ANALYSIS OF PLOWZONE EXCAVATION METHODS

A research problem noted in the data recovery plan was the investigation of the effect of screen size mesh in plow zone excavations at historic sites. All artifacts recovered in the field were passed through a 1/2" mesh screen after washing and marking and before cataloging. The artifacts passing through the 1/2" mesh were catalogued separately from those larger than 1/2". In this manner, two catalogues were developed: one of artifacts recovered from 1/4" mesh screening and one of artifacts recovered from 1/2" mesh screening. As would be expected, the 1/4" screening recovered more artifacts. However, it was more

TABLE 15

ARTIFACT DISTRIBUTION MAPS AND SCREEN MESH SIZES

Variable	Total Site		Farm Complex	
	1/2"	1/4"	1/2"	1/4"
Rhenish				
White Salt Glaze				
Scratch Blue		x		
Brown Stoneware	x	x	x	x
Gray Stoneware				
Tin Glaze		x		x
Creamware	x	x	x	x
Pearlware	x	x		x
Whiteware	x	x	x	x
Ironstone	x	x		
Yellowware		x		x
Porcelain	x	x		x
Staffordshire				
Whieldon				
Buckley				
Jackfield				
Pipe Stem		x		
Window Glass		x		x
Bottle Glass	x	x		x
Nails	x	x	x	x
Iron Fragments	x	x	x	x
Clothing Group				
Gun Flints				
18th Cen. Ceramics		x		x
19th Cen. Ceramics	x	x	x	x
Arch. Group	x	x	x	x
Total Ceramics	x	x	x	x
Total Artifacts	x	x	x	x

x = sufficient artifacts to make meaningful maps

important to know if different results and site interpretations resulted from the recovery of additional artifacts by use of 1/4" mesh. Stated another way, it was important to know if the additional artifacts gathered from 1/4" mesh screening resulted merely in redundant information.

In order to investigate the gains in information, or the absence of such gains, from 1/4" screening, artifact distribution maps were prepared based on both 1/4" and 1/2" maps. Also, artifact counts from squares were analyzed for different artifact classes to see if the effects of 1/4" screening varied with artifact frequency and age. Finally, the effects of screen mesh size and artifact recovery rates on mean ceramic dates and pipe stem dates were considered.

SPATIAL DATA

Table 15 lists the varied artifact classes noted in the site catalogue and notes the artifact classes for which there were sufficient artifacts to make meaningful maps. Both the entire site and the dwelling complex area were considered. In some cases insufficient data were gathered from the 1/2" screens to make maps while the 1/4" screen data were sufficient to make meaningful distribution maps. For the entire archaeological site it would not have been possible to make distribution maps for scratch blue ceramics, tin glaze ceramics, yellowware, total eighteenth century ceramics, pipes, and window glass if only a 1/2" screen was used. Within the farm building complex itself it would not have been possible to make distribution maps for tin glaze ceramics, pearlware, yellowware, porcelain, window glass, bottle glass, and total eighteenth century ceramics with only the 1/2" screen. Because several of these artifact categories were significant in interpreting structures and activity areas, this simple test shows that use of the 1/4" screens did gather significant, non-redundant data. This was particularly true of the eighteenth century ceramics and architectural categories within the farmstead complex section of the site.

With regard to the artifact categories where there were sufficient data to produce distribution maps, 1/2" and 1/4" maps were printed and compared. Both contour maps and three dimensional surface plots were prepared because topographic mapping of artifact densities can be misleading if inappropriate contour intervals are chosen (Dunnell and Jermann 1979). Figures 66 to 78 show the comparative maps and plots for the total site area and Figures 79 to 87 show comparative maps and plots for the building complex area.

Tables 16 and 17 summarize the differences seen when the 1/2" and 1/4" maps were compared for the total site and building complex area. Two basic comparisons of the maps were noted. First, the number of clusters, or artifact concentrations, identified on the 1/4" maps, but not on the 1/2" maps, was noted. Second, changes in relationships among artifact clusters were noted. For example, it was noted if an artifact concentration changed from being the highest density value on the map to being a smaller value when going from the 1/2" to the 1/4" maps. It was also noted if an artifact concentration's density increased on the 1/4" maps. The combination of detecting additional artifact clusters and identifying changing relationships among artifact clusters was seen as a useful way of summarizing differences between the 1/2" and 1/4" maps. Nonetheless, subjective descriptions of differences are also described below.

For the maps of artifact categories within the entire site, both similarities and differences among 1/2" and 1/4" maps were noted. Four artifact classes (Brown Stoneware, Creamware, Nails, and Total Artifacts) showed no additional clusters identified on the 1/4" maps and no changes in cluster relationships. Four artifact classes (Bottle Glass, Iron Fragments, Nineteenth

TABLE 16

COMPARATIVE MAP DIFFERENCES - TOTAL SITE

Variable	# New Clusters	Changed Relationship	N
Brown Stoneware	0	N	48
Creamware	0	N	3277
Pearlware	3	N	1819
Whiteware	5	Y	498
Ironstone	4	Y	35
Porcelain	7	Y	153
Bottle Glass	0	Y	1867
Nails	0	N	816
Iron Fragments	0	Y	401
19th Cen. Ceramics	0	Y	2943
Arch. Group	0	Y	1676
Total Ceramics	3	Y	6632
Total Artifacts	0	N	10956

TABLE 17

COMPARATIVE MAP DIFFERENCES - BUILDING COMPLEX AREA

Variable	# New Clusters	Changed Relationship	N
Brown Stoneware	1	N	48
Creamware	3	N	3277
Whiteware	1	Y	498
Nails	0	N	816
Iron Fragments	3	Y	401
19th Cen. Ceramics	3	N	2943
Arch. Group	0	Y	1676
Total Ceramics	0	N	6632
Total Artifacts	0	N	10956

century Ceramics, and the Architecture Group) showed no additional clusters, but did identify changes in cluster relationships. One artifact class (Pearlware) showed additional artifact clusters on the 1/4" map, but there were no changes in cluster relationships. Artifact classes (Whiteware, Ironstone, Porcelain, and Total Ceramics) showed both the identification of additional clusters and changing cluster relationships.

Among the cases where no new clusters were identified, but changing cluster relationships noted, bottle glass data showed a marked reduction of moderate cluster densities in the center of the map (Figure 72). The main concentration on the 1/4" map is

much more well-defined. There is a complete change in cluster relationships between the iron fragments maps (Figure 74). The location of the major iron fragment cluster changes dramatically with the addition of the 1/4" data and the major cluster is more clearly focused on the building complex area in the 1/4" data. Maps for nineteenth century ceramics are also quite different (Figures 75). The 1/2" map shows a large number of discrete clusters while the 1/4" map shows a single, smoothed and focused cluster. A similar change in relationships is seen in maps for the architectural group of artifacts (Figure 76).

The maps for pearlware distributions over the entire site are of interest because the 1/4" map shows the identification of several additional clusters (Figure 68), but no real change in cluster relationships is apparent. Nonetheless, the main artifact concentration is more tightly focused on the 1/4" map. Among the artifact classes for which both additional clusters were identified, and changed cluster relationships noted, the dominant pattern was for the 1/4" maps to show 3-7 additional peripheral, generally low density clusters (see Figures 69-72, 77 and 78).

For the maps of artifact categories within the building complex area, both similarities and differences among 1/2" and 1/4" maps were noted. Three artifact classes (Nails, Total Ceramics, Total Artifacts) showed no additional clusters identified on the 1/4" maps and no changes in cluster relationships. One artifact class, the architecture group, showed no additional clusters, but did identify changes in cluster relationships. The major change in cluster relationships for the architecture group is to show a greater homogeneity of concentrations (Figure 85). Three artifact classes (Brown Stoneware, Creamware, Nineteenth Century Ceramics) showed additional artifact clusters on the 1/4" map but there were no changes in cluster relationships. As was the case for the total site maps, the new clusters seen on the 1/4" map were peripheral low level clusters (Figures 79-80, and 84). Two maps identified both additional clusters and changed cluster relationships. The whiteware 1/4" map (Figure 81) shows a dual cluster not apparent on the 1/2" map and the iron fragment 1/4" map (Figure 83) shows a more focused cluster in the northeast quadrant of the building complex area.

Table 18 summarizes the map differences described above for both the total site and the building conference, approximately 30% of the maps show no differences when the 1/4" data are added. Relationships among clusters changed quite often, 30-60% of the time, among the remaining maps and represent significant changes in the maps when 1/4" data are added for consideration. Identification of additional peripheral clusters were identified 30-50% of the time, but this is not as critical a shortcoming of the 1/2" maps as the changed cluster relationships. The most critical difference, the identification of changed relationships and new clusters, occurred 20-50% of the time. A variety of errors are therefore introduced by the use of only the 1/2" maps.

TABLE 18

SUMMARY MAP DIFFERENCES

	Total Site	Building Complex
No New Clusters	8 (61%)	4 (44%)
No Changed Relationships	5 (38%)	6 (67%)
New Cluster	5 (38%)	5 (55%)
Changed Relationships	8 (61%)	3 (33%)
No New Clusters and No Changed Relationships	4 (31%)	3 (33%)
No New Clusters and Changed Relationships	4 (31%)	1 (11%)
New Clusters, No Changed Relationships	1 (7%)	3 (33%)
New Clusters, Changed Relationships	4 (31%)	2 (22%)

Artifact counts were also analyzed to see if differences between maps were related to artifact frequency. Artifact counts are included in Tables 16 and 17 and Table 19 summarizes rankings of artifact classes by artifact frequencies, number of clusters added by consideration of 1/4" data, and by error score. The error score used in ranking was obtained by assigning the following values to various categories of errors on the 1/2" maps: 1 = additional clusters and new cluster relationships, 2 = no new clusters but new cluster relationships, 3 = new clusters but no new relationships, and 4 = no new clusters and no new relationships.

Artifact frequencies were then compared to errors by applying the Spearman rank-order correlation coefficient (Thomas 1976:395-406). When the total site data are considered, the added cluster ranks yield a value for Spearman's rank-order correlation coefficient of -.303. The value for error scores is -.289. The value for added clusters in the building complex is 0.170 and the value for error scores is -.038. All values were calculated using a correction factor for squared variates (Thomas 1976:402). In all cases, the low values indicate that there is no relationship between differences between 1/4" and 1/2" maps and artifact frequencies. Mapping errors on 1/2" maps can occur for artifact classes with both high and low frequencies.

TABLE 19

COMPARATIVE ARTIFACT COUNTS AND ERROR RANKINGS

Artifact Class	N	Rank By Artifact Count	Rank By # Of Added Clusters	Rank By Error Score
Total Site				
Brown Stoneware	48	12	9.5	11.5
Creamware	3277	3	9.5	11.5
Pearlware	1819	6	4.5	9.0
Whiteware	498	9	2.0	2.5
Ironstone	35	13	3.0	2.5
Porcelain	153	11	1.0	2.5
Bottle Glass	1867	5	9.5	6.5
Nails	816	8	9.5	11.5
Iron Fragments	401	10	9.5	6.5
19th Cen. Ceramics	2943	4	9.5	6.5
Arch. Group	1676	7	9.5	6.5
Total Ceramics	6632	2	4.5	2.5
Total Artifacts	10956	1	9.5	11.5
Building Complex				
Brown Stoneware	48	9	4.5	5.0
Creamware	3277	3	2.0	5.0
Whiteware	498	7	4.5	1.5
Nails	816	6	7.5	8.0
Iron Fragments	401	8	2.0	1.5
19th Cen. Ceramics	2943	4	2.0	5.0
Arch. Group	1676	5	7.5	3.0
Total Ceramics	6632	2	7.5	8.0
Total Artifacts	10956	1	7.5	8.0

ARTIFACT COUNTS

Artifact counts for individual 5'X 5' excavation units were also compared for 1/2" and 1/4" screen data. A series of crosstabulation matrices were developed to compare 1/4" and 1/2" artifact counts and are listed in Table 20. The matrices in Table 20 compare artifact frequencies for 1/2" and 1/4" screens by noting, for example, how many squares which had no artifacts from 1/2" screening showed either no artifacts, 1-5 artifacts, or more than 5 artifacts from 1/4" data. To a certain extent, the matrices follow a "confusion matrix" format (Snee 1977) and the greater the concentration of artifact counts on the diagonal, the more similar are the 1/4" and 1/2" artifact counts. Divergences into the upper right corner of the matrices show changes in frequency when 1/4" data are considered. There can be no divergences into the lower left corner because 1/4" screening

TABLE 20

ARTIFACT COUNT MATRICES

Rhenish 1 (<1%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	3	1
<1	0	0	299

Tin Glaze 68 (22%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	8	68
<1	0	0	227

Yellowware 115 (38%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	10	14
1-5	0	6	91
<1	0	0	182

White Salt Glaze 26 (8%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	21	26
<1	0	0	256

Creamware 212 (70%)

1/4" \ 1/2"	>5	1-5	<1
>5	17	63	61
1-5	0	26	88
<1	0	0	48

Porcelain 59 (19%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	2	0
1-5	0	40	57
<1	0	0	204

Scratch Blue 13 (4%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	5	13
<1	0	0	285

Pearlware 223 (74%)

1/4" \ 1/2"	>5	1-5	<1
>5	2	54	43
1-5	0	26	126
<1	0	0	52

Staffordshire 17 (6%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	7	17
<1	0	0	279

Brown Stoneware 4 (1%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	30	4
<1	0	0	269

Whiteware 95 (31%)

1/4" \ 1/2"	>5	1-5	<1
>5	1	13	12
1-5	0	47	69
<1	0	0	161

Whieldon 6 (2%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	5	6
<1	0	0	292

Gray Stoneware 4 (1%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	32	4
<1	0	0	267

Ironstone 20 (6%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	12	20
<1	0	0	271

Buckley 22 (7%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	12	22
<1	0	0	269

Jackfield 42 (14%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	18	42
<1	0	0	243

Pipe Stem 35 (12%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	1
1-5	0	15	34
<1	0	0	253

Window Glass 200 (66%)

1/4" \ 1/2"	>5	1-5	<1
>5	3	21	31
1-5	0	40	148
<1	0	0	60

TABLE 20 (Cont.)

Bottle Glass 174 (57%)

1/4" \ 1/2"	>5	1-5	<1
>5	27	83	16
1-5	0	81	75
<1	0	0	21

Nails 109 (36%)

1/4" \ 1/2"	>5	1-5	<1
>5	7	30	9
1-5	0	98	70
<1	0	0	89

Iron Fragments 36 (12%)

1/4" \ 1/2"	>5	1-5	<1
>5	2	13	1
1-5	0	90	22
<1	0	0	175

Clothing Group 20 (7%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	17	20
<1	0	0	266

Gun Flints 0 (0%)

1/4" \ 1/2"	>5	1-5	<1
>5	0	0	0
1-5	0	8	0
<1	0	0	295

18th Cen. Ceramics 201 (66%)

1/4" \ 1/2"	>5	1-5	<1
>5	20	88	48
1-5	0	46	65
<1	0	0	36

19th Cen. Ceramics 221 (73%)

1/4" \ 1/2"	>5	1-5	<1
>5	10	96	37
1-5	0	38	88
<1	0	0	34

Architecture Group 192 (63%)

1/4" \ 1/2"	>5	1-5	<1
>5	16	73	30
1-5	0	72	89
<1	0	0	23

Total Ceramics 228 (75%)

1/4" \ 1/2"	>5	1-5	<1
>5	38	145	42
1-5	0	24	41
<1	0	0	13

Total Artifacts 168 (55%)

1/4" \ 1/2"	>5	1-5	<1
>5	116	151	12
1-5	0	17	5
<1	0	0	2

could not recover fewer artifacts than 1/2" screening. All artifact classes in Table 15 were included in this analysis.

Table 21 summarizes the differences in artifact count matrices and also notes changes in artifact counts by squares between 1/2" and 1/4" screens for three frequency categories (No Artifacts, 1-5 Artifacts, More Than 5 Artifacts). Percentage changes in artifact counts were compared using a difference-of-proportion test and significant differences are noted, and counted, for individual artifact classes in Table 21. Of the 28 artifact classes, 24 (86%) show at least 2 significant differences. The four artifact classes with less than 2 significant differences all have fewer than 50 artifacts indicating that the small differences are associated with small sample sizes. However, when artifact count rank and ranks based on number of significant differences among 1/2" and 1/4" artifact

TABLE 21

ARTIFACT COUNT DIFFERENCES

Variable	Screen Size	N	Square Count <1	1-5	>5	Sig. Dif.	% Mis-Classified
Rhenish	1/2	3	300	3	0		
	1/4	4	299	4	0	0	<1
White Salt Glaze	1/2	22	282	21	0		
	1/4	56	256*	47*	0	2	8
Scratch Blue	1/2	5	298	5	0		
	1/4	18	285*	18*	0	2	4
Brown Stoneware	1/2	36	273	30	0		
	1/4	48	269	34	0	0	1
Gray Stoneware	1/2	39	271	32	0		
	1/4	46	267	36	0	0	1
Tin Glaze	1/2	9	295	8	0		
	1/4	121	227*	76*	0	2	22
Creamware	1/2	318	197	89	17		
	1/4	3277	48*	114*	128*	3	70
Pearlware	1/2	149	221	80	2		
	1/4	1819	52*	152*	85*	3	74
Whiteware	1/2	98	242	60	1		
	1/4	498	161*	116*	23*	3	31
Ironstone	1/2	13	291	12	0		
	1/4	35	271*	32*	0	2	6
Yellowware	1/2	20	287	16	0		
	1/4	545	182*	97*	18*	3	38
Porcelain	1/2	49	261	42	0		
	1/4	153	204*	97*	0	2	19
Staffordshire	1/2	7	296	7	0		
	1/4	31	279*	24*	0	2	6
Whieldon	1/2	5	298	5	0		
	1/4	11	292*	11*	0	2	6
Buckley	1/2	12	291	12	0		
	1/4	37	269*	34*	0	2	7
Jackfield	1/2	19	285	18	0		
	1/4	86	243*	60*	0	2	14

TABLE 21 (Cont.)

Variable	Screen Size	N	Square Count <1	1-5	>5	Sig. Dif.	% Mis-Classified
Pipe Stem	1/2	20	288	15	0		
	1/4	89	253*	49*	1	2	12
Window Glass	1/2	108	239	61	3		
	1/4	860	60*	188*	37*	3	66
Bottle and Vessel Glass	1/2	519	112	164	27		
	1/4	1867	21*	156	107*	2	57
Nails	1/2	317	168	128	7		
	1/4	816	89*	168*	35*	3	36
Iron Fragments	1/2	195	198	103	2		
	1/4	401	175*	112	10*	2	12
Clothing Group	1/2	41	286	17	0		
	1/4	195	266*	37*	0	2	7
Gun Flint	1/2	8	295	8	0		
	1/4	8	295	8	0	0	0
18th Cen. Ceramic Total	1/2	436	149	134	20		
	1/4	3689	36*	111	143*	2	66
19th Cen. Ceramic Total	1/2	319	159	134	10		
	1/4	2943	34*	126	125*	2	73
Architecture Group	1/2	425	142	145	16		
	1/4	1676	23*	161	98*	2	63
Total Ceramic	1/2	755	96	169	38		
	1/4	6632	13*	65*	210*	3	75
Total Artifacts	1/2	2386	19	168	116		
	1/4	10956	2*	22*	270*	3	55

* = significant difference

counts are compared using Spearman's rank-order correlation coefficient no correlation is indicated (-.230 for ranks based on numbers of significant differences and .111 for ranks based on percentage of misclassifications). In sum, the artifact count data comparisons indicate that a large number of significant underestimations of artifact frequencies per excavation unit occur when using 1/2" data. Also, except for cases of very low artifact frequency, which have the fewest inaccuracies, there is no relationship between sample size and frequencies of inaccuracies.

PIPE STEM DATE

The final comparison between the 1/2" and 1/4" data involved the computation of a pipe bore diameter date (Binford 1961) for both 1/2" and 1/4" data. The date determined using the 1/4" data is 1743.23 and the date derived from the 1/2" data is 1743.61. There is no difference between dates derived from the 1/4" and 1/2" data.

DISCUSSION OF RESULTS

Except for determinations of a pipe stem date for the site, the analysis of artifact counts and spatial distributions for 1/2" and 1/4" data show that use of 1/4" screens on plow zone deposits yields additional, significant, and, most importantly, non-redundant information. For the Whitten Road site, some important maps could not be made at all using the 1/2" screen data (see Table 15). Also, significant differences were observed in artifact distribution maps. New spatial clusters and changed relationships among spatial clusters were noted when maps of 1/4" data were compared to 1/2" data maps. Furthermore, these significant differences are not systematically related to artifact frequencies; both numerous and less frequent artifact classes are affected. Finally, important errors in artifact counts occurred more than 80% of the time in the 1/2" data estimates compared to the 1/4" estimates. Again these errors were not systematically related to artifact frequencies. In conclusion, there can be no doubt that use of 1/4" screens adds significant, non-redundant information and there can be no justification for use of 1/2" screens, even in plow zone soils.