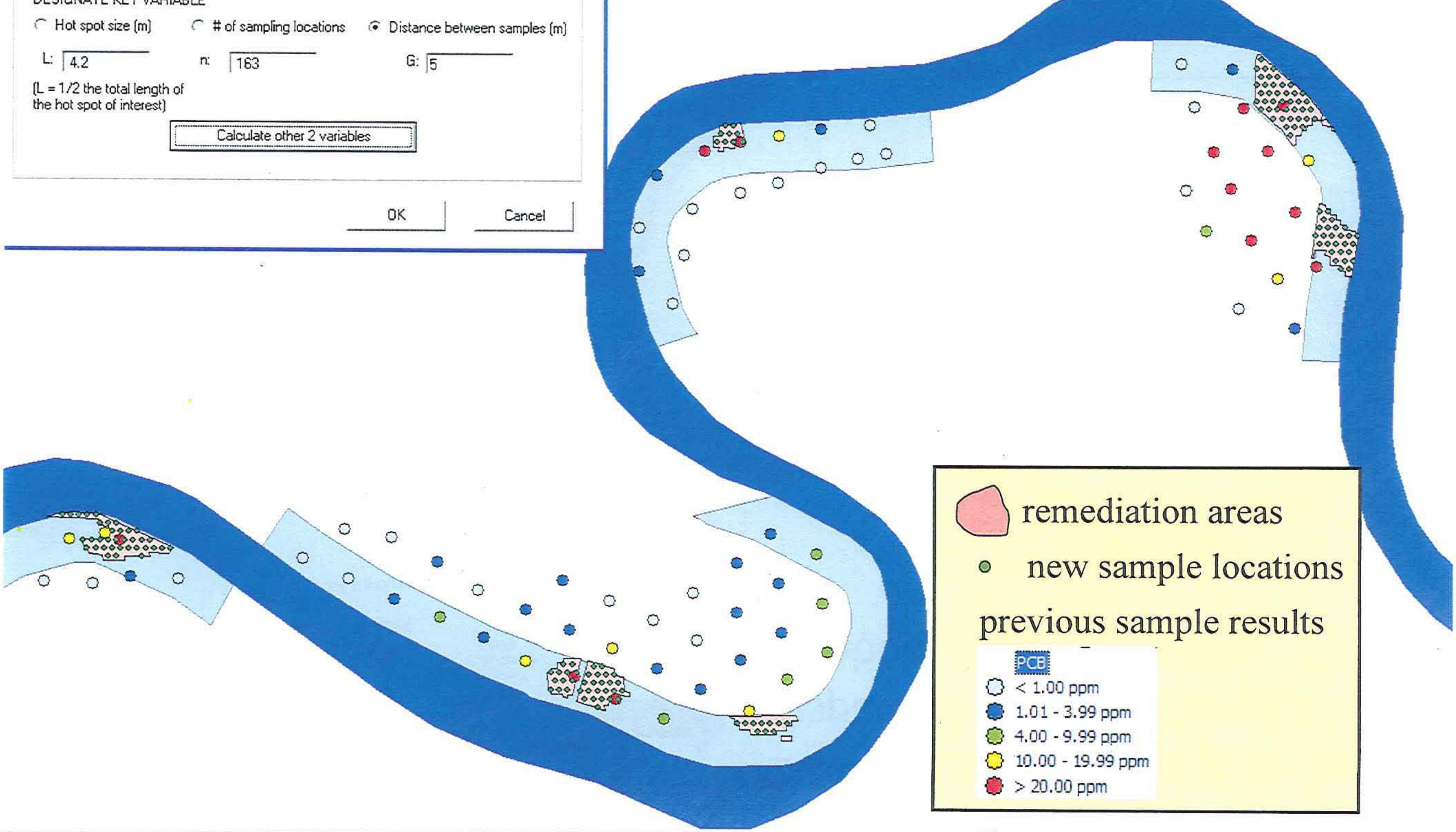
The following designs are based on a "hotspot" search. The logic is to find a hotspot of a certain size for a certain probability. For example, in the following slide, there is a 95% chance of finding a hotspot of radius 4.2 meters (diameter of about 27.5 feet) or greater.

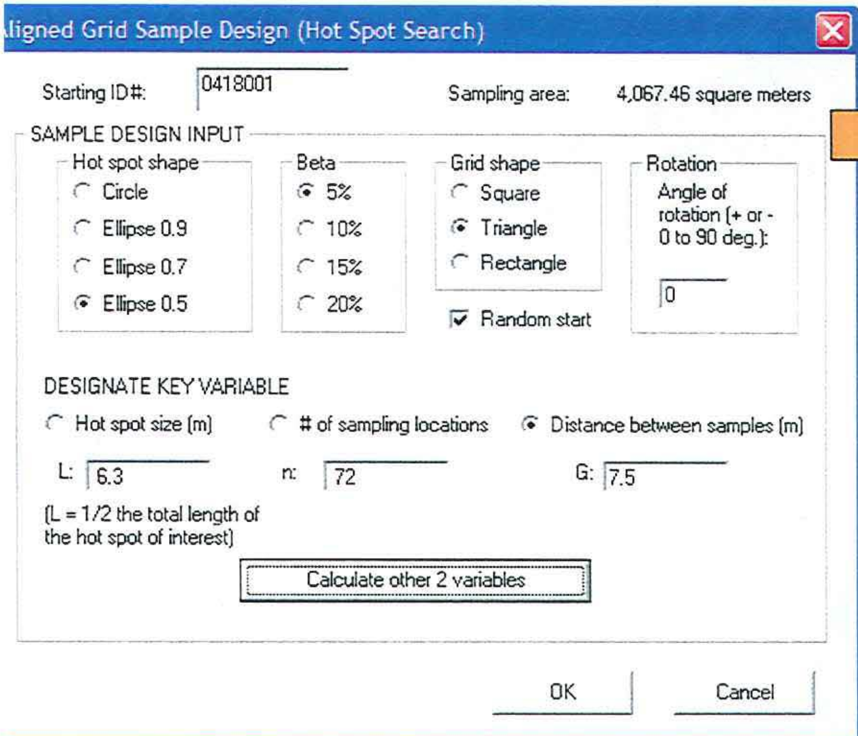
Aligned Grid ("hotspot" design)

0-6" remediation areas

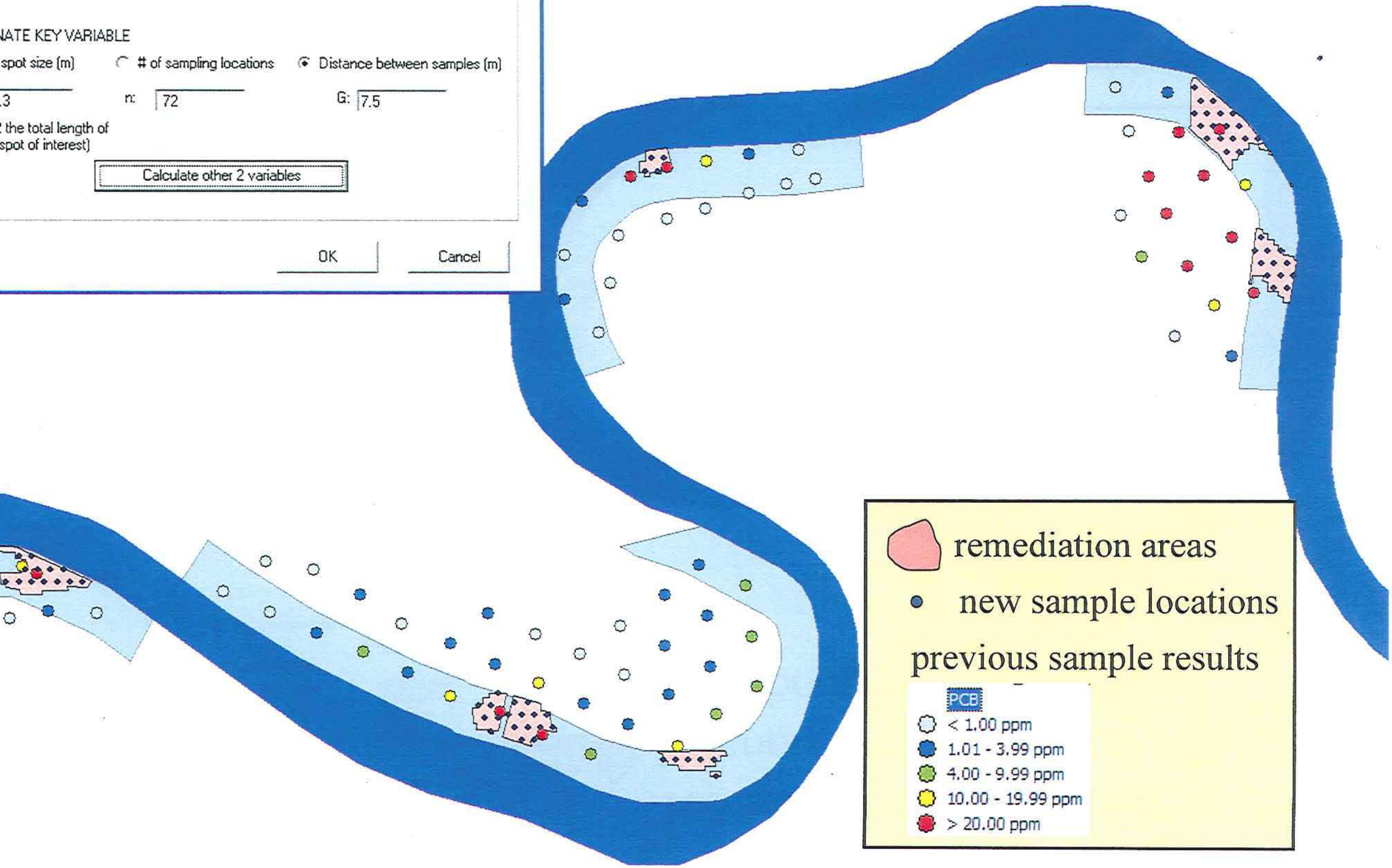


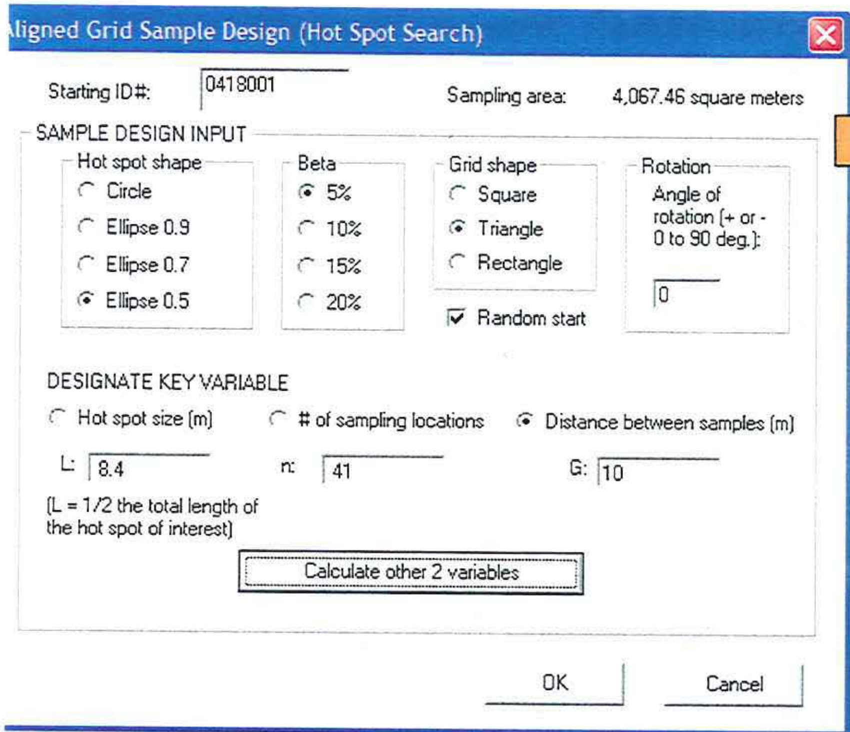
163 sample locations; would find hotspots with a diameter of 27.5 feet about 95% of the time



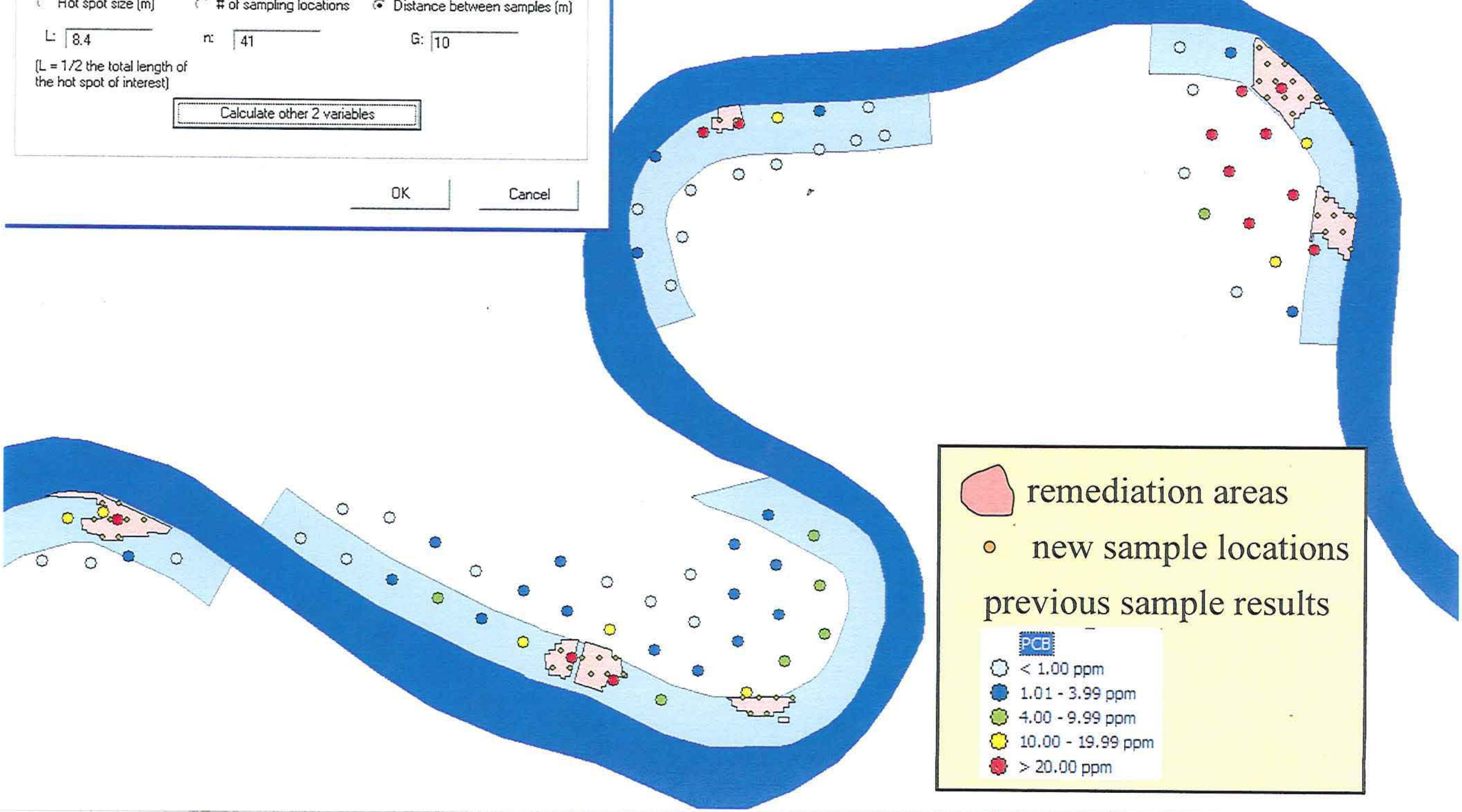


72 sample locations; would find hotspots with a diameter of 41.3 feet about 95% of the time



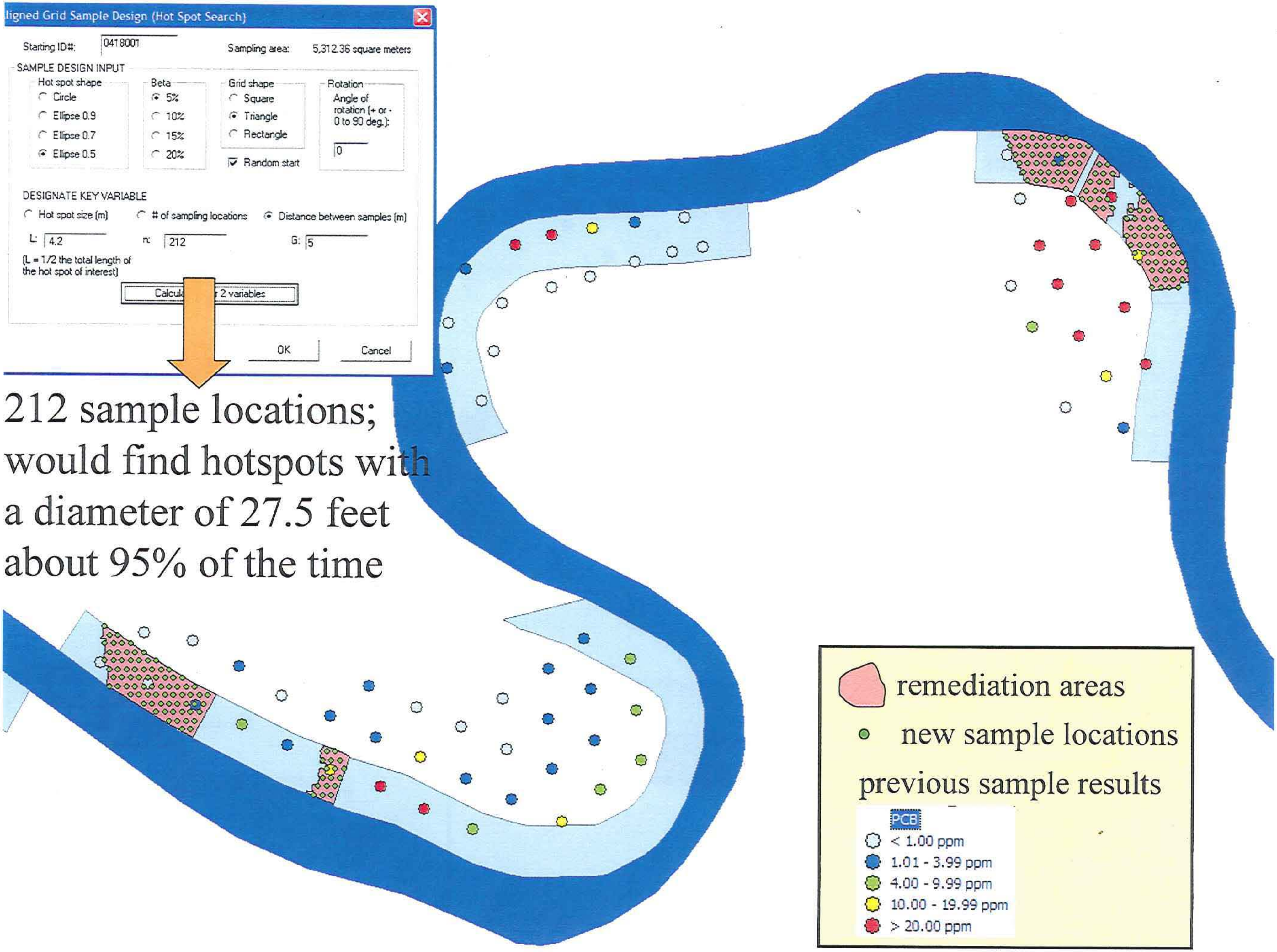


41 sample locations; would find hotspots with a diameter of 55.1 feet about 95% of the time

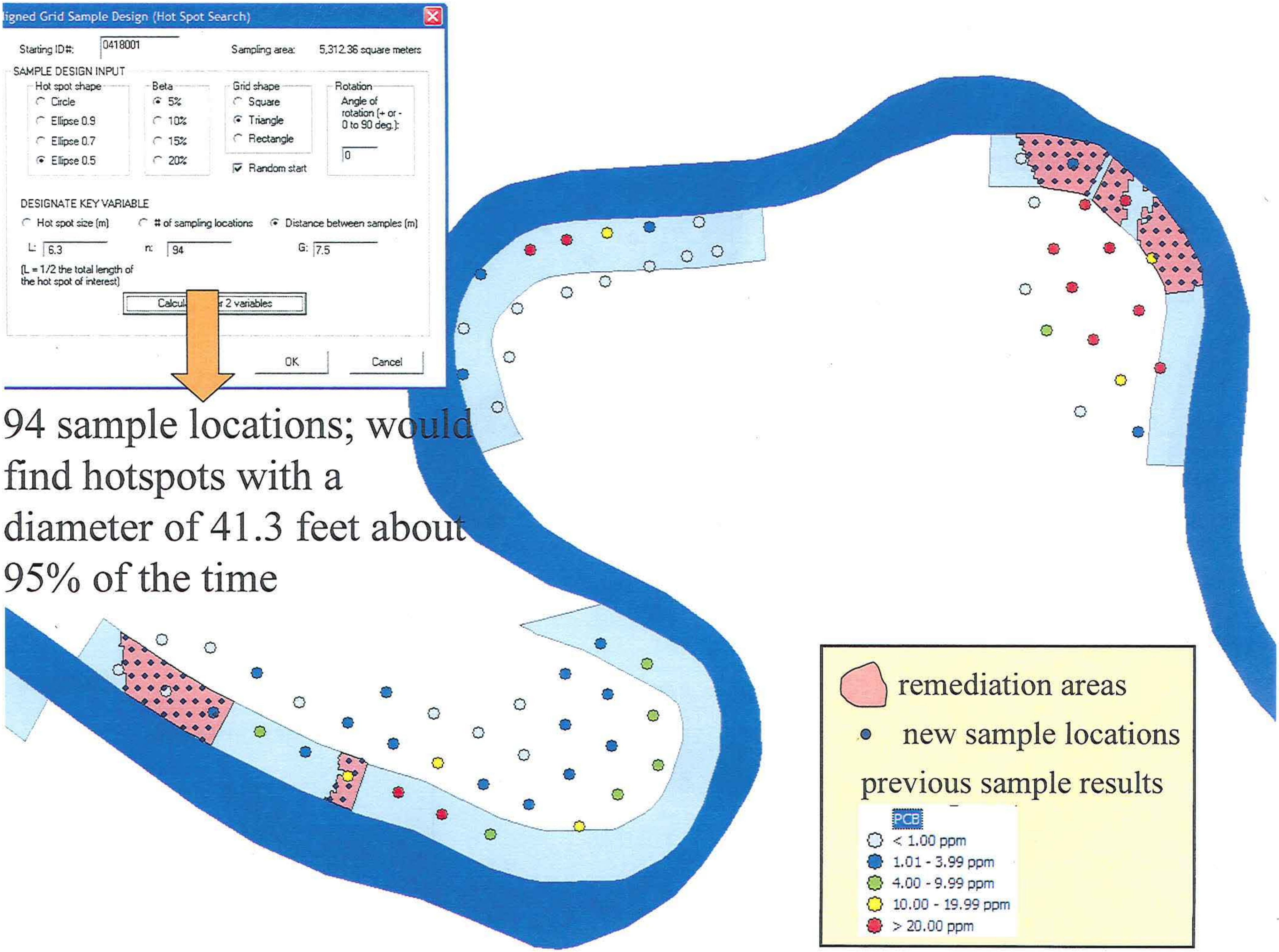


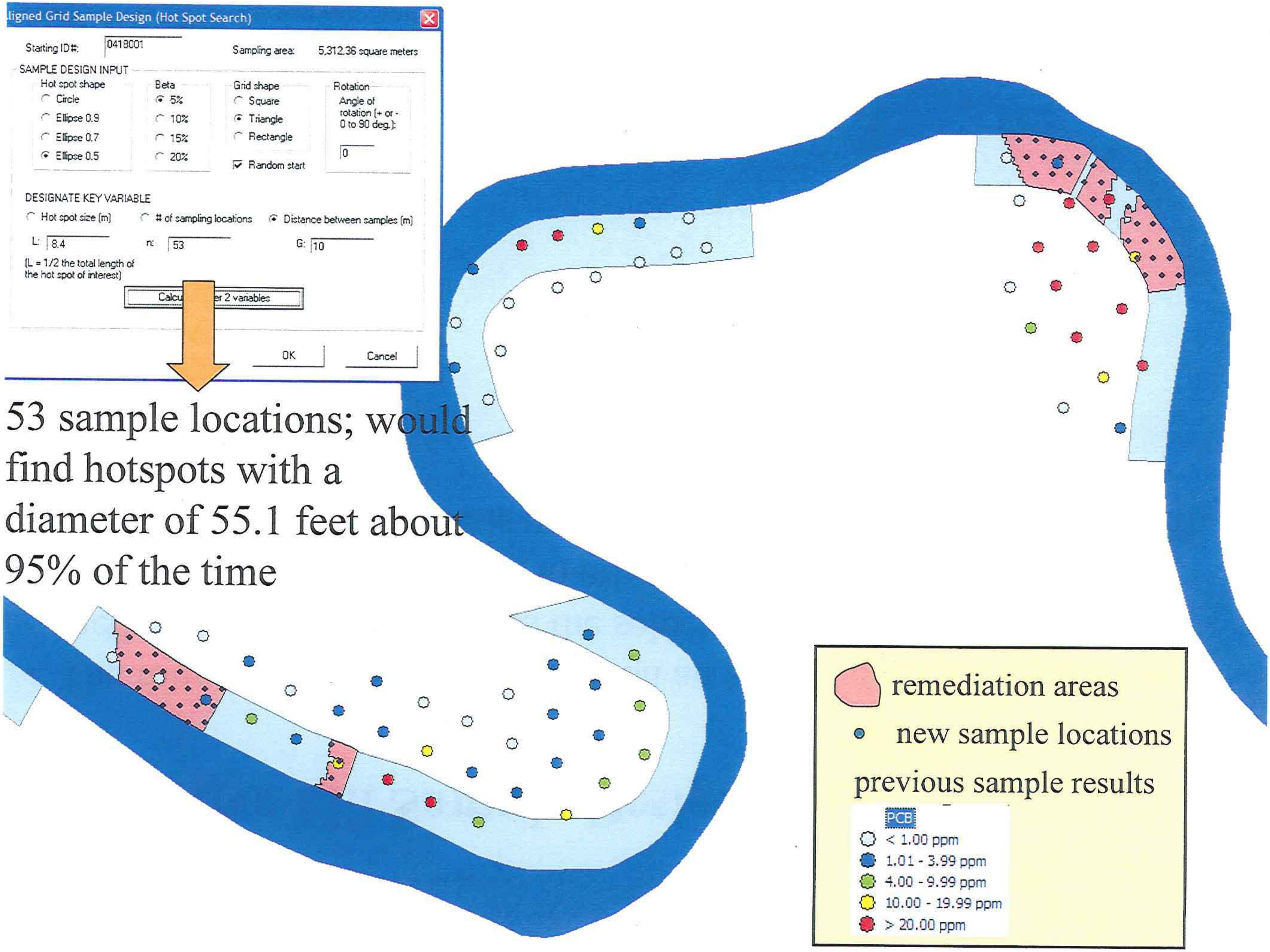
Aligned Grid ("hotspot" design)

6-18" remediation areas



ligned Grid Sample Design (Hot Spot Search)
Starting ID#: 0418001
Sampling area: 5,312.36 square meters
SAMPLE DESIGN INPUT
Hot spot shape
Circle
Ellipse 0.9
Ellipse 0.7
Ellipse 0.5
Beta
5%
10%
15%
20%
Grid shape
Square
Triangle
Rectangle
Random start
Rotation
Angle of rotation (+ or - 0 to 90 deg.):
0
DESIGNATE KEY VARIABLE
Hot spot size (m)
# of sampling locations
Distance between samples (m)
L: 4.2
n: 212
G: 5
(L = 1/2 the total length of the hot spot of interest)
Calcul... 2 variables
OK
Cancel
212 sample locations; would find hotspots with a diameter of 27.5 feet about 95% of the time
remediation areas
new sample locations
previous sample results
PCB
< 1.00 ppm
1.01 - 3.99 ppm
4.00 - 9.99 ppm
10.00 - 19.99 ppm
> 20.00 ppm


ligned Grid Sample Design (Hot Spot Search)
Starting ID#: 0418001
Sampling area: 5,312.36 square meters
SAMPLE DESIGN INPUT
Hot spot shape
Circle
Ellipse 0.9
Ellipse 0.7
Ellipse 0.5
Beta
5%
10%
15%
20%
Grid shape
Square
Triangle
Rectangle
Random start
Rotation
Angle of rotation (+ or - 0 to 90 deg.):
0
DESIGNATE KEY VARIABLE
Hot spot size (m)
# of sampling locations
Distance between samples (m)
L: 6.3
n: 94
G: 7.5
(L = 1/2 the total length of the hot spot of interest)
Calcul r 2 variables
OK
Cancel
94 sample locations; would find hotspots with a diameter of 41.3 feet about 95% of the time
remediation areas
new sample locations
previous sample results
PCB
< 1.00 ppm
1.01 - 3.99 ppm
4.00 - 9.99 ppm
10.00 - 19.99 ppm
> 20.00 ppm



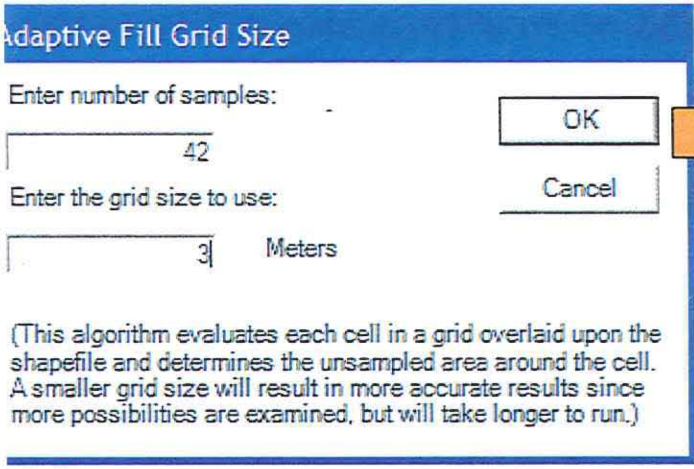
53 sample locations; would find hotspots with a diameter of 55.1 feet about 95% of the time

Adaptive Fill Sample Designs

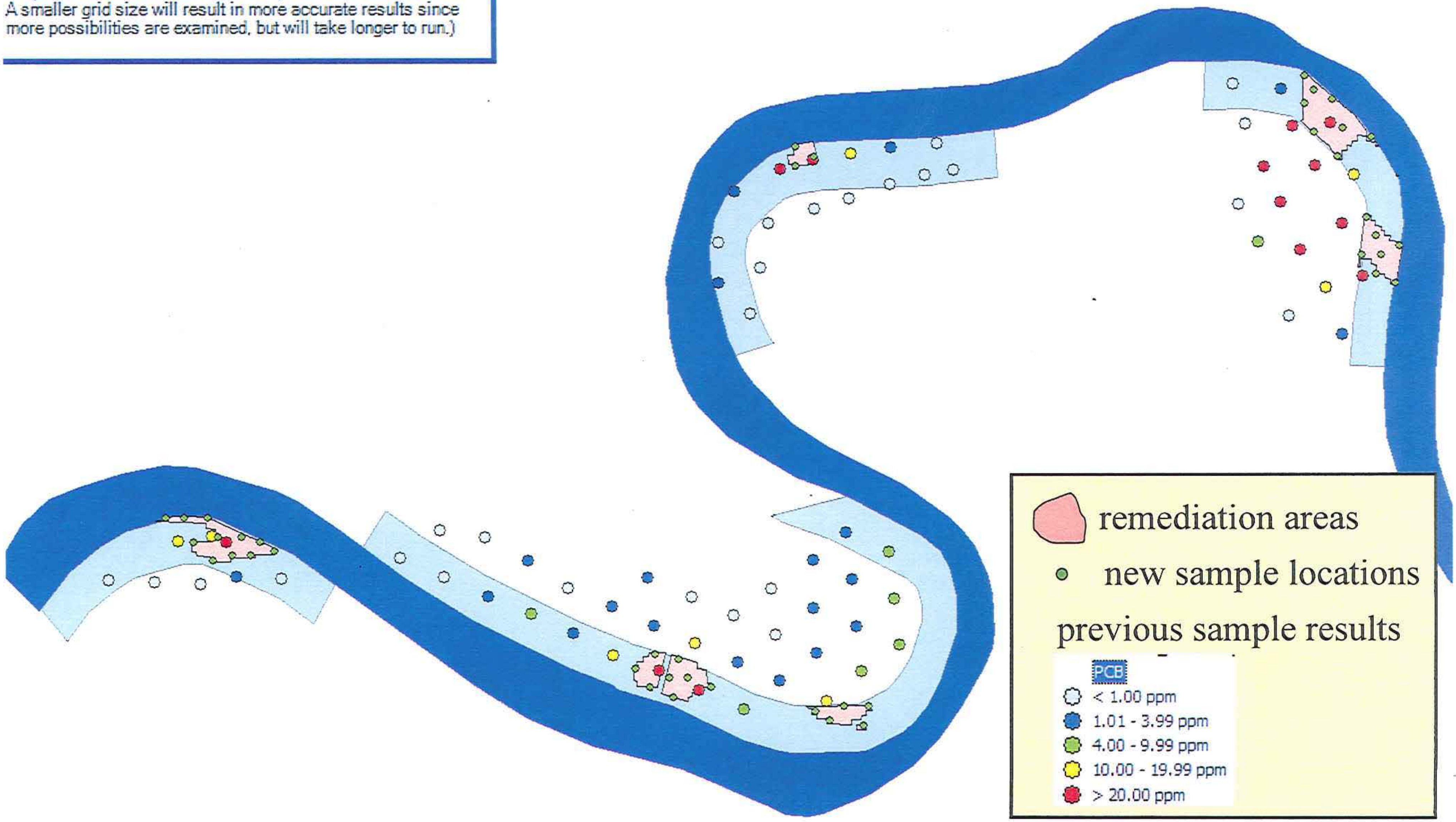
The following designs are based on an adaptive fill sample design method. The method places the selected number of samples in the most poorly sampled areas, in other words, away from existing sample locations. There is no statistical probability associated with this design.

Adaptive Fill Sample Designs

0-6" remediation areas

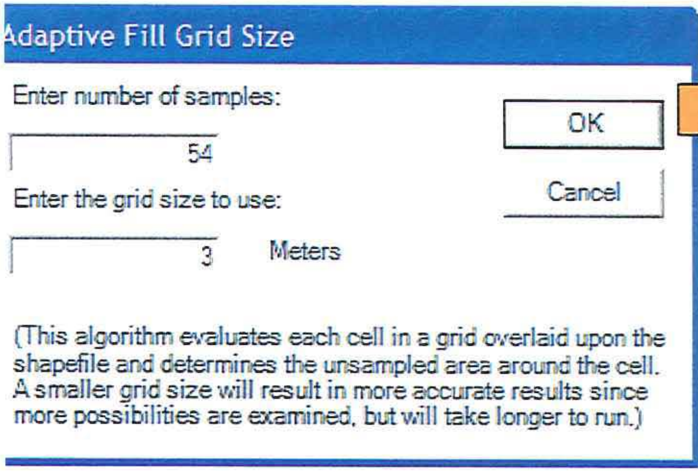


42 sample locations; would have about 1 sample per 100 square meters



Adaptive Fill Sample Designs

6-18” remediation areas



54 sample locations; would have about 1 sample per 100 square meters